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Soil
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Service

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

Soil Survey of Hocking County, Ohio

Foreword

This soil survey contains information that can be used in land-planning programs in Hocking 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 are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. If the water table is near the surface, the soil is 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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Soil Survey of
Hocking County, Ohio

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

HOCKING COUNTY is in the southeastern part of Ohio (fig. 1). It is bounded on the north by Perry and Fairfield Counties, on the west by Pickaway and Ross Counties, on the south by Vinton County, and on the east and southeast by Athens County. Hocking County has an area of 269,440 acres, or 421 square miles. The population in 1980 was 24,304 *(18)*. In that year the population of Logan, the county seat and the only city, was 6,557. The village of Laurelville is in the western part of the county, and Murray City is in the eastern part.

Figure 1.—Location of Hocking County in Ohio.

General Nature of the County

This section describes the climate; history; woodland, farming, and other land uses; geology; natural resources; and industries in Hocking County.

Climate

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

Hocking County has a continental climate characterized by wide annual and daily ranges in temperatures. Winters are cold and snowy. Summers are warm and humid and are occasionally marked by very hot days. Rainfall is well distributed throughout the year. The normal annual precipitation is adequate for all the crops commonly grown in the county. The growing season in the valleys differs slightly from that on the ridgetops. The last freeze in spring and the earliest freeze in fall generally occur in the valleys because cool air flows down the slopes into the valleys on clear nights with light winds.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Athens, Ohio, in the period 1951 to 1978. 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 32 degrees F, and the average daily minimum temperature is 21 degrees. The lowest temperature on record, which occurred at Athens on January 28, 1963, is -27 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Athens on July 14, 1954, is 104 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 39 inches. Of this, 21 inches, or about 55 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 18 inches. Heavy rains, which occur at any time of the year, and severe thunderstorms in summer cause flash flooding, particularly in narrow valleys. The heaviest 1-day rainfall during the period of record was 3.65 inches at Athens on July 12, 1966. Thunderstorms occur on about 45 days each year. The average seasonal snowfall is about 14 inches.

The average relative humidity in midafternoon is about 55 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 35 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 8 miles per hour, in spring.

History

The earliest inhabitants of the survey area were the ancient moundbuilders, whose earthen or stone mounds, numbering about 20, remain throughout the county *(7)*. Later, the Delaware, Shawnee, and Wyandot Indians all claimed this area as part of their territories. The Wyandot Indians established a permanent village southeast of Logan, near where Old Town Creek empties into the Hocking River. "Hocking" is a contraction of the Delaware Indian word "Hock-Hocking," which means bottle- or jug-shaped.

The early permanent settlers generally came to the survey area from the states to the east, particularly Pennsylvania and Virginia. Also, several groups of settlers came directly from Germany. The settlers lived by hunting, trading, and farming. Farming became more important as markets for farm produce became available along the Ohio and Mississippi Rivers. These markets became accessible in 1840, when the Hocking Canal was completed. The canal was a satisfactory outlet until 1870, when the first railroad was completed through the survey area.

By an act of the Ohio Legislature on March 1, 1818, Hocking County was formed from parts of Athens, Fairfield, and Ross Counties. As new counties were formed, the boundaries of Hocking County changed until 1850, when the current boundaries were established.

Logan, the county seat, was laid out in 1816 by Governor Thomas Worthington and named after a famous Mingo Indian chief. A gristmill built nearby attracted many early settlers. Logan became the trading center of the area when the Hocking Canal, which ran through the city, was completed. The local resources of iron ore, limestone, and coal made Logan an early center of iron manufacturing. Furniture, clothing, and clay brick and tile also were manufactured in Logan. The population of Logan has risen slowly but steadily through the years from about 100 in 1820 to 6,557 in 1980.

Woodland, Farming, and Other Land Uses

The dominant land use in Hocking County is woodland. Forest land comprises approximately 171,500 acres, or about 64 percent of the total land area in the county *(16)*. Lumber, pallets, posts, and pulpwood are the major forest products.

About 26 percent of the county was used for crops and pasture in 1979 *(17)*. About 14 percent, or 36,753 acres, was cropland and 12 percent, or 32,052 acres, was pasture. Most of the cropland is in the western part of the county, near Laurelville. In 1985, the leading crops were corn, grown on 8,300 acres; hay, grown on 7,500 acres; and wheat, grown on 1,000 acres *(6)*.

Of the cash receipts from farm marketing in 1984, 29 percent was from the sale of cattle, 16 percent from the sale of corn, 11 percent from the sale of hogs, and 44 percent from the sale of other crops and livestock *(9)*.

Recreation also is a very important land use in the county. The Hocking Hills State Park and other state parks seasonally attract thousands of people to the county. A report of the Buckeye Hills-Hocking Valley Regional Development District indicates that 43,461 acres was used for outdoor recreational purposes in October 1983. Of this acreage, public recreational areas made up a total of 34,651 acres.

Geology

The bedrock in Hocking County consists of sedimentary rock from the Mississippian and Pennsylvanian Systems *(8, 10)*. The Mississippian System consists of the Cuyahoga and Logan Formations. The Cuyahoga Formation consists of Cuyahoga Shale overlain by Blackhand Sandstone. The Logan Formation overlies the Cuyahoga Formation. It consists of sandstone, shale, and conglomerate. The Mississippian bedrock is exposed in the western half of the county, and crops out roughly west of a line extending from the Marion Falls-Gore Township line to the middle of Benton Township. East of this line the Logan Formation is overlain by the Pottsville, Allegheny, and Conemaugh Groups of the Pennsylvanian System. These groups consist mainly of sandstone, shale, and coal.

The bedrock in Hocking County dips gently to the south-southeast. Erosion has exposed the older Mississippian rock in the western half of the county and the younger Pottsville and Allegheny rocks in the east. The Conemaugh rock of the Pennsylvanian System is of the least extent; it is exposed only in small areas of Ward and Starr Townships.

Only the extreme western edge of Hocking County was subject to the actions of glacial ice. About 200,000 years ago, the Illinoian glacier advanced into the northwest corner of Perry Township, traveling in a southeasterly direction. It advanced to approximately the present site of South Perry to the east and directly south of Haynes in section 15 of Salt Creek Township. About 19,000 years ago, the Wisconsinan glacier entered only a few miles into the extreme western edges of Perry Township and south to section 6 of Salt Creek Township. These glacial ice sheets created the gently rolling and undulating topography in these townships.

The actions of these two glaciers had other noticeable impacts on the landscape of Hocking County. The Illinoian glacier blocked an old river that was flowing northwest in the present Hocking River Valley. The glacier reversed this river's drainage to the southeast. It also blocked Salt Creek, reversing it to its present southeasterly direction. The later Wisconsinan glaciation did not noticeably change the drainage patterns of Hocking County. The meltwaters of these glaciers flowed down the Hocking River and Salt Creek Valleys, depositing sand and gravel and creating large terraces along these valleys. These terraces blocked the small tributary streams flowing into the Hocking River and Salt Creek, creating lakes in these tributary valleys, as is evidenced by the lacustrine (lake) deposits in the valleys.

Natural Resources

The dominant natural resources in Hocking County are coal, oil and natural gas, sand and gravel, timber, and clay.

Coal mining in Hocking County is extensive and is still economically important. The middle Kittaning (No. 6) coal is the most important and extensively mined coalbed in the county *(4)*. Quakertown (No. 2) and Sharon (No. 1) coals were deep mined to a small extent. The Brookville (No. 4), Clarion (No. 4a), lower Kittaning (No. 5), middle Kittaning (No. 6), and Freeport (No. 7) coalbeds have been surface mined. All mining has been in the eastern and southern parts of Hocking County, in the Pottsville and Allegheny Groups.

Gas and oil wells have been drilled in the Clinton Sandstone, of Silurian age, since the early 1900's. Drilling has produced a combination of gas and oil wells, but it was primarily for oil. The average depth of these wells is 2,700 feet. Drilling into the Berea Sandstone, of Mississippian age, at 500 to 800 feet is primarily for gas only. The Clinton Sandstone is far more productive than the Berea Sandstone. Drilling of gas and oil wells has greatly increased in recent years because of deregulation and the energy crisis of 1974.

Two active sand and gravel pits are located southeast of Logan, in the Hocking River Valley. The sand and gravel were deposited as outwash material by meltwater from the Illinoian and Wisconsinan glaciers.

Timber harvesting is a big industry in the county. The harvest areas are generally small and are scattered throughout the county. Most of the timber is harvested as sawlogs. A substantial amount is harvested for pulpwood and minor amounts for veneer wood.

The middle Mercer and Flint Ridge clays have been mined in the eastern half of the county for use in the clay products industry. The clay was used primarily in the production of clay tile and brick. In recent years clay mining has all but ceased in the county as the demand for clay products has decreased.

Industry

The dominant industries in Hocking County are coal, oil, and natural gas production; the manufacture of clay products; logging; light manufacturing; the production of construction aggregate; and tourism.

Coal is strip-mined in the eastern and southern parts of the county, mainly in Washington, Starr, Green, and Ward Townships. Oil and gas wells are in scattered areas throughout the county. So too are the several small sawmills that form the local logging industry. Locally mined clay is used in the production of clay tile and bricks. The products of light manufacturing include automobile parts, electrical products, grinding stones, and premanufactured chimney flues and stairways. Gravel and sand are mined in some areas.

Also important to the local economy is the tourist industry. Six state parks seasonally attract thousands of people to the county. Private campgrounds, restaurants, motels, small country stores, and state-run camping facilities are available to the public.

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 biologic 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 considerable 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, soil 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 interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were 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 were 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 state with a fairly high degree of probability 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. Among the references used were the soil survey maps made for conservation planning on individual farms prior to the start of the project soil survey, *The Geology of Northern Hocking County, Ohio (10)*, and *The Geology of Southern Hocking County, Ohio (8)*.

Before the fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on aerial photographs made in 1976 at a scale of 1:38,000 and enlarged to a scale of 1:15,840. U.S. Geological Survey topographic maps at a scale of 1:24,000 were studied to relate land and image features.

Soil scientists made traverses on foot to examine the soils. The traverses were as few as 200 yards apart in areas of the Cardington-Alexandria association and in other areas where the soil pattern is very complex. This association is described under the heading "General Soil Map Units." In areas where land use is less intensive, such as the steep hillsides of the Westmoreland-Guernsey association, the traverses were about a quarter mile apart.

As the traverses were made, the soil scientists divided the landscape into segments in which use and management of the soils were different. A hillside, for example, 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 at intervals of 100 to 300 yards, 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 through the use of 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 by hand with shovels, spades, and spud bars.

Soil mapping was recorded on the 1976 photo base maps and later transferred to film positive mylars of aerial photographs taken in 1982. The drainageways were mapped in the field. Most cultural features were recorded from visual observations, but some were transferred from U.S. Geological Survey 7.5-minute topographic maps.

At the beginning of the survey, sample blocks were selected to represent the major landscapes in the county. These were mapped at a rate roughly half of that used in the rest of the county. Extensive notes were taken on the composition of map units in these preliminary study areas. These preliminary notes were modified as mapping progressed and the final assessment of the composition of the individual map units was made.

Transects were made to determine the composition of soil complexes, such as the Shelocta-Cruze and Westmoreland-Guernsey complexes in the unglaciated part of the county.

Samples for chemical analysis, physical analysis, and 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 analysis are stored in a computerized data file at the laboratory. The analysis for engineering properties were made by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section, Columbus, Ohio. A description of the laboratory procedures can be obtained on request from the two laboratories. The results of the laboratory analyses can be obtained from the Department of Agronomy, Ohio State University; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Soil Conservation Service, State Office, 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 refinements in series concepts and the application of the latest soil classification system.

Soil Descriptions

1. Westmoreland-Guernsey Association

Deep, strongly sloping to very steep, well drained and moderately well drained soils formed in residuum and colluvium, derived from siltstone, shale, and sandstone, and in loess; on uplands

This association consists of soils on ridgetops and dissected hillsides. The ridgetops are mainly narrow and have many high points and low saddles. The hillsides make up about three-fourths of the area. They are commonly benched. Valleys generally are narrow. Slopes range from 8 to 70 percent.

This association makes up about 20 percent of the county. It is about 50 percent Westmoreland soils, 25 percent Guernsey soils, and 25 percent soils of minor extent.

Westmoreland soils are on the steeper parts of hillsides and the higher points and edges of ridgetops. They are moderately steep to very steep, well drained, medium textured soils formed in colluvium and residuum derived from siltstone, sandstone, and shale. Permeability is moderate, and available water capacity is low or moderate.

Guernsey soils are on the flatter parts of ridgetops, in saddles, and on benches on hillsides. They are strongly sloping to very steep, moderately well drained, medium textured soils formed in loess and residuum derived from shale and siltstone. Permeability is slow or moderately slow, and available water capacity is moderate. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The shrink-swell potential is high.

Of minor extent in this association are Bethesda and Wellston soils. Bethesda soils have more rock fragments throughout than the major soils. They are in areas disturbed by surface mining. Wellston soils have a loess mantle that is thicker than that of the major soils. They are on ridgetops.

Most of this association is woodland. Some areas are used as pasture or cropland. The soils are moderately suited or well suited to use as woodland. On ridgetops they are moderately suited or well suited to pasture and moderately suited or poorly suited to row crops and small grains and to building site development. They are poorly suited to use as sites for septic tank absorption fields. In the steep and very steep areas on hillsides, they are generally not suited to use as cropland, building sites, and sites for septic tank absorption fields. They are poorly suited or generally not suited to pasture.

The slope, the erosion hazard, and droughtiness are the major limitations in areas used for farming. The slope of both the major soils and the seasonal high water table, high shrink-swell potential, and slow or moderately slow permeability in the Guernsey soils are the main limitations affecting urban uses.

2. Shelocta-Cruze-Wellston Association

Deep, gently sloping to very steep, well drained and moderately well drained soils formed in residuum and colluvium, derived from siltstone, shale, and sandstone, and in loess; on uplands

This association consists of soils on ridgetops and dissected hillsides. The ridgetops are narrow and have many high points and low saddles. The hillsides make up about three-fourths of the area. They are commonly benched. Valleys generally are narrow. Slopes range from 2 to 70 percent.

This association makes up about 35 percent of the county. It is about 40 percent Shelocta soils, 20 percent Cruze soils, 15 percent Wellston soils, and 25 percent soils of minor extent.

Shelocta soils are on the steeper parts of hillsides and the higher points and shoulders of ridgetops. They are strongly sloping to very steep, well drained, medium textured soils formed in colluvium and residuum derived from siltstone, sandstone, and shale. Permeability and available water capacity are moderate.

Cruze soils are in saddles and on the flatter parts of ridgetops. They also are on benches on hillsides. They are strongly sloping to very steep, moderately well drained, medium textured soils formed in colluvium and residuum derived from shale and siltstone. Permeability is moderately slow or slow, and available water capacity is moderate. The seasonal high water table is at a depth of 18 to 36 inches during extended wet periods. The shrink-swell potential is high.

Wellston soils are mainly on the higher parts of ridgetops. They are gently sloping and strongly sloping, well drained, medium textured soils formed in loess and in residuum derived from siltstone and sandstone. Permeability is moderate, and available water capacity is high.

Of minor extent in this association are Bethesda and Berks soils. Bethesda soils have more rock fragments throughout than the major soils. They are in areas disturbed by surface mining. The moderately deep Berks soils are on the steepest parts of hillsides.

Most of this association is wooded. Some areas are used as pasture or cropland. The soils are moderately suited or well suited to use as woodland. On the flatter parts of ridgetops, they are moderately suited or well suited to use as pasture, cropland, and building sites. They are moderately well suited or poorly suited to use as sites for septic tank absorption fields. In the steep and very steep areas on hillsides, they are poorly suited or generally unsuited to pasture. They are generally unsuited to row crops and to use as sites for buildings and septic tank absorption fields.

The slope and the erosion hazard are the major limitations in areas used for farming. The slope of all the major soils and the seasonal high water table, moderately slow or slow permeability, and high shrink-swell potential in the Cruze soil, are the main limitations affecting urban uses.

3. Shelocta-Dekalb-Lily Association

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

This association consists of soils on hillsides and ridgetops. The ridgetops are narrow and have many high points and low saddles. The hillsides make up about three-fourths of the area. They commonly are broken by large rock outcrops or cliffs. Slopes range from 8 to 70 percent.

This association makes up about 31 percent of the county. It is about 40 percent Shelocta soils, 20 percent Dekalb soils, 10 percent Lily soils, and 30 percent soils of minor extent.

Shelocta soils are on the upper parts of hillsides above the rock outcrops. They are deep, strongly sloping to very steep, medium textured soils formed in colluvium and residuum derived from siltstone, sandstone, and shale. Permeability and available water capacity are moderate.

Dekalb soils are on the lower parts of hillsides in areas where rock cliffs are less than 40 feet high. They are moderately deep, very steep, moderately coarse textured soils formed in residuum derived from sandstone and siltstone. Permeability is rapid. Available water capacity is very low.

Lily soils are on the upper parts of hillsides and on ridgetops. They are moderately deep, strongly sloping and moderately steep, medium textured soils formed in loess and residuum derived from sandstone. Permeability is moderately rapid, and available water capacity is low.

Of minor extent in this association are Cedarfalls, Wellston, and Zanesville soils. Cedarfalls soils are on hillsides below sandstone cliffs. They have more sand in the subsoil than Shelocta, Dekalb, and Lily soils. Wellston soils are on ridgetops. They have a silt mantle that is thicker than that of Lily soils. Zanesville soils are on the flatter parts of ridgetops. They have a fragipan.

Most of this association is used as woodland. A few areas have been cleared and are used as pasture or cropland. Many areas are in the Hocking Hills State Park. This park is used for recreation or as habitat for wildlife. The soils are well suited, moderately suited, or poorly suited to use as woodland. On ridgetops they are moderately suited or well suited to use as pasture and woodland. They are moderately suited or poorly suited to row crops and to use as sites for buildings and septic tank absorption fields. In the steep and very steep areas on hillsides, they are moderately suited to poorly suited to use as woodland, poorly suited or generally unsuited to pasture, and generally unsuited to cultivated crops and to use as sites for buildings and septic tank absorption fields.

The slope, the erosion hazard, and droughtiness are the major limitations in areas used for farming. The slope of all the major soils and the moderate depth to bedrock in the Dekalb and Lily soils are the main limitations affecting urban uses.

4. Cardington-Alexandria Association

Deep, gently sloping to steep, moderately well drained and well drained soils formed in glacial till; on uplands

This association consists of soils on the undulating Wisconsinan till plain. The soils are on slight rises, knolls, and broad ridges that have a well defined drainage pattern. Streams are small, and flood plains are narrow. Slopes range from 2 to 40 percent.

This association makes up about 1 percent of the county. It is about 65 percent Cardington soils, 30 percent Alexandria soils, and 5 percent soils of minor extent.

Cardington soils are on the tops and sides of broad ridges. They are gently sloping and strongly sloping, moderately well drained, medium textured soils formed in Wisconsinan glacial till. Permeability is moderately slow, and available water capacity is moderate. The seasonal high water table is at a depth of 18 to 36 inches during extended wet periods.

Alexandria soils are on hillsides. They are strongly sloping to steep, well drained, medium textured soils formed in Wisconsinan glacial till. Permeability is moderately slow, and available water capacity is moderate. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods.

Of minor extent in this association are the somewhat poorly drained Bennington soils in swales, in depressions, and on flats.

Most of this association is cropland. Corn, soybeans, and wheat are the principal crops. Some of the steeper areas along drainageways are used as pasture or woodland. The soils are well suited to use as woodland. In the gently sloping and strongly sloping areas, they are well suited or moderately suited to use as cropland. They are moderately suited to use as sites for buildings and poorly suited to use as sites for septic tank absorption fields. In the moderately steep and steep areas, they are poorly suited or generally unsuited to cropland and to urban uses.

The erosion hazard and slope are the major limitations in areas used for farming. The slope and moderately slow permeability of both the major soils and the seasonal high water table in the Cardington soils are the main limitations affecting urban uses.

5. Hickory-Cincinnati-Cana Variant Association

Deep, gently sloping to steep, well drained and moderately well drained soils formed in glacial till, loess, and shale residuum; on uplands

This association consists of soils on the undulating Illinoian till plain. Most areas are on broad ridges and are dissected along drainageways. Streams are small, and flood plains are narrow. Slopes range from 2 to 40 percent.

This association makes up about 3 percent of the county. It is about 35 percent Hickory soils, 20 percent Cincinnati and similar soils, 10 percent Cana Variant soils, and 35 percent soils of minor extent.

Hickory soils are on hillsides along drainageways. They are strongly sloping to steep, well drained, medium textured soils formed in glacial till. Permeability is moderate, and available water capacity is high.

Cincinnati soils are on broad ridges. They are gently sloping and strongly sloping, well drained, and medium textured and have a dense and brittle fragipan in the subsoil. They formed in loess and the underlying glacial till. Permeability is moderate above the fragipan and slow or moderately slow in and below the fragipan. Available water capacity is moderate. The seasonal high water table is at a depth of 30 to 48 inches during extended wet periods.

Cana Variant soils are strongly sloping and moderately steep, moderately well drained, and medium textured and formed in glacial till and the underlying residuum derived from shale bedrock. Permeability is moderate or moderately slow in the upper part of the profile and slow in the lower part. Available water capacity is high or moderate. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Of minor extent in this association are Alford, Licking, Melvin, Negley, and Stonelick soils. Alford soils have fewer coarse fragments in the lower part than the major soils. They are in the flatter areas on high terraces. Licking soils have more clay in the subsoil than the major soils. They are on lacustrine terraces. Negley soils have more gravel in the lower part than the major soils. They are on high outwash terraces. Melvin and Stonelick soils have a subsoil that is more weakly expressed than that of the major soils. They are on flood plains.

About half of this association is used for row crops. The rest is used as pasture or woodland. The soils are well suited to use as woodland. In the gently sloping and strongly sloping areas, they are well suited or moderately well suited to use as cropland, moderately well suited to use as sites for buildings, and poorly suited to use as sites for septic tank absorption fields. In the moderately steep and steep areas, they are poorly suited or generally unsuited to crops and to most urban uses.

The slope and the erosion hazard are the major limitations in areas used for farming. The slope of all the major soils and the restricted permeability and seasonal high water table in the Cincinnati and Cana Variant soils are the main limitations affecting most urban uses.

6. Chagrin-Otwell-Wheeling Association

Deep, nearly level to moderately steep, well drained and moderately well drained soils formed in alluvium, loess, glacial outwash, and lacustrine deposits; on flood plains and terraces

This association consists of soils on flood plains and terraces in valleys. The landscape consists of relatively broad flood plains and slightly higher terraces along the sides of valleys. Slopes range from 0 to 18 percent.

This association makes up about 5 percent of the county. It is about 40 percent Chagrin soils, 20 percent Otwell soils, 10 percent Wheeling soils, and 30 percent soils of minor extent.

Chagrin soils are on flood plains, and Otwell and Wheeling soils are on the slightly higher terraces.

Chagrin soils are nearly level, well drained, and medium textured and formed in alluvium. Permeability is moderate, and available water capacity is high. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. These soils are frequently flooded.

Otwell soils are gently sloping to moderately steep, well drained and moderately well drained, and medium textured and formed in loess and in the underlying lacustrine deposits. Permeability is very slow. Available water capacity is moderate. The seasonal high water table is at a depth of 24 to 72 inches during extended wet periods.

Wheeling soils are nearly level, well drained, and medium textured and formed in silty alluvium and in the underlying glacial outwash. Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate.

Of minor extent in this association are Euclid, Glenford, Negley, and Orrville soils. Euclid and Orrville soils are somewhat poorly drained. Euclid soils are on low terraces. Orrville soils are lower on the flood plains than Chagrin soils. Glenford and Negley soils do not have a fragipan. Glenford soils have more silt in the substratum than Chagrin and Wheeling soils. Negley soils have a solum that is thicker than that of Chagrin and Wheeling soils. Glenford soils are on low lacustrine terraces, and Negley soils are on high outwash terraces.

Most of this association is cropland. Corn is the main crop. A few areas are used as pasture or woodland. The soils are well suited to use as woodland. The nearly level and gently sloping soils are well suited to corn, soybeans, and pasture. Flooding damages winter wheat on Chagrin soils. The strongly sloping and moderately steep Otwell soils are moderately suited or poorly suited to use as cropland and as sites for buildings. Wheeling soils are well suited to urban uses.

Flooding is a severe hazard if the Chagrin soils are used as sites for buildings and septic tank absorption fields. The slope, the erosion hazard, the very slow permeability, and the seasonal high water table limit the Otwell soils as sites for urban uses.

7. Chagrin-Orrville-Otwell Association

Deep, nearly level to moderately steep, well drained to somewhat poorly drained soils formed in alluvium, loess, and lacustrine deposits; on flood plains and terraces

This association consists of soils on flood plains and terraces in valleys. The landscape consists of relatively narrow flood plains and slightly higher terraces along the sides of valleys. Slopes range from 0 to 18 percent.

This association makes up about 5 percent of the county. It is about 35 percent Chagrin soils, 25 percent Orrville soils, 15 percent Otwell soils, and 25 percent soils of minor extent.

Chagrin soils are on the higher parts of the flood plains. They are nearly level, well drained, medium textured soils formed in alluvium. Permeability and available water capacity are moderate. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. These soils are frequently flooded.

Orrville soils are slightly lower on the flood plains than the Chagrin soils. They are nearly level, somewhat poorly drained, medium textured soils formed in alluvium. Permeability is moderate. Available water capacity is high. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. These soils are frequently flooded.

Otwell soils are gently sloping to moderately steep, well drained and moderately well drained, and medium textured and are on terraces. They formed in loess and in the underlying lacustrine deposits. Permeability is very slow. Available water capacity is moderate. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Of minor extent in this association are Chili, Euclid, Glenford, Licking, and Negley soils. Chili soils have more gravel in the subsoil than the major soils. They are on outwash terraces. Euclid and Glenford soils are more developed in the subsoil than Chagrin and Orrville soils and do not have a fragipan. Euclid soils are on low terraces, and Glenford soils are on lacustrine terraces. Licking soils have more clay in the subsoil than the major soils. They are on lacustrine terraces. Negley soils are on high outwash terraces. Their solum is thicker than that of the major soils.

This association is used as cropland, pasture, or woodland. Some areas that are idle are reverting to native vegetation. The soils are well suited to use as woodland. The nearly level and gently sloping soils are well suited to corn and soybeans and to use as pasture. Flooding damages winter wheat on Chagrin and Orrville soils. The strongly sloping and moderately steep Otwell soils are moderately suited or poorly suited to use as cropland and as sites for buildings.

Flooding is a severe hazard if the Chagrin and Orrville soils are used as sites for buildings and septic tank absorption fields. The seasonal high water table limits the Orrville and Otwell soils as sites for urban uses. In addition, the slope, the erosion hazard, and the very slow permeability limit the Otwell soils.

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, Alexandria silt loam, 12 to 18 percent slopes, eroded, is a phase of the Alexandria 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. Shelocta-Cruze silt loams, 15 to 25 percent slopes, 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* that are mapped in complex with soils. Such areas have little or no soil material and support little or no vegetation. Rock outcrop in the Cedarfalls-Rock outcrop complex, 40 to 70 percent slopes, is an example. Some areas of Rock outcrop 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 result from a better knowledge of soils or from modification and refinements in the concepts of soil series. Some differences result from the 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

AdD2—Alexandria silt loam, 12 to 18 percent slopes, eroded. This deep, strongly sloping and moderately steep, well drained soil is on dissected hillsides of the Wisconsinan till plain. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay. Slopes generally are smooth and commonly range from 100 to 400 feet in length. Most areas are long and narrow and range from about 10 to 200 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches thick. It is yellowish brown and dark yellowish brown, firm clay loam. The substratum to a depth of about 80 inches is yellowish brown, firm clay loam glacial till. In places the lower part of the subsoil and the substratum are gravelly or very gravelly clay loam.

Included with this soil in mapping are a few small areas of the moderately well drained Cardington soils between drainageways, seeps and springs on the lower part of some slopes, and a few areas where the slope is about 30 percent. Also included, on the upper part of the slopes, are small areas of severely eroded soils that have a silty clay loam surface layer. Inclusions make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Alexandria soil. Available water capacity is moderate. Runoff is rapid. The seasonal high water table is between depths of 48 and 72 inches during extended wet periods. The root zone is restricted mainly to the 26- to 47-inch zone above the compact glacial till.

Most areas of this soil are used as cropland. Some areas are pastured, and a few areas are wooded.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Using water bars and establishing a vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Special equipment is needed for site preparation and planting.

This soil is poorly suited to hay and moderately suited to pasture. The slope limits the use of some mowing and renovation equipment. If the soil is plowed during seedbed preparation, erosion is a severe hazard. Soil compaction and increased runoff result from grazing when the soil is too wet. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is poorly suited to corn, soybeans, and winter wheat. Erosion is a severe hazard when the soil is cultivated. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface will help to control erosion and minimize crusting. In some areas the included seeps and springs interfere with tillage. Subsurface drains will remove the excess water from these areas.

This soil is poorly suited to use as a site for buildings and septic tank absorption fields because of the slope and the moderately slow permeability. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour will help to minimize seepage of effluent to the surface. The hazards of runoff and erosion increase during construction. They can be reduced by maintaining a good vegetative cover wherever possible.

Because of the slope, this soil is poorly suited to use as a site for camp and picnic areas. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-1.

AdE—Alexandria silt loam, 18 to 25 percent slopes. This deep, moderately steep, well drained soil is on dissected hillsides of the Wisconsinan till plain. Slopes generally are smooth and commonly range from 100 to 300 feet in length. Most areas are long and narrow and range from about 10 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. It is yellowish brown and dark yellowish brown, firm clay loam. The substratum to a depth of about 80 inches is olive brown, firm clay loam glacial till. In places the lower part of the subsoil is gravelly or very gravelly clay loam.

Included with this soil in mapping are a few small seeps and springs on the lower part of some slopes and a few areas that have a slope of about 40 percent. Also included, on the upper part of the slopes, are small areas of severely eroded soils that have a surface layer of silty clay loam in which tilth is fair. Inclusions make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Alexandria soil. Available water capacity is moderate. Runoff is very rapid. The seasonal high water table is between depths of 48 and 72 inches during extended wet periods. The root zone is restricted mainly to the 26- to 47-inch zone above the compact glacial till.

Most areas of this soil are used for pasture. Some areas are wooded, and a few areas are used as cropland.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Using water bars and establishing a vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Special equipment is needed for site preparation and planting.

This soil is poorly suited to hay and moderately suited to pasture. The slope limits the use of mowing and renovation equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. Soil compaction and increased runoff result from grazing when the soil is too wet. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is generally not suited to corn, soybeans, and winter wheat. Erosion is a very severe hazard when the soil is cultivated.

This soil is poorly suited to use as a site for buildings and septic tank absorption fields because of the slope and the moderately slow permeability. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour will help to minimize the seepage of effluent to the surface. The hazards of runoff and erosion increase during construction. They can be reduced by maintaining a vegetative cover wherever possible.

Because of the slope, this soil is generally not suited to use as a site for camp and picnic areas.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

AdF—Alexandria silt loam, 25 to 40 percent slopes. This deep, steep, well drained soil is on dissected hillsides of the Wisconsinan till plain. Slopes generally are smooth and convex and commonly range from 100 to 300 feet in length. Most areas are long and narrow and range from about 10 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown firm clay loam and silty clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 80 inches is olive brown, mottled, firm, calcareous loam and clay loam glacial till. In places more gravel is in the lower part of the subsoil and in the substratum.

Included with this soil in mapping are a few areas of the moderately well drained Cana Variant soils on the lower part of the slopes, a few areas that have a slope of about 50 percent, and seeps and springs on the lower part of some slopes. Also included, on the upper part of the slopes, are severely eroded soils that have a surface layer of silty clay loam in which tilth is fair. Inclusions make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Alexandria soil. Available water capacity is moderate. Runoff is very rapid. The seasonal high water table is between depths of 48 and 72 inches during extended wet periods. The root zone is restricted mainly to the 26- to 47-inch zone above the compact glacial till.

Most areas of this soil are wooded. A few areas are used as pasture or are cultivated.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Using water bars and establishing a vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Special equipment is needed for site preparation and planting.

This soil is generally unsuited to hay and poorly suited to pasture. The slope limits the use of mowing and renovation equipment. Grazing when the soil is wet compacts the soil and increases the runoff rate. Deferment of grazing during wet periods and other good management practices help to keep the pasture in good condition.

This soil is generally unsuited to row crops and small grains. Erosion is a very severe hazard when the soil is cultivated. The slope limits the use of equipment.

This soil is generally unsuitable as a site for buildings, septic tank absorption fields, camp areas, and picnic areas because of the slope and the moderately slow permeability.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-3.

AfB—Alford silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on upland ridges and coves and on terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsurface layer is yellowish brown, friable silt loam about 5 inches thick. The subsoil is about 47 inches thick. The upper part is yellowish brown, friable, silt loam, and the lower part is dark yellowish brown, firm silt loam. In some areas the soil is moderately well drained. In a few areas glacial till is below a depth of about 70 inches.

Included with this soil in mapping are small areas of Otwell and Zanesville soils, which have a fragipan. Otwell soils are on the broader parts of the higher terraces, and Zanesville soils are in the broader areas on upland ridgetops. Also included are some areas on terraces where rapidly permeable sand and gravel are below a depth of about 70 inches and areas where the slope is about 15 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Alford soil. Available water capacity is high. Runoff is medium. The root zone is deep.

Most areas of this soil are used as cropland. Some areas are used as permanent pasture, and a few areas are wooded.

This soil is well suited to trees. Mechanical planting and mowing are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to hay and pasture. Erosion is a moderate hazard if the soil is cultivated. During pasture renovation, a system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control increase forage production and help to control erosion.

This soil is well suited to corn, soybeans, and winter wheat. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, a crop rotation that includes grasses and legumes, and grassed waterways will help to control erosion and minimize surface crusting.

This soil is well suited to use as a site for buildings and septic tank absorption fields, camp areas, and picnic areas. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing basement walls and foundations will help to prevent the structural damage caused by shrinking and swelling of the soil. Keeping a vegetative cover on camp and picnic areas will help to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

AfC—Alford silt loam, 6 to 12 percent slopes. This deep, strongly sloping, well drained soil is on upland ridges and on terraces. Most areas are irregularly shaped and range from 5 to 35 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm silt loam and silty clay loam about 55 inches thick. The substratum to a depth of about 90 inches is dark yellowish brown, firm silt loam. In places the soil is moderately well drained. In a few areas bedrock is between depths of 40 and 60 inches.

Included with this soil in mapping are small areas of Otwell and Zanesville soils, which have a fragipan. Otwell soils are on the broader parts of terraces, and Zanesville soils are in the broader areas on upland ridgetops. Also included are a few areas where bedrock between depths of 40 and 60 inches interferes with excavation and a few small areas that have a slope of about 20 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Alford soil. Available water capacity is high. Runoff is rapid. The root zone is deep.

Most areas of this soil are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Mechanical tree planting and mowing are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is moderately suited to hay and well suited to pasture. If the soil is overgrazed or is plowed during pasture renovation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface when a seedbed is prepared, no-till planting, and strip seeding will help to reduce the runoff rate and control erosion. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of mechanized equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. Erosion is a hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion and minimize surface crusting.

Because of the slope and a moderate shrink-swell potential, this soil is only moderately suited to use as a site for buildings. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Reinforcing basement walls and foundations minimizes the structural damage caused by shrinking and swelling of the soil.

This soil is moderately suited to use as a site for septic tank absorption fields. Installing the distribution lines on the contour will help to minimize seepage of effluent to the surface.

This soil is moderately suited to use as a site for camp and picnic areas. The slope is a limitation. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IIIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

AgB—Allegheny loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on stream terraces. Slopes generally are smooth or convex. Most areas are long and narrow or irregularly shaped and range from 5 to about 40 acres in size.

Typically, the surface layer is dark yellowish brown, friable loam about 7 inches thick. The subsurface layer is light olive brown, friable loam about 3 inches thick. The subsoil is yellowish brown, firm and friable loam, sandy loam, and gravelly sandy loam about 38 inches thick. It is mottled below a depth of about 24 inches. The substratum to a depth of about 80 inches is yellowish brown, mottled, friable sandy loam. In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Otwell soils in the slightly lower positions and a few small areas of Chagrin and Pope soils on flood plains. Otwell soils have a fragipan. Chagrin and Pope soils have less clay movement in the subsoil than the Allegheny soil. Also included are a few small areas where the slope is about 15 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Allegheny soil. Runoff is medium. Available water capacity is moderate. The root zone is deep.

Most areas of this soil are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Mechanical tree planting and mowing are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stones on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. Erosion is a moderate hazard. During pasture renovation, strip seeding or a system of conservation tillage that keeps plant residue on the surface when a seedbed is prepared will help to control erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. Under good management, row crops can be grown year after year. A system of conservation tillage that leaves crop residue on the surface, a crop rotation that includes grasses and legumes, and grassed waterways help to control erosion.

This soil is well suited to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. Maintaining a good vegetative cover helps to control runoff and erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

AgC—Allegheny loam, 6 to 12 percent slopes. This deep, strongly sloping, well drained soil is on stream terraces. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 2 inches thick. The subsurface layer is brown, friable loam about 2 inches thick. The subsoil is yellowish brown, firm loam and sandy loam about 41 inches thick. The substratum to a depth of about 80 inches is yellowish brown, very friable sandy loam and fine sandy loam. In some places the surface layer is silt loam or fine sandy loam. In other places the subsoil has more gravel. In a few areas the substratum has more sand.

Included with this soil in mapping are small areas of Otwell soils on terraces and Chagrin and Pope soils on flood plains. Otwell soils have a fragipan. Chagrin and Pope soils have less clay movement in the subsoil than the Allegheny soil. Also included are a few areas where the slope is about 20 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Allegheny soil. Runoff is rapid. Available water capacity is moderate. The root zone is deep.

Most areas of this soil are used for pasture. Some areas are used as cropland, and a few areas are wooded.

This soil is well suited to trees. Mechanical planting and mowing are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is moderately suited to hay and well suited to pasture. If the soil is overgrazed or is plowed during pasture renovation, erosion is a hazard. During reseeding, a system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control runoff and erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in the steeper included areas limits the use of mechanized equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. Erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and a crop rotation that includes grasses and legumes will help to control erosion.

Because of the slope, this soil is only moderately suited to use as a site for buildings and septic tank absorption fields. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour will minimize seepage of effluent to the surface.

This soil is moderately suited to use as a site for camp and picnic areas. The erosion hazard and the slope limit these uses. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. Maintaining a good vegetative cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

BeA—Bennington silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is in swales, in depressions, and on flats on Wisconsinan till plains. Most areas are irregularly shaped and range from 5 to about 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is yellowish brown and dark yellowish brown, mottled, firm clay loam and silty clay loam about 26 inches thick. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm clay loam glacial till. In some places the depth to carbonates is about 50 inches. In a few areas the soil is poorly drained and has a dark surface layer.

Included with this soil in mapping are small areas of the moderately well drained Cardington soils on the convex parts of knolls and ridges and along drainageways. Also included are a few small areas of the moderately well drained Glenford soils on lacustrine terraces. Included soils make up about 15 percent of most areas of the map unit.

Permeability is slow in the Bennington soil. Available water capacity is moderate. Runoff is slow. The seasonal high water table is between depths of 12 and 30 inches during extended wet periods. The root zone is limited mainly to the 28- to 42-inch zone above the compact glacial till.

Most areas of this soil are used for cultivated crops. Some areas are used for pasture, and a few areas are wooded.

This soil is well suited to trees. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

Drained areas of this soil are well suited to hay and pasture. Undrained areas are moderately suited to these uses. In undrained areas the seasonal high water table limits the use of equipment. Also, the pasture cannot be grazed during wet periods. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

Undrained areas of this soil are moderately suited to corn, soybeans, and winter wheat. Drained areas are well suited to these crops. The surface layer crusts after hard rains. Adequately drained areas are suitable for a system of conservation tillage that leaves crop residue on the surface. This practice minimizes surface crusting and helps to control erosion.

This soil is poorly suited to use as a site for buildings. The seasonal high water table is a limitation. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Proper landscaping of building lots drains surface water away from foundations. Because of the greater possibility of wet basements, the swales should not be used as building sites.

This soil is poorly suited to use as a site for septic tank absorption fields. The seasonal high water table and the slow permeability are limitations. Installing perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is poorly suited to use as a site for camp and picnic areas. The seasonal high water table and the slow permeability are limitations. Surface and subsurface drains are used to remove excess water. Special surfacing material generally is needed in camp areas.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is C-1.

BtB—Bethesda channery loam, 0 to 8 percent slopes. This deep, nearly level and gently sloping, well drained soil is on narrow benches on hillsides in areas that have been surface mined for coal. It is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. A few stones and boulders are at the surface and throughout the soil. Most areas were contour strip-mined and have long, narrow benches below the highwalls. Generally, shallow ponds are at the base of the highwalls. In a few areas mountaintop mining has removed the entire ridgetop. This mining left broad, irregularly shaped areas without highwalls. Areas of this soil are 5 to several hundred acres in size.

Typically, the surface layer is variegated brown and grayish brown, friable channery loam about 4 inches thick. The substratum to a depth of about 60 inches is variegated grayish brown, dark grayish brown, and yellowish brown, firm very channery silty clay loam. In places the soil has more sand, is more acid, or both. In many recently mined areas, the surface layer is extremely channery silty clay loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils do not have so many coarse fragments directly below the surface layer as the Bethesda soil. Also included are stockpiles of natural soil material, coal, and rock. Inclusions make up about 10 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low because of the high percentage of coarse fragments and the compactness of the material. Runoff is medium. The root zone is very shallow.

Most areas are idle. A few areas are used as pasture, woodland, or cropland.

This soil is suited to the trees adapted to the site. Grasses and legumes provide ground cover during the establishment of trees. Occasional stones and boulders on and below the surface interfere with the use of equipment.

This soil is generally unsuited to corn, soybeans, winter wheat, hay, and pasture. Droughtiness, strongly acid to extremely acid reaction, and the very shallow root zone are limitations.

Onsite investigation is needed to determine the suitability of this soil as a site for buildings. After the soil has settled, it is moderately well suited to this use. The depth of the soil over bedrock and storm water runoff should be considered during site investigations. Areas that are deeper to bedrock generally require longer periods of time for settlement. In a few areas where the soil was wooded before it was mined, trees and woody debris are buried. These areas should not be developed because of the hazard of future subsidence. Stones and boulders in the substratum hinder excavation. Droughtiness is a limitation on sites for lawns during dry periods.

This soil is poorly suited to use as a site for septic tank absorption fields. The moderately slow permeability and the unstable nature of the soil severely limit this use. Installing the absorption field in suitable fill material will improve the filtering capacity.

This soil has a highly corrosive effect on concrete and a moderately corrosive effect on uncoated steel. Coated steel or heavy-duty PVC pipe should be used in drain and sewer lines. High-quality polyethylene pipe should be used in water lines.

This soil is moderately suited to use as a site for camp and picnic areas. The moderately slow permeability and small stones are the major limitations. Also, a plant cover cannot be easily established and maintained. Adding a layer of suitable soil material will cover the small stones and improve plant growth.

The land capability classification is VIs. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is E-3.

BtC—Bethesda channery loam, 8 to 20 percent slopes. This deep, strongly sloping and moderately steep, well drained soil is on narrow benches on hillsides and on ridgetops in areas that have been surface mined for coal (fig. 2). It is mixed rock

Figure 2.—Reclaiming an area of Bethesda channery loam, 8 to 20 percent slopes.

fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. A few stones and boulders are at the surface and throughout the soil. Most areas were contour strip-mined and have long, narrow benches below highwalls. Generally, shallow ponds are at the base of the highwalls. In a few areas mountaintop mining has removed the entire ridgetop. This mining has left broad, irregularly shaped areas with highwalls. Areas of this soil range from 5 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown, friable channery loam about 4 inches thick. The substratum to a depth of about 60 inches is grayish brown and yellowish brown, firm very shaly loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Cruze and Guernsey soils are moderately well drained. Berks soils are moderately deep to bedrock. Shelocta and Westmoreland soils do not have so many coarse fragments directly below the surface layer as the Bethesda soil. Included soils make up about 10 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low because of the high percentage of coarse fragments and the compactness of the soil material. Runoff is rapid or very rapid. The root zone is very shallow.

Most areas are idle. A few areas are used as pasture, woodland, or cropland.

This soil is suited to trees adapted to the site. Grasses and legumes provide ground cover during the establishment of trees. Occasional stones or boulders on and below the surface interfere with the use of equipment.

This soil is generally unsuited to most agricultural uses because of droughtiness, extremely acid to strongly acid reaction, and the very shallow root zone.

Onsite investigation is needed to determine the suitability of this soil as a site for buildings. After the soil has settled, convex areas that have slopes of 8 to 15 percent are moderately well suited or poorly suited to use as sites for buildings. Drainageways and concave areas should not be developed. Areas that have buried trees or other woody debris beneath the surface are unsuitable as building sites. The depth of the soil over bedrock, the hazard of hillside slippage, and control of storm water runoff also are important considerations. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping and reduces the hazard of hillside slippage. Driveways should generally be constructed across the slope and designed so that water does not collect and flow in unpaved areas. Reseeding or mulching will help to control erosion during construction. Areas on spoil outslopes where slopes are more than 15 percent are generally unsuitable as sites for buildings. Boulders and stones hinder excavation and road construction.

Because the root zone is very shallow, droughtiness is a limitation on sites for lawns. Rock fragments interfere with mowing. Blanketing sites for lawns with suitable soil material provides a more favorable root zone, increases the available water capacity, and covers small stones that interfere with mowing.

This soil is poorly suited to use as a site for septic tank absorption fields. The moderately slow permeability and the unstable nature of the soil are limitations. Installing the absorption fields in suitable fill material will improve the absorption of effluent. Installing the distribution lines across the slope will minimize seepage of effluent to the surface.

This soil has a highly corrosive effect on concrete and a moderately corrosive effect on uncoated steel. Coated steel or heavy-duty PVC pipe should be used in drains and sewer lines. High-quality polyethylene pipe should be used in water lines.

This soil is moderately suited to use as a site for camp and picnic areas. The moderately slow permeability, the difficulty in establishing and maintaining a vegetative cover, the slope, and small stones are limitations. Adding a layer of suitable soil material will cover the small stones and improve plant growth. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is VIs. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is E-3.

BtE—Bethesda channery loam, 20 to 40 percent slopes. This deep, moderately steep and steep, well drained soil is on narrow benches of hillsides in areas that have been surface mined for coal. It is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. Most areas were contour strip-mined and have long, narrow benches below the highwalls. Generally, shallow ponds are at the base of the highwalls. Areas of this soil range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, friable channery loam about 3 inches thick. The substratum to a depth of about 60 inches is variegated grayish brown and yellowish brown, firm very shaly loam. In places the soil has more sand, is more acid, or both. In many areas the surface layer is very shaly loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils do not have so many coarse fragments directly below the surface layer as the Bethesda soil. Also included are stockpiles of natural soil material, coal, and rock. Inclusions make up about 10 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low because of the high percentage of coarse fragments and the compactness of the material. Runoff is very rapid. The root zone is very shallow. The upper part of the substratum is extremely acid to strongly acid.

Most areas are idle. A few areas are used as pasture, cropland, or woodland.

This soil is suited to trees adapted to the site. Grasses and legumes provide ground cover during the establishment of trees. The slope and occasional stones or boulders on and below the surface interfere with the use of equipment.

This soil is generally unsuited to most agricultural uses because of the slope, a very severe erosion hazard, droughtiness, extremely acid to strongly acid reaction, and the very shallow root zone.

Because of the slope, the moderately slow permeability, and the unstable nature of the soil, this soil is generally unsuited to use as a site for buildings and septic tank absorption fields. It is generally unsuited to use as a site for camp and picnic areas because of the slope and the difficulty in establishing and maintaining a vegetative cover.

The land capability classification is VIIe. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is E-2.

BtF—Bethesda channery loam, 40 to 70 percent slopes. This deep, very steep, well drained soil is on hillsides that have very narrow benches. It is in areas that have been surface mined for coal. It is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. Most areas were contour strip-mined and have highwalls and long, narrow benches below the highwalls. Generally, shallow ponds are at the base of the highwalls. Areas of this soil range from 10 to 50 acres in size.

Typically, the surface layer is variegated grayish brown and brown, friable channery loam about 4 inches thick. The substratum to a depth of about 60 inches is variegated grayish brown and yellowish brown, firm channery clay loam and very channery clay loam. In places the soil has more sand, is more acid, or both. In many areas the surface layer is channery or very channery silty clay loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils do not have so many coarse fragments directly below the surface layer as the Bethesda soil. Also included are stockpiles of natural soil material, coal, and rock. Inclusions make up about 10 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low because of the high percentage of coarse fragments and the compactness of the material. Runoff is very rapid. The root zone is very shallow. The upper part of the substratum is extremely acid to strongly acid.

Most areas are idle. A few areas are used as pasture or woodland.

This soil is suited to trees adapted to the site. In poorly vegetated areas planting grasses provides ground cover during the establishment of trees. Mechanical planting is not possible because of the very steep slope and the rock fragments in the surface layer.

This soil is generally unsuited to most agricultural uses because of the very steep slope, a very severe erosion hazard, droughtiness, extremely acid to strongly acid reaction, and the very shallow root zone.

This soil is generally unsuited to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas because of the very steep slope, the moderately slow permeability, and unstable fill. Large stones interfere with excavations.

The land capability classification is VIIe. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is H-1.

BuB—Bethesda silty clay loam, 0 to 8 percent slopes. This deep, nearly level and gently sloping, well drained soil is on ridgetops in areas that have been surface mined for coal. Grading and blanketing the surface with a layer of material removed from natural soils have reclaimed the soil. The substratum is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments range in size from thin, flat stone fragments to boulders. They are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. In most areas mountaintop mining has removed the entire ridgetop and has left broad, irregularly shaped areas that are smooth and do not have highwalls. Areas of this soil range from 10 to about 50 acres in size.

Typically, the surface layer is yellowish brown, friable silty clay loam about 13 inches thick. The substratum to a depth of about 60 inches is variegated gray, dark gray, and yellowish brown, firm very channery silty clay loam. In some areas the soil has more sand throughout, and in other areas it is more acid. In places the surface layer is channery loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils do not have so many coarse fragments directly below the surface layer as the Bethesda soil. Also included are a few areas where the slope is about 20 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low. Runoff is slow or medium. The root zone is shallow. The upper part of the substratum is extremely acid to strongly acid.

Most areas are used as hayland. Only a few areas are used as cropland or woodland.

This soil is suited to trees adapted to the site. Grasses and legumes provide ground cover during the establishment of trees. The low available water capacity, the shallow root zone, and acidity limit tree growth. Mechanical planting, harvesting, and mowing are suitable on this soil.

This soil is moderately suited to pasture and poorly suited to hay. The acidity, low fertility, the shallow root zone, and droughtiness are the major management concerns. Areas that have not been limed and fertilized generally have thin stands of grasses interspersed with many bare spots. A good plant cover and surface mulch help to control runoff and erosion and increase the rate of water infiltration. Orchardgrass, tall fescue, and Korean lespedeza are some of the best suited forage plants. Overgrazing depletes the stand and increases the runoff rate. Proper stocking rates and rotation grazing are needed. Limited grazing in winter and other wet periods helps to prevent surface compaction. In many areas a water supply for livestock is not available.

This soil is poorly suited to corn, soybeans, and winter wheat. The main limitations are the droughtiness, acidity, and shallow root zone. Erosion is a hazard if the soil is plowed. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes will help to control erosion and conserve soil moisture. The soil is suited to no-till farming.

Onsite investigation is needed to determine the suitability of this soil as a site for buildings. After the soil has settled, it is moderately well suited to this use. The depth of the soil over bedrock and storm water runoff should be considered during site investigations. Areas that are deeper to bedrock generally require longer periods for settlement. In a few areas where the soil was wooded before it was mined, trees and woody debris are buried. These areas should not be developed because of the hazard of future subsidence. Stones and boulders in the substratum hinder excavation. Droughtiness is a hazard on sites for lawns during dry periods.

This soil is poorly suited to use as a site for septic tank absorption fields. The moderately slow permeability and the unstable nature of the soil severely limit this use. Installing the absorption field in suitable fill material will improve the filtering capacity.

This soil has a highly corrosive effect on concrete and a moderately corrosive effect on uncoated steel. Coated steel or heavy-duty PVC pipe should be used in drain and sewer lines. High-quality polyethylene pipe should be used in water lines.

This soil is moderately suited to use as a site for camp and picnic areas. The moderately slow permeability and droughtiness limit this use. Special surfacing material is needed.

The land capability classification is IIIs. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is B-4.

BuC—Bethesda silty clay loam, 8 to 20 percent slopes. This deep, strongly sloping and moderately steep, well drained soil is on ridgetops in areas that have been surface mined for coal. Grading and blanketing the surface with a layer of material removed from natural soils have reclaimed the soil. The substratum is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments range in size from thin, flat stone fragments to boulders. They are mainly shale, siltstone, and sandstone and smaller amounts of coal and carbonaceous roof shale. In most areas mountaintop mining has removed the entire ridgetop and has left broad, irregularly shaped areas that are smooth and do not have highwalls. Areas of this soil are 50 to 200 acres in size.

Typically, the surface layer is yellowish brown, firm silty clay loam about 12 inches thick. The substratum to a depth of about 60 inches is variegated dark gray and yellowish brown, very firm very shaly silty clay loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils have fewer coarse fragments directly below the surface layer than the Bethesda soil. Also included are a few areas where the slope is about 30 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low. Runoff is rapid. The root zone is shallow. The upper part of the substratum is extremely acid to strongly acid.

Most areas are used as hayland. A few areas are used as cropland or woodland.

This soil is suited to trees adapted to the site. The low available water capacity, the shallow root zone, and acidity limit tree growth. Grasses and legumes provide ground cover during the establishment of trees. Mechanical planting, harvesting, and mowing are suitable on this soil.

This soil is poorly suited to hay and pasture. The major management concerns are the acidity, low fertility, and droughtiness. Areas that have not been limed and fertilized generally have thin stands of grasses interspersed with bare spots. In unvegetated areas much of the rainfall runs off the surface because of compaction, poor soil structure, and the moderately slow permeability. A good plant cover and surface mulch help to control runoff and erosion and increase the rate of water intake. Orchardgrass, tall fescue, and Korean lespedeza are some of the best suited forage plants. Overgrazing depletes the stand and increases the runoff rate. Proper stocking rates and rotation grazing are needed. Restricted grazing in winter and other wet periods helps to prevent surface compaction. Many areas do not have a water supply for livestock.

This soil is poorly suited to corn, soybeans, and winter wheat. The main limitations are the droughtiness, acidity, and shallow root zone. Erosion is a hazard if the soil is plowed. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes help to control erosion and conserve moisture. The soil is suited to no-till farming.

Onsite investigation is needed to determine the suitability of this soil as a site for buildings. After the soil has settled, convex areas where slopes are 8 to 15 percent are moderately well suited or poorly suited to use as sites for buildings. Drainageways and concave areas should not be developed. Areas where trees and other woody debris have been buried beneath the surface are unsuitable as building sites. The depth of the soil over bedrock, the susceptibility to hillside slippage, and control of storm water runoff also are important considerations. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping and reduces the hazard of hillside slippage. Driveways should generally be constructed across the slope and designed so that water does not collect and flow in unpaved areas. Reseeding or mulching will reduce the hazard of erosion during construction. Areas on spoil outslopes where slopes are more than 15 percent are generally unsuitable as sites for buildings and septic tank absorption fields. Stones hinder excavation and road construction. Because of the shallow root zone, droughtiness is a limitation on sites for lawns.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the slope and the moderately slow permeability. Installing the absorption field in suitable fill material will improve the absorption of effluent. Installing the distribution lines across the slope will minimize seepage of effluent to the surface.

This soil has a highly corrosive effect on concrete and a moderately corrosive effect on uncoated steel. Coated steel or heavy-duty PVC pipe should be used in drain and sewer lines. High-quality polyethylene pipe should be used in water lines.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the moderately slow permeability, the slope, and droughtiness. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IVs. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is B-4.

BuE—Bethesda silty clay loam, 20 to 40 percent slopes. This deep, moderately steep and steep, well drained soil is on hillsides in areas that have been surface mined for coal. Grading and blanketing the surface with a layer of material removed from natural soils have reclaimed the soil. The substratum is mixed rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. The rock fragments vary in size from thin, flat stone fragments to boulders. They are mainly shale, siltstone, and sandstone and smaller amounts of coal and dark roof shale. In most areas mountaintop mining has removed the entire ridgetop. Areas are irregularly shaped and range from about 40 to 200 acres in size.

Typically, the surface layer is brown, firm silty clay loam about 10 inches thick. The substratum to a depth of about 60 inches is variegated grayish brown and yellowish brown, very firm very shaly clay loam.

Included with this soil in mapping are small areas of Berks, Cruze, Guernsey, Shelocta, and Westmoreland soils. These soils are in unmined areas. Berks soils are moderately deep to bedrock. Cruze and Guernsey soils are moderately well drained. Shelocta and Westmoreland soils have fewer coarse fragments directly below the surface layer than the Bethesda soil. Also included are a few areas where the slope is about 50 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low. Runoff is very rapid. The root zone is shallow. The upper part of the substratum is extremely acid to strongly acid.

Most areas of this soil are used as hayland. A few areas are used as cropland or woodland.

This soil is suited to trees adapted to the site. The low available water capacity, the shallow root zone, and acidity limit tree growth. Grasses and legumes provide ground cover during the establishment of trees. The slope limits the use of some equipment. Laying out logging roads and skid trails on the contour facilitates the use of equipment and helps to control erosion.

This soil is generally unsuited to hay and poorly suited to pasture. The major management concerns are the acidity, low fertility, and droughtiness. Areas that have not been limed or fertilized generally have thin stands of grasses interspersed with bare spots. In unvegetated areas much of the rainfall runs off the surface because of compaction, poor soil structure, and the moderately slow permeability. A good plant cover and surface mulch help to control runoff and erosion and increase the rate of water infiltration. Orchardgrass, tall fescue, and Korean lespedeza are some of the best suited forage plants. Overgrazing depletes the stand and increases the runoff rate. Proper stocking rates and rotation grazing are needed. Restricted grazing in winter and other wet periods helps to prevent surface compaction. In many areas a water supply for livestock is not available.

This soil is generally unsuited to corn, soybeans, and winter wheat. The main limitations are the slope, droughtiness, acidity, and the shallow root zone. If the soil is plowed, erosion is a very severe hazard.

This soil is generally unsuited to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas because of the slope, the moderately slow permeability, and the unstable nature of the soil.

The land capability classification is VIe. No woodland ordination symbol has been assigned. The pasture and hayland suitability group is E-2.

CaC2—Cana Variant silt loam, 8 to 15 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on glaciated foot slopes in the uplands. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay. Most areas are irregularly shaped and range from 5 to 60 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 41 inches thick. The upper part is yellowish brown, friable silt loam; the next part is yellowish brown, mottled firm clay loam; and the lower part is yellowish brown, mottled, firm silty clay loam. The substratum is yellowish brown, firm silty clay loam. Yellowish brown, weathered shale bedrock is at a depth of about 65 inches. In places the lower part of the subsoil and the substratum have till pebbles. In a few areas the substratum has more sandstone fragments. In some areas the upper part of the soil has no till pebbles.

Included with this soil in mapping are a few areas where the slope is about 20 percent. These inclusions make up about 15 percent of most areas of the map unit.

Permeability is moderate or moderately slow in the upper part of the subsoil in the Cana Variant soil and slow in the lower part and in the substratum. Available water capacity is high. Runoff is rapid. During extended wet periods, the seasonal high water table is between depths of 24 and 42 inches. The root zone is deep.

Most areas of this soil are used for cultivated crops. A few areas are used as pasture or woodland.

This soil is well suited to trees. Mechanical planting and mowing are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is overgrazed or is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control runoff and erosion. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in the steeper included areas limits the use of some equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a very severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion and prevent surface crusting. The soil is well suited to no-till farming.

Because of the slope, the seasonal high water table, and the shrink-swell potential, this soil is only moderately suited to use as a site for buildings. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping.

This soil is poorly suited to use as a site for septic tank absorption fields. Installing the distribution lines on the contour will minimize seepage of the effluent to the surface. Mounding with suitable fill material can elevate the field above the weathered shale bedrock and thus increase the absorption rate. Subsurface drains upslope from the absorption field will intercept seepage water.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the slope, seasonal high water table, and slow permeability. Surface or subsurface drains will help to remove excess water. In some areas land shaping is needed. In areas that are subject to heavy traffic, establishing a ground cover helps to control erosion. Special surfacing material generally is needed in camp areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

CaD2—Cana Variant silt loam, 15 to 25 percent slopes, eroded. This deep, moderately steep, moderately well drained soil is on glaciated foot slopes in the uplands. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay. Most areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 34 inches thick. The upper part is dark yellowish brown, friable silt loam; the next part is dark yellowish brown, mottled, firm gravelly clay loam; and the lower part is variegated dark yellowish brown and light brownish gray, mottled, firm silty clay loam. The substratum is variegated light olive brown and light brownish gray, mottled, firm silty clay. Soft shale is at a depth of about 45 inches. In some places the lower part of the subsoil and the substratum have glacial till pebbles. In a few areas the substratum has more sandstone fragments. In some areas the upper part of the soil has no till pebbles.

Included with this soil in mapping are a few areas where the slope is about 35 percent. These inclusions make up about 15 percent of most areas of the map unit.

Permeability is moderate or moderately slow in the upper part of the Cana Variant soil and slow in the lower part. Available water capacity is moderate. Runoff is rapid. The seasonal high water table is between depths of 24 and 42 inches during extended wet periods. The root zone is deep.

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

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is moderately suited to pasture and poorly suited to hay. The slope limits the use of some mechanized equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is poorly suited to corn, soybeans, and winter wheat. The slope limits the use of some farm equipment. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control runoff and erosion.

This soil is poorly suited to use as a site for buildings and septic tank absorption fields. Drains at the base of footings and exterior basement wall coatings help to keep basements dry. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour helps to prevent the seepage of effluent to the surface. Interceptor drains upslope from the absorption field will help to remove excess water. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is poorly suited to use as a site for camp and picnic areas. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

CdB—Cardington silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on slight rises on till plains. Most areas are irregularly shaped and range from 10 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 27 inches thick. It is yellowish brown, firm silty clay loam in the upper part and yellowish brown, mottled, firm clay and clay loam in the lower part. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm clay loam glacial till. In some areas the subsoil has less clay. In a few areas the lower part of the subsoil and the substratum have more gravel.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington soils along drainageways and in small depressions. Also included are small areas of the well drained Alexandria soils on knolls and areas where the slope is about 15 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Cardington soil. Available water capacity is moderate. Runoff is medium. The seasonal high water table is between depths of 18 and 36 inches during extended wet periods. The root zone is restricted mainly to the 30- to 39-inch zone above the dense, compact glacial till.

Most areas are used as cropland. A few areas are used for pasture or woodland.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or contour strip seeding will help to control erosion during reseeding. Pasture rotation, proper stocking rates, deferred grazing during wet periods, mowing for weed control, and applications of lime and fertilizer help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. The surface layer crusts after hard rains. Random subsurface drains help to drain the wetter included soils. Erosion is a hazard if the soil is plowed during seedbed preparation. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes will help to control erosion and minimize surface crusting.

This soil is moderately suited to use as a site for buildings. Because of the seasonal high water table, it is better suited to buildings without basements than to buildings with basements. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. Using perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

Because of the seasonal high water table and the moderately slow permeability, this soil is only moderately suited to use as a site for camp areas and picnic areas. Surface and subsurface drains will remove excess water. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

CdC2—Cardington silt loam, 6 to 12 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on knolls and hillsides on dissected parts of till plains. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay and coarse fragments. Most areas are irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, firm clay loam about 23 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington soils in concave positions; small areas of the well drained Alexandria soils on the tops of knolls and the upper part of side slopes; and, on the upper part of the slopes, a few small areas of severely eroded soils that have a clay loam surface layer in which tilth is fair. Also included are some areas that have a slope of about 20 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Cardington soil. Available water capacity is moderate. Runoff is rapid. The seasonal high water table is between depths of 18 and 36 inches during extended wet periods. The root zone is restricted mainly to the 30- to 39-inch zone above the compact glacial till.

Most areas are used as cropland. A few areas are used for pasture or woodland.

This soil is well suited to trees. Mechanical planting

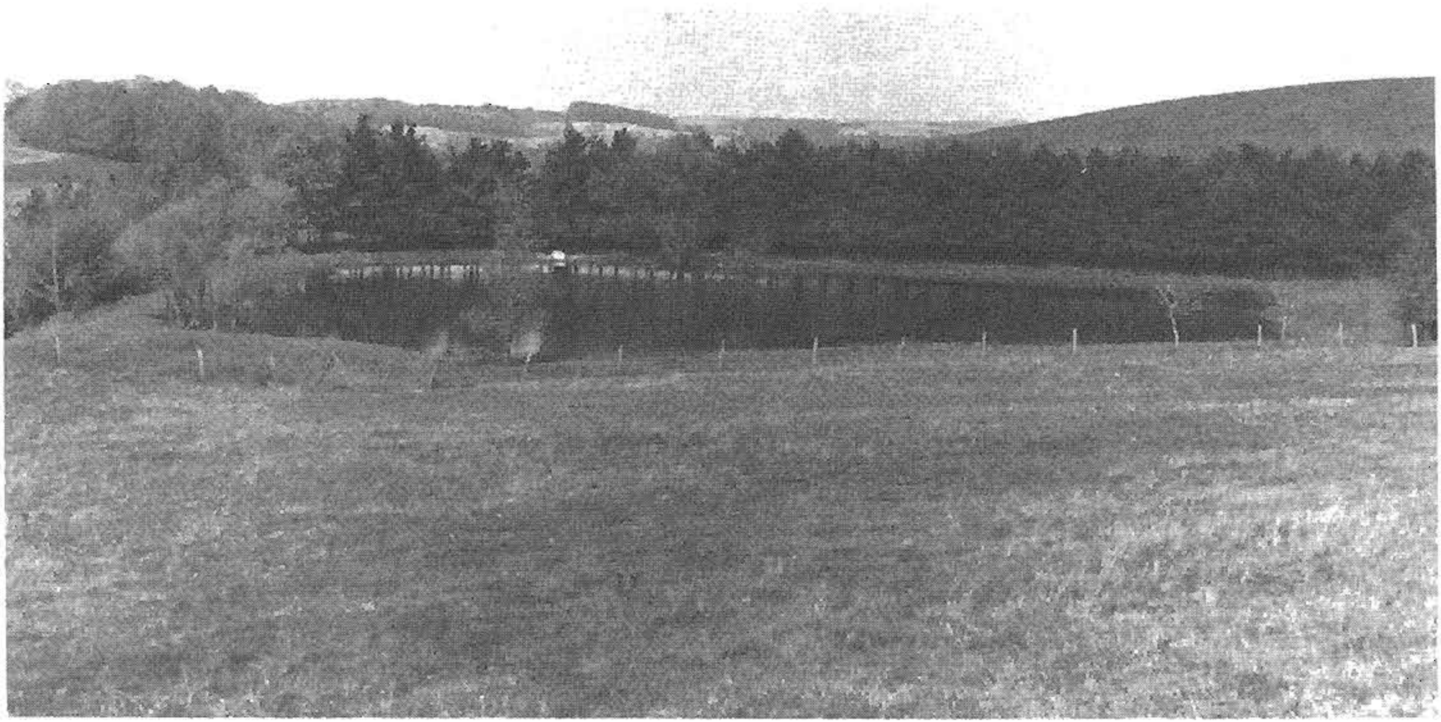

Figure 3.—A farm pond in a pastured area of Cardington silt loam, 6 to 12 percent slopes, eroded.

and mowing for weed control are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is moderately suited to hay and well suited to pasture. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or contour strip seeding helps to control erosion during reseeding. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The soil is well suited to farm ponds for watering livestock (fig. 3). The slope of some of the steeper included soils and wetness in the wetter included soils may limit the use of some equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. Erosion is a severe hazard if the soil is plowed (fig. 4). The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion and minimize surface crusting. The soil is well suited to no-till farming. In some wetter included soils, random surface or subsurface drains are needed.

This soil is moderately suited to use as a site for buildings. It is better suited to buildings without basements than to those with basements. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. In some of the steeper included areas, land shaping is needed.

Because of the seasonal high water table and the moderately slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Interceptor drains upslope from the absorption field will lower the water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains will remove excess water. In some areas land shaping is needed. In areas that are subject to heavy traffic, establishing a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

CeF—Cedarfalls-Rock outcrop complex, 40 to 70 percent slopes. This map unit consists of a Cedarfalls soil and outcrops of sandstone on upland hillsides. The Cedarfalls soil is deep, very steep, and well drained. It is at the base of high, massive escarpments of Blackhand Sandstone. In some areas sandstone boulders are on and below the surface of the soil. Areas are commonly long and narrow and range from 50 to several hundred acres in size. Most are about 50 percent Cedarfalls soil and 30 percent Rock outcrop. The Cedarfalls soil and Rock outcrop are so narrowly banded on the landscape that they could not be separated at the scale used in mapping.

Typically, the Cedarfalls soil has a surface layer of very dark grayish brown, very friable coarse sandy loam about 5 inches thick. The substratum is yellowish brown, very friable and loose coarse sandy loam and loamy coarse sand in the upper part, and light yellowish brown, loose coarse sand in the lower part. Strong brown, hard sandstone bedrock is at a depth of about 57 inches.

The Rock outcrop is on vertical cliffs and ledges and in some overhangs or rock shelters locally called caves. The cliffs and overhangs range from 40 to 200 feet in height. In most areas the cliffs parallel streams, forming gorges or canyons that vary in width. As the exposed bedrock weathers, sand grains break away from the rock and collect at the base of the cliffs, forming the Cedarfalls soil.

Included in mapping are small areas of Dekalb and Shelocta soils. The moderately deep Dekalb soils are in areas where the cliffs are less than 40 feet high. Shelocta soils have a subsoil. They are upslope from

Figure 4.—Gully and sheet erosion in a cultivated area of Cardington silt loam, 6 to 12 percent slopes, eroded.

Figure 5.—A wooded area of Cedarfalls-Rock outcrop complex, 40 to 70 percent slopes.

the Rock outcrop. Included soils make up about 20 percent of most areas of the map unit.

Permeability is rapid in the Cedarfall soil. Available water capacity is low. Runoff is rapid. The root zone is deep.

Most areas of this map unit are wooded (fig. 5). They are in Hocking Hills State Park and Hocking Hills State Forest. Many areas are scenic and have hiking trails. More hiking trails and scenic lookout points can be developed.

The Cedarfalls soil is moderately suited to trees. The narrow gorges have a microclimate that is much cooler and moister than is typical of Hocking County. Hemlock and aspen are the predominant trees in the gorges. Laying out haul roads and skid trails on or nearly on the contour and establishing water bars help to control erosion. The slope and rock outcrops severely limit the use of planting and harvesting equipment. The trees can be logged from above or below the cliffs. Special equipment is needed for site preparation and planting. No timber cutting is currently allowed or expected in the future in Hocking Hills State Park.

Because of the very steep slope and the rock outcrops, the Cedarfalls soil is generally unsuited to row crops, pasture, and hay and to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas.

The land capability classification is VIIs. The Cedarfalls soil is assigned the woodland ordination symbol 4R and the pasture and hayland suitability group H-1. The Rock outcrop is not assigned a woodland ordination symbol or a pasture and hayland suitability group.

Cg—Chagrin silt loam, frequently flooded. This deep, nearly level, well drained soil is on the higher parts of flood plains (fig. 6). Most areas are long and narrow and range from 5 to several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is brown, friable silt loam about 16 inches thick. The subsoil is dark yellowish brown, friable silt loam and loam about 27 inches thick. The substratum to a depth of about 80 inches is yellowish brown, friable and loose stratified loam, fine sandy loam, and loamy fine sand. In some places the subsoil has more silt. In other places the soil has less clay. In some areas it is moderately well drained. In other areas it is more acid.

Included with this soil in mapping are small areas of the poorly drained Melvin and the somewhat poorly drained Orrville soils in the lower positions on the flood plains. These soils make up about 15 percent of most areas of the map unit.

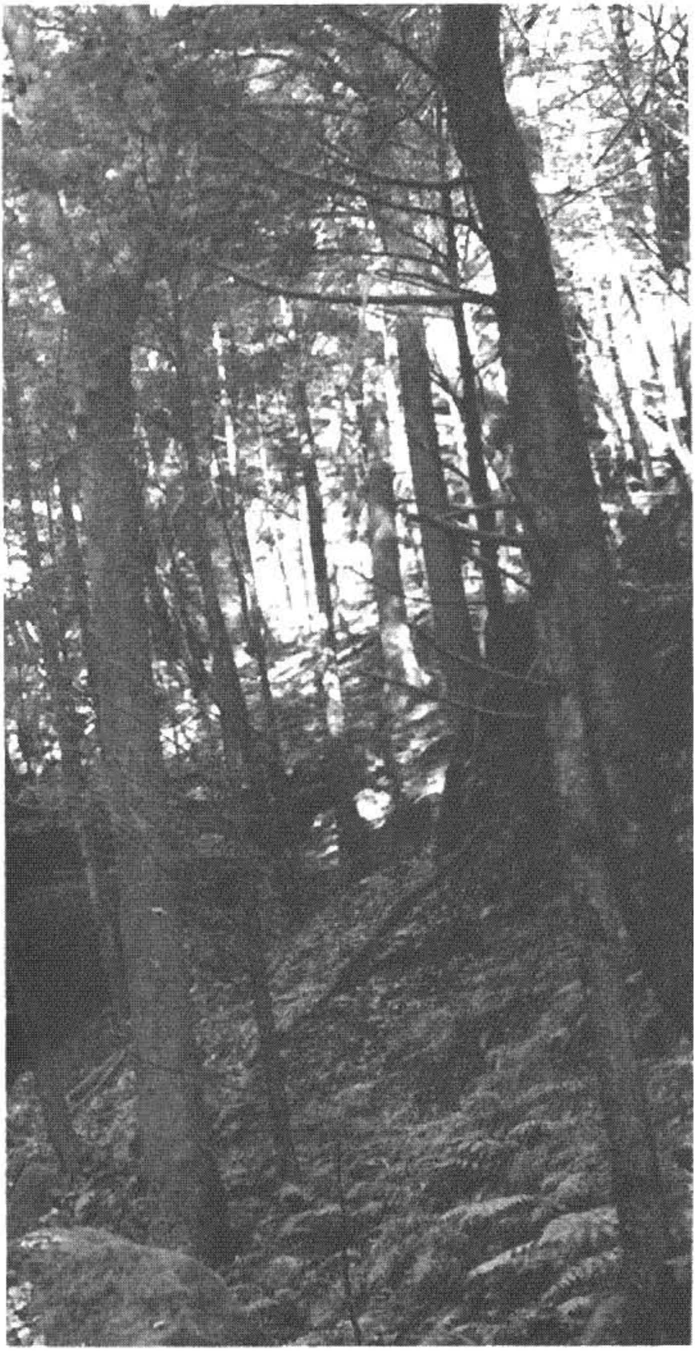

Figure 5.—A wooded area of Cedarfalls-Rock outcrop complex, 40 to 70 percent slopes.

Figure 6.—Flooding on Chagrin silt loam, frequently flooded.

Permeability is moderate in the Chagrin soil. Available water capacity is high. Runoff is slow. The root zone is deep. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods.

Most areas are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Planting, harvesting, and mowing can be done during periods when the soil is not flooded.

Areas protected from flooding are well suited to hay and pasture. Sediment from stream overflow lowers the quality of forage. Proper stocking rates, deferred grazing during wet periods, pasture rotation, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn and soybeans. Floodwater can damage winter grain crops. Streambank erosion is a major source of sediment and is the cause of water pollution. In some areas it can be controlled by clearing the channel of debris and planting willows on the streambanks. In most areas, however, stabilizing eroding streambanks is difficult. Weed control is a problem on this soil because weed seeds are carried in by floodwater. A system of conservation tillage that leaves crop residue on the surface and crop rotations improve tilth.

This soil is generally unsuited to use as a site for buildings, septic tank absorption fields, and camp areas because of the flooding. It is well suited to use as a site for picnic areas.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-5.

ChA—Chili loam, 0 to 3 percent slopes. This deep, nearly level, well drained soil is on outwash terraces. Most areas are elongated or irregularly shaped and range from 15 to 50 acres in size.

Typically, the surface layer is dark brown, friable loam about 10 inches thick. The subsoil is about 34 inches thick. The upper part is dark yellowish brown and yellowish brown, friable loam; the next part is brown, friable gravelly sandy clay loam; and the lower part is brown, very friable gravelly sandy loam. The substratum to a depth of about 80 inches is brown, loose, very gravelly loamy sand. In some areas the soil is moderately well drained. In a few areas it contains more silt and less sand and gravel in the subsoil.

Included with this soil in mapping are small areas of Euclid, Licking, and McGary soils. The somewhat poorly drained Euclid and McGary soils are in depressions. The moderately well drained Licking soils are on slight rises on lacustrine terraces. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately rapid in the Chili soil. Runoff is slow. Available water capacity is moderate. The root zone is deep.

Most areas are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Mechanical planting, harvesting, and mowing are suitable on this soil.

This soil is well suited to pasture and hay. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. Droughtiness is a limitation. A system of conservation tillage that leaves crop residue on the surface and crop rotations help to conserve moisture.

This soil is well suited to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. Installing the distribution lines of septic tank absorption fields in suitable fill material will elevate the field above the coarse textured substratum and improve the filtering of effluent. In areas that are subject to heavy traffic, maintaining a vegetative cover helps to control erosion.

The land capability classification is IIs. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

ChC2—Chili loam, 8 to 15 percent slopes, eroded. This deep, strongly sloping, well drained soil is on slope breaks on outwash terraces. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas are irregularly shaped and range from 5 to about 30 acres in size.

Typically, the surface layer is brown, friable loam about 9 inches thick. The subsoil is yellowish brown and brown, firm gravelly loam and gravelly clay loam about 45 inches thick. The substratum to a depth of about 80 inches is yellowish brown, loose gravelly sand.

Included with this soil in mapping are small areas of Chagrin soils on flood plains and Licking soils on lacustrine terraces. Chagrin soils have less clay movement in the subsoil than the Chili soil. Licking soils are moderately well drained. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately rapid in the Chili soil. Runoff is medium. Available water capacity is moderate. The root zone is deep.

Most areas are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Mechanical planting, harvesting, and mowing are suitable on this soil. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and hay. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is moderately suited to corn, soybeans, and winter wheat. It is droughty during dry periods. If the soil is plowed, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface will help to control erosion and conserve moisture. Contour stripcropping, crop rotations that include grasses and legumes, grassed waterways, and diversions also help to control erosion.

This soil is moderately suited to use as a site for buildings and septic tank absorption fields. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour helps to minimize seepage of effluent to the surface. Installing the distribution lines in suitable fill material elevates the field above the coarse textured substratum and thus improves the filtering capacity.

This soil is moderately suited to use as a site for camp and picnic areas. In some areas land shaping is needed. Adding fill material facilitates the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

CkB—Cincinnati silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on broad ridgetops of the Illinoian till plain. Most areas are irregularly shaped and range from 10 to 60 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil extends to a depth of about 80 inches. It is brown and yellowish brown, friable and firm silt loam in the upper part; a fragipan of yellowish brown, mottled, very firm and brittle loam in the next part; and yellowish brown, firm clay loam in the lower part. In some areas the silty mantle is more than 60 inches thick. In a few areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Hickory soils along drainageways. These soils do not have a fragipan. Also included are areas where the slope is about 15 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate above the fragipan in the Cincinnati soil and slow or moderately slow in and below the fragipan. The root zone is restricted mainly to the 18 to 38 inches above the fragipan. Available water capacity is moderate in the root zone. Runoff is medium. A perched seasonal high water table is between depths of 30 and 48 inches during extended wet periods.

Most areas are used as cropland. A few areas are used as pasture.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to hay and pasture. If the soil is plowed during seedbed preparation, erosion is a moderate hazard. Surface compaction and increased runoff result from grazing when the soil is too wet. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a moderate hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes help to control erosion and minimize surface crusting.

Because of the wetness, this soil is better suited to use as a site for buildings without basements than to buildings with basements. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and slow or moderately slow permeability. Interceptor drains upslope from the absorption fields will help to remove seepage water above the fragipan. Installing the absorption field in suitable fill material and enlarging the field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. The slow or moderately slow permeability is a limitation. Special surfacing material generally is needed in camp areas. In areas that are subject to heavy traffic, maintaining a vegetative cover helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-3.

CkC2—Cincinnati silt loam, 6 to 12 percent slopes, eroded. This deep, strongly sloping, well drained soil is on hillsides on dissected parts of the Illinoian till plain. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer. Individual areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil extends to a depth of about 80 inches. It is yellowish brown, firm silt loam in the upper part; a fragipan of yellowish brown, mottled, firm and brittle loam in the next part; and yellowish brown, firm clay loam in the lower part. In places the silty mantle is thicker. In a few areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Hickory soils along drainageways. These soils do not have a fragipan. Also included are small areas where the slope is about 20 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate above the fragipan in the Cincinnati soil and slow or moderately slow in and below the fragipan. The root zone is restricted mainly to the 18 to 36 inches above the fragipan. Available water capacity is moderate in the root zone. Runoff is rapid. A perched seasonal high water table is between depths of 30 and 48 inches during extended wet periods.

Most areas are used as cropland. A few areas are used as pasture.

This soil is well suited to trees. Mechanical planting and mowing are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. The slope in the steeper included areas may limit the use of some mechanized equipment. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Pasture rotation, deferred grazing during wet periods, proper stocking rates, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in the steeper included areas may limit the use of some mechanized equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control runoff and erosion.

Because of the slope and the seasonal high water table, this soil is only moderately suited to use as a site for buildings. In some areas land shaping is needed. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the slow or moderately slow permeability and the seasonal high water table. Interceptor drains upslope from the absorption fields will help to remove seepage water above the fragipan. Enlarging the absorption fields will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the slope and the slow or moderately slow permeability. In some areas land shaping is needed. Special surfacing material generally is needed in camp areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-3.

CtC—Cruze silt loam, 8 to 15 percent slopes. This deep, strongly sloping, moderately well drained soil is on ridgetops and on benches on hillsides. Most areas are long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 7 inches thick. The subsoil is about 41 inches thick. The upper part is dark yellowish brown, firm silty clay loam; the next part is yellowish brown and light olive brown, mottled, firm silty clay; and the lower part is light olive brown, mottled, firm silty clay loam. Light olive brown, soft clay shale bedrock is at a depth of about 48 inches. In places the upper part of the subsoil has more silt and less clay.

Included with this soil in mapping are small areas of the well drained Shelocta, Wellston, and Westmore soils. These soils have less clay in the upper part of the subsoil than the Cruze soil. Shelocta soils are in saddles and on shoulder slopes. Wellston soils are on the higher parts of ridges. Westmore soils are on the broader parts of ridgetops. Also included are a few areas where the slope is about 25 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow or slow in the Cruze soil. Runoff is rapid. Available water capacity is moderate. The seasonal high water table is between depths of 18 and 36 inches during extended wet periods. The root zone is deep.

Most areas are wooded. Some areas are used as pasture, and a few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is overgrazed or is plowed during pasture renovation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control runoff and erosion during reseeding. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. In cultivated areas erosion is a severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion and minimize surface crusting.

Because of the seasonal high water table and a high shrink-swell potential, this soil is only moderately suited to use as a site for buildings. The limitations are the seasonal high water table and high shrink-swell potential. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Subsurface drains upslope from the buildings will intercept seepage water. Backfilling along foundations and basement walls with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the moderately slow or slow permeability. Interceptor drains upslope from the absorption field will help to remove excess water. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the slope, the seasonal high water table, and the moderately slow or slow permeability. Subsurface drains help to remove excess water. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

DkF—Dekalb-Shelocta-Rock outcrop complex, 40 to 70 percent slopes. This map unit consists of very steep, well drained soils and Rock outcrop on upland hillsides. In most areas it is about 50 percent Dekalb soil, 20 percent Shelocta soil, and 15 percent Rock outcrop. The moderately deep Dekalb soil is on the upper part of hillsides and below escarpments. The deep Shelocta soil is on foot slopes. The Rock outcrop occurs as sandstone escarpments. Areas are commonly long and narrow or irregularly shaped and range from 50 to several hundred acres in size. The two soils and the Rock outcrop are in such narrow bands on hillsides that they could not be separated at the scale used in mapping.

Typically, the Dekalb soil has a surface layer of very dark grayish brown, friable channery fine sandy loam about 4 inches thick. The subsoil is about 28 inches thick. It is yellowish brown and friable. The upper part is channery fine sandy loam, the next part is very channery fine sandy loam, and the lower part is extremely channery fine sandy loam. Strong brown, hard, massive sandstone bedrock is at a depth of about 32 inches. In places the depth to bedrock is about 45 inches. In a few areas the subsoil has less sand and more silt.

Typically, the Shelocta soil has a surface layer of very dark grayish brown, friable channery silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 3 inches thick. The subsoil is firm channery silty clay loam about 36 inches thick. The upper part is yellowish brown, and the lower part is light yellowish brown and light brownish gray. The substratum is strong brown, firm very channery silty clay loam. Layered, light brownish gray shale and siltstone bedrock is at a depth of about 54 inches. In places the subsoil has less clay.

The Rock outcrop is on vertical cliffs and ledges as much as 40 feet high on the upper third of the hillsides. It commonly parallels a stream. In some areas the ledges are more than 40 feet high.

Included in mapping are small areas of Cedarfalls soils below the areas of Rock outcrop. These soils are sandier throughout than the Dekalb and Shelocta soils. Also included are small areas of moderately well drained soils that are moderately deep over clay shale bedrock. These soils are in bands on hillsides. Included soils make up about 15 percent of most areas of the map unit.

Permeability is rapid in the Dekalb soil and moderate in the Shelocta soil. Available water capacity is very low or low in the Dekalb soil and moderate in the Shelocta soil. The root zone is moderately deep in the Dekalb soil and deep in the Shelocta soil. Runoff is very rapid on both soils.

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

Because of the higher available water capacity and deeper root zone, the Shelocta soil is better suited to trees than the Dekalb soil. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. The very steep slope and Rock outcrop severely limit the use of equipment. The Rock outcrop should be avoided when haul roads, skid trails, and log landings are established. Planting seedlings that have been transplanted once and mulching around seedlings will reduce the seedling mortality rate. Building haul roads and skid trails on the contour helps to control erosion and facilitates the use of equipment. Water bars also help to control erosion. Special equipment is needed for site preparation and planting. Plant competition on the Shelocta soil can be controlled by removing vines and the less desirable trees and shrubs.

This unit is generally unsuited to row crops, hay, and pasture and to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. The main limitations are the very steep slope, the Rock outcrop, and the erosion hazard. The bedrock between depths of 20 and 40 inches in the Dekalb soil also is a limitation.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Dekalb soil is 4R on north aspects, 3R on south aspects; the one assigned to the Shelocta soil is 4R on both north and south aspects. The Dekalb and Shelocta soils are in pasture and hayland suitability group H-1. The Rock outcrop is not assigned a woodland ordination symbol or a pasture and hayland suitability group.

EcA—Euclid silt loam, rarely flooded. This deep, nearly level, somewhat poorly drained soil is on low terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is brown and dark grayish brown, friable silt loam about 5 inches thick. The subsoil is grayish brown and yellowish brown, mottled, firm silt loam about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, firm silt loam. In some areas the subsoil has a higher clay content. In a few areas it has more sand and less silt.

Included with this soil in mapping are a few of the higher areas that are not subject to flooding and small areas of the moderately well drained Glenford soils. Glenford soils are generally in the higher landscape positions. Also included are a few areas where the slope is about 8 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Euclid soil. Available water capacity is high. Runoff is slow. The seasonal high water table is between depths of 12 and 30 inches during extended wet periods. The root zone is deep.

Most areas are wooded. Some areas are used as pasture, and a few areas are used as cropland.

This soil is well suited to trees. The trees can be logged when the soil is frozen or during the drier parts of the year.

This soil is moderately suited to pasture. Drained areas are well suited to hay. The seasonal high water table and rare flooding limit grazing and the use of equipment during wet periods. The forage species selected for planting should be those that are tolerant of wetness. Proper stocking rates, deferred grazing during wet periods, pasture rotation, mowing for weed control, and applications of lime and fertilizer help to minimize surface compaction and improve the growth of forage plants.

Drained areas are well suited to corn, soybeans, and winter wheat. Subsurface and surface drains are needed to remove excess water. The surface layer crusts after hard rains. In adequately drained areas, a system of conservation tillage that leaves crop residue on the surface can minimize surface crusting.

This soil is generally unsuited to use as a site for buildings and septic tank absorption fields because of the flooding hazard, the seasonal high water table, and the moderately slow permeability.

This soil is poorly suited to use as a site for camp and picnic areas. The main limitations are the seasonal high water table, the flooding hazard, and the moderately slow permeability. The camp and picnic areas can be used during periods when the soil is not flooded. Surface and subsurface drains will remove excess water. Adding fill material will facilitate the use of camp areas. Special surfacing material generally is needed in these areas.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is C-3.

GfA—Glenford silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on lacustrine terraces. Most areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is yellowish brown, mottled, firm silt loam and silty clay loam about 33 inches thick. The substratum to a depth of about 80 inches is grayish brown and yellowish brown, firm silt loam and silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Euclid and McGary soils and a few spots of poorly drained soils. Euclid soils are in depressions on the slightly lower terrace levels. McGary soils are in the slightly lower terrace positions. Also included are some areas on terrace breaks that have a slope of about 15 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderately slow in the Glenford soil. Available water capacity is high. Runoff is slow. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. Proper stocking rates, pasture rotation, deferred grazing during wet periods, mowing for weed control, and applications of lime and fertilizer help to keep the pasture in good condition. Subsurface drains are needed in included wetter soils to remove excess water.

This soil is well suited to corn, soybeans, and winter wheat. The surface layer crusts after heavy rains. A system of conservation tillage that leaves crop residue on the surface helps to reduce surface crusting. In some areas grassed waterways are used to remove excess surface water. Subsurface drains are needed in the wetter included soils.

Because of the seasonal high water table and a moderate shrink-swell potential, this soil is only moderately suited to use as a site for buildings. It is better suited to buildings without basements than to buildings with basements. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Backfilling along basement walls with material that has a low shrink-swell potential will help to prevent the structural damage caused by shrinking and swelling of the soil. The wetter included soils should not be used as sites for buildings.

This soil is moderately suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the moderately slow permeability. Perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains will remove excess water. Special surfacing material generally is needed in camp areas.

The land capability classification is I. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

GfB—Glenford silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on lacustrine terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is yellowish brown, friable silt loam, and the lower part is yellowish brown, mottled, friable silty clay loam and silt loam. The substratum to a depth of about 80 inches is yellowish brown, mottled, friable silt loam. In some areas the soil is well drained. In a few areas the subsoil has more clay or sand and less silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Euclid and McGary soils in depressions on the slightly lower terrace levels and a few spots of poorly drained soils in depressions. Also included, on slope breaks, are small areas of soils that have a slope of about 15 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately slow in the Glenford soil. Available water capacity is high. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland (fig. 7). Some areas are used as pasture, and a few areas are wooded.

This soil is well suited to trees. Planting and mowing are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, mowing for weed control, and applications of lime and fertilizer help to keep the pasture in good condition. Subsurface drains will remove excess water from the wetter included soils.

This soil is well suited to corn, soybeans, and winter wheat. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes help to minimize surface crusting and control erosion. Grassed waterways can be used to remove excess surface water. Random subsurface drains will remove excess water from the wetter included soils.

Because of the seasonal high water table and a moderate shrink-swell potential, this soil is only moderately suited to use as a site for buildings. It is better suited to buildings without basements than to buildings with basements. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along basement

Figure 7.—An area of Glenford silt loam, 2 to 6 percent slopes, used as cropland. This soil is prime farmland. Shelocta and Berks soils are on the hills in the background.

walls with material that has a low shrink-swell potential will help to prevent the structural damage caused by shrinking and swelling of the soil. The wetter included soils should not be used as sites for buildings.

This soil is moderately suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the moderately slow permeability. Perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains will remove excess water. Special surfacing material generally is needed in camp areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control runoff and erosion.

The land capability classification is IIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-6.

GuC—Guernsey silt loam, 8 to 15 percent slopes. This deep, strongly sloping, moderately well drained soil is on ridgetops and benches on upland hillsides. Most areas are long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 35 inches thick. The upper part is strong brown, firm silt loam; the next part is yellowish brown, mottled, firm silty clay loam; and the lower part is yellowish brown, mottled, firm silty clay. The substratum is variegated grayish brown and yellowish brown, very firm silty clay. Weathered, gray shale and strong brown siltstone bedrock is at a depth of about 51 inches. In places the loess mantle is thicker.

Included with this soil in mapping are small areas of the well drained Wellston, Westmore, and Westmoreland soils. Westmoreland soils are on shoulder slopes and the sides of saddles. Wellston soils are on the higher parts of ridges. Westmore soils are on the broader parts of ridgetops. Also included are a few areas of soils that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately slow or slow in the Guernsey soil. Runoff is rapid. Available water capacity is moderate. The seasonal high water table is between depths of 24 and 42 inches during extented wet periods. The root zone is deep.

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

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is overgrazed or is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Pasture rotation, proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion.

Because of the seasonal high water table and a high shrink-swell potential, this soil is only moderately suited to use as a site for buildings. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations and basement walls with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. Subsurface drains upslope from the buildings will intercept seepage water. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the moderately slow or slow permeability. Interceptor drains upslope from the absorption field will help to remove excess water. Increasing the size of the absorption field will improve the absorption of effluent. Installing the distribution lines on the contour will minimize seepage of effluent to the surface.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the slope, the seasonal high water table, and the moderately slow or slow permeability. Subsurface drains help to remove excess water. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

HmD2—Hickory silt loam, 12 to 18 percent slopes, eroded. This deep, strongly sloping and moderately steep, well drained soil is on hillsides on dissected parts of the Illinoian till plain. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay. Most areas are long and narrow and range from 10 to 200 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay loam about 38 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In places the surface layer is clay loam.

Included with this soil in mapping are small areas of Cincinnati soils and areas of soils that have a slope of about 30 percent. Cincinnati soils have a fragipan. They are commonly in the less sloping areas between waterways. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Hickory soil. Available water capacity is high. Runoff is rapid. The root zone is deep.

Most areas are used as cropland. Some areas are wooded, and a few areas are used as pasture.

This soil is well suited to trees. Building haul roads and skid trails on the contour helps to control erosion and facilitates the use of equipment. Water bars also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings.

Figure 8.—A pastured area of Hickory silt loam, 12 to 18 percent slopes, eroded.

Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Special equipment is needed for site preparation and planting.

This soil is moderately suited to hay and pasture (fig. 8). The slope limits the use of some mechanized equipment. If the soil is plowed during pasture renovation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion. Soil compaction and increased runoff result from grazing when the soil is too wet. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is poorly suited to corn, soybeans, and winter wheat. In some areas the slope restricts the use of mechanized equipment. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control runoff and erosion.

Because of the slope and a moderate shrink-swell potential, this soil is poorly suited to use as a site for buildings. In some areas land shaping may be needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Backfilling along foundations and basement walls with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. The slope is a limitation. Installing the distribution lines on the contour will minimize seepage of effluent to the surface.

This soil is poorly suited to use as a site for camp and picnic areas. The slope is a limitation. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

Maintaining a good vegetative cover helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is A-1.

HmE—Hickory silt loam, 18 to 25 percent slopes. This deep, moderately steep, well drained soil is on hillsides on dissected parts of the Illinoian till plain. Most areas are long and narrow and range from 10 to 150 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 38 inches of yellowish brown, friable loam and firm clay loam. The substratum to a depth of about 80 inches is dark yellowish brown, firm gravelly clay loam glacial till.

Included with this soil in mapping are a few small areas of Cana Variant and Cincinnati soils. The moderately well drained Cana Variant soils are on the lower part of slopes. Cincinnati soils have a fragipan. They are in the less sloping areas between drainageways. Also included are a few areas of soils that have a slope of about 10 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Hickory soil. Available water capacity is high. Runoff is very rapid. The root zone is deep.

Most areas are used for pasture or hay. Some areas are wooded, and a few areas are used as cropland.

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a vegetative cover also help to control erosion. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is moderately suited to pasture and poorly suited to hay. The slope limits the use of some mechanized equipment. If the soil is plowed during pasture renovation, erosion is a severe hazard. Using no-till, trash mulch, or strip seeding will help to control erosion. Soil compaction and increased runoff result from grazing when the soil is too wet. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is generally unsuited to cultivated crops. If the soil is cultivated, erosion is a very severe hazard.

Because of the slope, this soil is poorly suited to use as a site for buildings and septic tank absorption fields. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour will minimize seepage of effluent to the surface.

This soil is generally unsuitable as a site for camp and picnic areas because of the slope.

The land capability classification is VIe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is A-2.

HmF—Hickory silt loam, 25 to 40 percent slopes. This deep, steep, well drained soil is on hillsides on dissected parts of the Illinoian till plain. Most areas are long and narrow and range from 10 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay loam about 36 inches thick. The substratum to a depth of about 80 inches is yellowish brown, firm gravelly clay loam glacial till. In places the surface layer is clay loam or silty clay loam.

Included with this soil in mapping are small areas of Cana Variant and Cincinnati soils. The moderately well drained Cana Variant soils are on the lower part of some slopes. Cincinnati soils have a fragipan. They are on shoulder slopes. Also included are a few areas of soils that have a slope of about 50 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Hickory soil. Available water capacity is high. Runoff is very rapid. The root zone is deep.

Most areas are wooded. A few areas are used for pasture.

This soil is well suited to trees. If the ground cover is removed, erosion is a severe hazard. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a vegetative cover also help to control erosion. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

Because of the slope, this soil is generally unsuited to hay and poorly suited to pasture. The slope limits the use of mechanized equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, deferred grazing during wet periods, applications of lime and fertilizer, pasture rotation, and mowing for weed control help to keep the pasture in good condition.

This soil is generally unsuited to row crops and small grains and to use as a site for buildings, septic tank absorption fields, camp areas, and picnic areas because of the slope. Maintaining a ground cover helps to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is A-3.

LkB—Licking silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on lacustrine terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 58 inches thick. The upper part is yellowish brown and brown, firm silt loam; the next part is brown, mottled, firm silty clay loam; and the lower part is yellowish brown, mottled, firm silty clay. The substratum to a depth of about 80 inches is brown, mottled, firm silty clay. In some areas the soil is well drained.

Included with this soil in mapping are small areas of Euclid, Glenford, McGary, and Otwell soils. The somewhat poorly drained Euclid soils are in the slightly lower terrace positions. Glenford soils are intermingled with some areas of the Licking soil. They have less clay in the subsoil and substratum than the Licking soil. The somewhat poorly drained McGary soils are in swales and depressions. Otwell soils have a fragipan. They are on the slightly higher terrace levels. Also included are a few areas of soils that have a slope of about 15 percent or less than 2 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is slow in the Licking soil. Available water capacity is moderate. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as pasture. A few areas are wooded or used as cropland.

This soil is well suited to trees. Planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. If the soil is overgrazed or is plowed during pasture renovation, erosion is a hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Grazing when the soil is too wet compacts the surface and increases the hazard of erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

If conservation practices are used, this soil is well suited to corn, soybeans, and winter wheat. Areas without conservation practices are only moderately suited to these crops. If the soil is plowed, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses and legumes will help to control erosion. In some of the wetter included soils in swales, a subsurface drainage system is needed to facilitate the use of equipment.

This soil is moderately suited to use as a site for buildings. The main limitations are the seasonal high water table and a high shrink-swell potential. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations and basement walls with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the slow permeability. Perimeter drains around the absorption fields will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains help to remove excess water. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion. Special surfacing material is needed on camp sites.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

LkC2—Licking silt loam, 6 to 12 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on lacustrine terraces. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay and a lower organic matter content. Most areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 46 inches thick. The upper part is yellowish brown, firm silty clay loam, and the lower part is yellowish brown, mottled, firm silty clay. The substratum to a depth of about 80 inches is brown, mottled, firm clay. In some areas the soil is well drained. In a few places the surface layer is silty clay loam. In places the soil is more gray in the lower part.

Included with this soil in mapping are small areas of Euclid, Glenford, McGary, and Otwell soils. The somewhat poorly drained Euclid soils are in the slightly lower terrace positions. Glenford soils are intermingled with some areas of the Licking soil. They have less clay in the subsoil and substratum than the Licking soil. The somewhat poorly drained McGary soils are in swales and depressions. Otwell soils have a fragipan in the subsoil. They are in the slightly higher terrace positions. Also included are a few areas of soils that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is slow in the Licking soil. Available water capacity is moderate. Runoff is rapid. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as pasture. A few areas are wooded or used as cropland.

This soil is well suited to trees. Planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is moderately suited to pasture and hay. The slope in some of the steeper included areas limits the use of equipment. If the soil is overgrazed or is plowed during pasture renovation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

If conservation practices are used, this soil is moderately suited to corn, soybeans, and winter wheat. Areas without conservation practices are poorly suited to these crops. If the soil is plowed, erosion is a very severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion.

This soil is moderately suited to use as a site for buildings. The main limitations are the seasonal high water table and a high shrink-swell potential. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the slow permeability. Interceptor drains upslope from the absorption fields will intercept laterally moving water. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains can be used to remove excess water. In some areas land shaping is needed. In areas that are subject to heavy traffic, maintaining an adequate ground cover helps to control erosion. Special surfacing material is needed on camp sites. Adding fill material will facilitate the use of the camp areas.

The land capability classification is IVe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

LkD2—Licking silt loam, 12 to 18 percent slopes, eroded. This deep, strongly sloping and moderately steep, moderately well drained soil is on lacustrine terraces. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer, which thus has a higher percentage of clay and a lower organic matter content. Most areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is yellowish brown, firm silty clay loam, and the lower part is yellowish brown and brown, mottled, firm silty clay loam and silty clay. The substratum to a depth of about 80 inches is brown, mottled, firm clay. In some areas the soil is more gray in the lower part. In a few areas it is well drained. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Euclid, Glenford, McGary, and Otwell soils. The somewhat poorly drained Euclid and McGary soils are in depressions and near seeps or springs. Glenford soils are intermingled with some areas of the Licking soil. They have less clay in the subsoil and substratum than the Licking soil. Otwell soils have a fragipan in the subsoil. They are in the slightly higher terrace positions. Also included are a few areas of soils that have a slope of about 35 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is slow in the Licking soil. Available water capacity is high. Runoff is rapid. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as pasture. A few areas are wooded or are used as cropland.

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is moderately suited to pasture and poorly suited to hay. The slope may limit the use of some mechanized equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control will help to keep the pasture in good condition.

Unless conservation practices are used, this soil is generally unsuited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a very severe hazard.

This soil is poorly suited to use as a site for buildings. In some areas land shaping is needed. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Reinforcing foundations and basement walls and backfilling with suitable material will help to prevent the structural damage caused by shrinking and swelling of the soil. Drains at the base of footings and exterior basement wall coatings help to keep basements dry.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the slope, the seasonal high water table, and the slow permeability. Interceptor drains upslope from the absorption fields will intercept laterally moving water. Installing the distribution lines on the contour will minimize seepage of effluent to the surface. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is poorly suited to use as a site for camp and picnic areas. The main limitations are the slope, the seasonal high water table, and the slow permeability. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-6.

LnC—Lily silt loam, 8 to 15 percent slopes. This moderately deep, strongly sloping, well drained soil is on rounded upland ridgetops. Most areas are long and narrow and range from l0 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown and strong brown, firm silt loam, and the lower part is brown, firm channery sandy clay loam. Hard sandstone bedrock is at a depth of about 32 inches. In some areas the subsoil has less sand and more silt. In other areas hard bedrock is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Berks, Dekalb, and Shelocta soils and, on the higher parts of ridgetops, a few small areas where hard bedrock is at a depth of about 15 inches. Berks and Dekalb soils contain more rock fragments in the subsoil than the Lily soil. They are in the steeper areas and near slope breaks. The deep Shelocta soils are generally on shoulder slopes and in saddles on ridgetops. Also included are a few areas that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately rapid in the Lily soil. Available water capacity is low. Runoff is medium. The root zone is moderately deep.

Most areas are wooded. A few areas are used as pasture or cropland.

This soil is well suited to trees. The shallower rooted tree species should be selected for planting. Mechanical tree planting, harvesting, and mowing are suitable on this soil. Blasting is required in deep excavations for haul roads and log landings. The roads and landings should be located on better suited soils nearby.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of mechanized equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion.

This soil is moderately suited to use as a site for buildings without basements and poorly suited to buildings with basements. The depth to bedrock severely limits excavations for basements. In some areas blasting may be required. In the steeper included areas, land shaping may be needed.

Because of the depth to bedrock, this soil is poorly suited to use as a site for septic tank absorption fields. Installing the absorption field in suitable fill material will improve the filtering capacity.

This soil is moderately suited to use as a site for camp and picnic areas. In some areas land shaping is needed, but it is restricted by the bedrock between depths of 20 and 40 inches. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-1.

LnD—Lily silt loam, 15 to 25 percent slopes. This moderately deep, moderately steep, well drained soil is on upland ridges and hillsides. Most areas are irregularly shaped and range from 10 to several hundred acres in size.

Typically, the surface layer is brown, friable silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 6 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown, firm loam, and the lower part is strong brown, firm sandy clay loam. The substratum is yellowish brown, friable gravelly sandy loam. Hard sandstone bedrock is at a depth of about 31 inches. In some areas the subsoil has less sand, fewer coarse fragments, and more silt. In other areas the depth to hard bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Berks, Dekalb, and Shelocta soils. Berks and Dekalb soils have a higher content of coarse fragments in the subsoil than the Lily soil. They are in the steeper areas and on slope breaks. The deep Shelocta soils are generally on shoulder slopes and in saddles on ridgetops. Also included, on the higher parts of ridgetops, are a few areas where bedrock is at a depth of about 15 inches. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderately rapid in the Lily soil. Available water capacity is low. Runoff is rapid. The root zone is moderately deep.

Most areas are wooded. A few areas are used as pasture or cropland.

This soil is well suited to trees. The shallower rooted tree species should be selected for planting. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Blasting is required in deep excavations for haul roads and log landings. The roads and landings should be located on better suited soils nearby. Special equipment is needed for site preparation and planting.

This soil is poorly suited to hay and pasture. The slope limits the use of equipment. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

Because of the slope and droughtiness, the steeper areas of this soil are generally unsuited to corn, soybeans, and winter wheat. The slope limits the use of some mechanized equipment. If the soil is plowed, erosion is a severe hazard.

This soil is poorly suited to use as a site for buildings. In most areas land shaping is needed. This practice is limited, however, by the bedrock between depths of 20 and 40 inches. The depth to hard bedrock severely limits excavations for basements. In some areas blasting is required.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the slope and the depth to bedrock. Installing the absorption field in suitable fill material will improve the filtering capacity. Installing the distribution lines on the contour minimizes seepage of effluent to the surface.

This soil is poorly suited to use as a site for camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion. Adding fill material will facilitate the use of the camp and picnic areas. Land shaping is needed, but it is restricted by the bedrock between depths of 20 and 40 inches.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is F-1.

McA—McGary silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on lacustrine terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is light olive brown, yellowish brown, and brown, mottled, firm silty clay loam; the next part is grayish brown and yellowish brown, mottled, firm silty clay; and the lower part is grayish brown and light olive brown, very firm silty clay. The substratum to a depth of about 80 inches is grayish brown, mottled, very firm silty clay. In some areas the subsoil and substratum have less clay and more silt. In other areas the soil is poorly drained.

Included with this soil in mapping are small areas of Licking and Chili soils. The moderately well drained Licking soils are in the higher terrace positions. The well drained Chili soils are on outwash terraces. Included soils make up about 15 percent of most areas of the map unit.

Permeability is slow or very slow in the McGary soil. Available water capacity is moderate. Runoff is slow. The seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are wooded or pastured.

This soil is moderately suited to trees. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting techniques that spread the roots of seedlings and that improve soil-root contact will reduce the seedling mortality rate. Harvesting procedures that do not leave widely spaced or isolated trees will reduce the windthrow hazard.

This soil is moderately suited to pasture and well suited to hay. The seasonal high water table limits the use of equipment. Grazing when the soil is too wet compacts the soil and increases the runoff rate and the hazard of erosion. Proper stocking rates, deferred grazing during wet periods, pasture rotation, mowing for weed control, and applications of lime and fertilizer help to keep the pasture in good condition.

In areas that have been artificially drained, this soil is well suited to corn, soybeans, and winter wheat. Undrained areas are moderately suited to these crops. Surface and subsurface drains are commonly used to remove excess water. Subsurface drains should be closely spaced for uniform drainage. Drained areas are suited to a system of conservation tillage that leaves crop residue on the surface and to crop rotations. The surface layer crusts after hard rains. Tilling when the soil is wet results in compaction. Returning crop residue to the soil will minimize surface crusting.

This soil is poorly suited to use as a site for buildings. The main limitations are the seasonal high water table and a high shrink-swell potential. Landscaping building sites drains surface water away from buildings. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the seasonal high water table and the slow or very slow permeability. The absorption field should be landscaped for good surface drainage away from the field. Perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is poorly suited to use as a site for camp and picnic areas. The main limitations are the seasonal high water table and the slow or very slow permeability. Surface and subsurface drains help to remove excess water. Special surfacing material generally is needed in camp areas.

The land capability classification is IIIw. The woodland ordination symbol is 4C. The pasture and hayland suitability group is C-2.

Me—Melvin silt loam, frequently flooded. This deep, nearly level, poorly drained soil is in the lowest positions on flood plains. Most areas are long and narrow and range from 5 to 50 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is gray, mottled, firm silt loam about 10 inches thick. The substratum to a depth of about 60 inches also is gray, mottled, firm silt loam. In places the soil is more acid in the subsoil, contains more sand and less silt in the subsoil and substratum, or is somewhat poorly drained.

Included with this soil in mapping are small areas of Chagrin and Orrville soils. The well drained Chagrin soils are on the highest parts of the flood plains. The somewhat poorly drained Orrville soils are in the slightly higher areas on the flood plains. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Melvin soil. Available water capacity is high or very high. Runoff is very slow. The seasonal high water table is near the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are wooded or are used as pasture.

This soil is well suited to trees adapted to wet sites. The trees can be logged during periods when the soil is not flooded, during periods when the soil is frozen, or during the drier parts of the year. Planting seedlings that have been transplanted once will reduce the seedling mortality rate. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

This soil is poorly suited to pasture and moderately suited to hay. It is poorly suited to grazing early in spring. The seasonal high water table limits the use of equipment. Sediment from stream overflow reduces the quality of forage. Grazing when the soil is too wet compacts the soil and increases the runoff rate and the hazard of erosion. The forage species selected for planting should be those that are tolerant of wet conditions. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to prevent surface compaction and improve the growth of forage plants.

Drained areas that are protected from flooding are moderately suited to corn, soybeans, and winter wheat. Undrained areas are poorly suited to these crops. Winter grain crops are commonly damaged by the flooding and the seasonal high water table. Surface and subsurface drains help to lower the water table. The seasonal high water table and the flooding delay planting and harvesting. Unless the soil is artificially drained, the crops should be planted late in the season. The surface crusts after hard rains. It compacts if tilled when wet. Retaining crop residue and tilling at the optimum moisture content will minimize compaction and surface crusting.

This soil is generally unsuitable as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. The main limitations are the flooding and the seasonal high water table.

The land capability classification is IIIw. The woodland ordination symbol is 6W. The pasture and hayland suitability group is C-3.

NeC—Negley silt loam, 8 to 15 percent slopes. This deep, strongly sloping, well drained soil is on high outwash terraces. Most areas are irregularly shaped and range from 5 to about 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil to a depth of about 80 inches is brown and strong brown, firm loam, clay loam, and gravelly clay loam. In some places the subsoil has more sand. In other places it is thinner.

Included with this soil in mapping are small areas of Licking and Otwell soils. The moderately well drained Licking soils are on the slightly lower lacustrine terraces. Otwell soils have a fragipan. They are in the slightly higher terrace positions. Also included are a few areas that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate or moderately rapid in the Negley soil. Available water capacity is moderate. Runoff is medium. The root zone is deep.

Most areas are used as pasture or hayland. A few areas are wooded or are used as cropland.

This soil is well suited to trees. Planting and mowing are suitable on this soil. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Grazing when the soil is too wet compacts the soil and increases the runoff rate and the hazard of erosion. The slope in some of the steeper included areas limits the use of equipment. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, crop rotations that include grasses and legumes, grassed waterways, and diversions will help to control erosion.

This soil is moderately suited to use as a site for buildings and septic tank absorption fields. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour helps to minimize seepage of effluent to the surface.

Because of the slope, this soil is only moderately suited to use as a site for camp and picnic areas. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover will help to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 5A. The pasture and hayland suitability group is A-1.

NeD—Negley silt loam, 15 to 25 percent slopes. This deep, moderately steep, well drained soil is on high outwash terraces. Most areas are long and narrow and range from 5 to about 40 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil to a depth of about 80 inches is brown and strong brown, firm loam, clay loam, and sandy loam. In some areas the subsoil is thinner.

Included with this soil in mapping are small areas of Licking and Otwell soils. The moderately well drained Licking soils are on the lower lacustrine terraces. Otwell soils have a fragipan. They are in the slightly higher terrace positions. Also included are a few areas that have a slope of about 10 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate or moderately rapid in the Negley soil. Available water capacity is moderate. Runoff is rapid. The root zone is deep.

Most areas are used as hayland or pasture. A few areas are wooded or are used as cropland.

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is moderately suited to pasture and poorly suited to hay. The slope limits the use of some equipment. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

The steeper areas of this soil are generally unsuited to corn, soybeans, and winter wheat. The less sloping areas are poorly suited to these crops. If the soil is plowed, erosion is a very severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion.

This soil is poorly suited to use as a site for buildings and septic tank absorption fields. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Installing the distribution lines of septic tank absorption fields on the contour helps to prevent seepage of effluent to the surface.

This soil is poorly suited to use as a site for camp and picnic areas. The slope is a limitation. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is VIe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is A-2.

NeE—Negley silt loam, 25 to 40 percent slopes. This deep, steep, well drained soil is on dissected hillsides on high outwash terraces. Most areas are long and narrow and range from 5 to about 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable loam about 3 inches thick. The subsoil to a depth of about 80 inches is brown and strong brown, firm sandy clay loam, gravelly sandy clay loam, very gravelly sandy clay loam, and very gravelly sandy loam. In places the subsoil is not so red and has more gravel. In a few areas it is thinner.

Included with this soil in mapping are small areas of Otwell soils and areas that have a slope of about 60 percent. Otwell soils have a fragipan. They are in the slightly higher terrace positions. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate or moderately rapid in the Negley soil. Available water capacity is moderate. Runoff is very rapid. The root zone is deep.

Most areas are wooded. A few areas are used as pasture.

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is poorly suited to pasture and generally unsuited to hay. The slope limits the use of equipment.

If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is generally unsuited to corn, soybeans, and winter wheat. The slope limits the use of farm equipment. If the soil is plowed, erosion is a very severe hazard.

Because of the slope, this soil is generally unsuitable as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. Construction for recreation and urban uses is difficult.

The land capability classification is VIe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is A-3.

NeF—Negley silt loam, 40 to 70 percent slopes. This deep, very steep, well drained soil is on dissected hillsides on high outwash terraces. Most areas are long and narrow and range from 5 to about 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of about 80 inches or more. It is brown, friable silt loam in the upper part; strong brown, firm clay loam in the next part; and brown and yellowish red, firm gravelly clay loam in the lower part. In some areas the subsoil has more sand and gravel. In other areas the surface layer is loam.

Included with this soil in mapping are small areas of Otwell soils and areas of soils that have a slope of about 30 percent. Otwell soils have a fragipan. They are in the slightly higher terrace positions. Also included, in the valley of the Hocking River west of Logan, are areas where sandstone outcrops are on the lower third of the slope. Inclusions make up about 20 percent of most areas of the map unit.

Permeability is moderate or moderately rapid in the Negley soil. Available water capacity is moderate. Runoff is very rapid. The root zone is deep.

Most areas are wooded. A few areas are used as pasture.

This soil is well suited to trees. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is generally unsuited to hay, pasture, corn, soybeans, and winter wheat. The slope limits the use of most farming equipment.

Because of the slope, this soil is generally unsuitable as a site for buildings, septic tank absorption fields, camp areas, and picnic areas. Construction for recreation and urban uses is very difficult. Maintaining a ground cover helps to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 5R. The pasture and hayland suitability group is H-1.

Or—Orrville silt loam, frequently flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Most areas are long and narrow and range from 10 to several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. It is mottled below a depth of about 7 inches. The subsoil is brown and dark grayish brown, mottled, friable silt loam about 33 inches thick. The substratum to a depth of about 80 inches is gray and dark gray, mottled, friable loam and silt loam. In a few areas the subsoil and substratum have less sand and more silt.

Included with this soil in mapping are small areas of Chagrin and Melvin soils. The well drained Chagrin soils are commonly in the higher areas on the flood plains and near the stream channels. The poorly drained Melvin soils are in the lowest positions on the flood plains. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Orrville soil. Runoff is slow. Available water capacity is high. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The root zone is deep.

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

This soil is well suited to trees. The trees can be harvested and planted during periods when the soil is not flooded.

Drained areas are well suited to hay and pasture. Sediment from stream overflow lowers the quality of forage. The seasonal high water table and the flooding limit the selection of species for planting. Both surface and subsurface drains improve pasture stands, increase yields, and permit grazing earlier in spring. Grazing when the soil is too wet compacts the surface and increases the runoff rate. Applications of lime and fertilizer, mowing for weed control, proper stocking rates, pasture rotation, and timely deferment of grazing help to minimize surface compaction.

Drained areas are well suited to corn and soybeans. Undrained areas are moderately suited to these crops. Flooding commonly damages winter grain crops, such as winter wheat. It generally occurs before corn and soybeans are planted, so that flood damage is minimal. In drained areas a system of conservation tillage that leaves crop residue on the surface, crop rotations, and conventional tillage are suitable.

This soil is generally unsuited to use as a site for buildings, septic tank absorption fields, and camp areas because of the flooding and the seasonal high water table. It can be used as a site for picnic areas during the drier parts of the year.

The land capability classification is IIw. The woodland ordination symbol is 5A. The pasture and hayland suitability group is C-3.

OtB—Otwell silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained and moderately well drained soil is on terraces. Most areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 65 inches thick. The upper part is yellowish brown, friable silt loam and firm silty clay loam; the next part is a fragipan of yellowish brown, very firm and brittle silty clay loam; and the lower part is yellowish brown, firm silty clay loam. The subsoil is mottled below a depth of about 17 inches. The substratum to a depth of about 90 inches is yellowish brown, mottled, firm silty clay loam. In some areas the fragipan is weakly developed. In other areas the subsoil has more sand.

Included with this soil in mapping are small areas of Berks, Glenford, Licking, and Westmoreland soils, which do not have a fragipan. Berks and Westmoreland soils are on uplands. Glenford and Licking soils are on the slightly lower terrace levels, generally closer to the streams. Also included are small areas that have a slope of about 15 percent and small areas of somewhat poorly drained soils on the flatter parts of the landscape. Included soils make up about 15 percent of most areas of the map unit.

Permeability is very slow in the Otwell soil. The root zone is restricted mainly to the part of the profile above the fragipan. Available water capacity of this zone is moderate. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used as pasture. A few areas are used as woodland or hayland.

This soil is well suited to trees. Tree planting and mowing for weed control are easily accomplished. Planting seedlings that have been transplanted once will reduce the seedling mortality rate. Harvesting procedures that do not leave widely spaced or isolated trees will reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to hay and pasture. If the soil is plowed during seedbed preparation, erosion is a hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Grazing when the soil is too wet compacts the surface and increases the runoff rate and the hazard of erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. The surface layer crusts after heavy rains. A system of conservation tillage that leaves crop residue on the surface, crop rotations that include grasses and legumes, diversions, and grassed waterways help to control erosion and minimize surface crusting. Both surface and subsurface drains are used to remove water from wet spots. Subsurface drains are effective if they are installed above the very slowly permeable fragipan.

This soil is moderately suited to use as a site for buildings. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry.

Because of the seasonal high water table and the very slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Perimeter drains around the absorption field will lower the seasonal high water table. Increasing the size of the absorption field and mounding the field with suitable fill material will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Subsurface drains will remove excess water. These drains are more effective if they are installed above the very slowly permeable fragipan. Special surfacing material generally is needed on camp sites. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 3D. The pasture and hayland suitability group is F-3.

OtC—Otwell silt loam, 6 to 12 percent slopes. This deep, strongly sloping, well drained and moderately well drained soil is on terraces. Most areas are irregularly shaped and range from about 5 to 70 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is dark yellowish brown, friable silt loam about 8 inches thick. The subsoil is about 48 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam, and the lower part is a fragipan of yellowish brown, mottled, very firm and brittle silt loam. The substratum to a depth of about 80 inches is yellowish brown, mottled, firm silt loam. In some areas the fragipan is weakly developed. In a few areas the subsoil has more sand.

Included with this soil in mapping are small areas of Berks, Licking, and Westmoreland soils, which do not have a fragipan. Berks and Westmoreland soils are on uplands. Licking soils are in the slightly lower terrace positions. Also included are small areas that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is very slow in the Otwell soil. The root zone is restricted mainly to the part of the profile above the fragipan. Available water capacity of this zone is moderate. Runoff is rapid. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

Most areas are used as pasture or hayland. A few areas are used as woodland or cropland.

This soil is well suited to trees. Tree planting and mowing for weed control are easily accomplished. Planting seedlings that have been transplanted once will reduce the seedling mortality rate. Harvesting procedures that do not leave widely spaced or isolated trees will reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Grazing when the soil is too wet compacts the surface and increases the runoff rate and the hazard of erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, crop rotations that include grasses and legumes, grassed waterways, and diversions help to control erosion and minimize surface crusting. Both surface and subsurface drains help to remove water from wet spots. Subsurface drains are effective if they are installed above the very slowly permeable fragipan.

This soil is moderately suited to use as a site for buildings. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry.

Because of the slope, the seasonal high water table, and the very slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Installing the distribution lines on the contour minimizes seepage of effluent to the surface. Interceptor drains upslope from the absorption field will remove seepage water above the fragipan. Increasing the size of the absorption field and installing the field in suitable fill material will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Special surfacing material generally is needed on camp sites. Adding fill material will facilitate the use of these sites. Subsurface drains will remove excess water. These drains are more effective if they are installed above the very slowly permeable fragipan. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 3D. The pasture and hayland suitability group is F-3.

OtD2—Otwell silt loam, 12 to 18 percent slopes, eroded. This deep, strongly sloping and moderately steep, well drained and moderately well drained soil is on hillsides on the dissected parts of terraces. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer. Most areas are long and narrow and range from 5 to about 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 59 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam; the next part is a fragipan of yellowish brown, mottled, very firm and brittle silty clay loam; and the lower part is yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 80 inches also is yellowish brown, mottled, firm silty clay loam. In places the surface layer is silty clay loam or channery silty clay loam.

Included with this soil in mapping are small areas of Berks, Dekalb, Licking, Shelocta, and Westmoreland soils, which do not have a fragipan. Berks, Dekalb, Shelocta, and Westmoreland soils are on uplands. Licking soils are on the slightly lower terrace levels. Included soils make up about 20 percent of most areas of the map unit.

Permeability is very slow in the Otwell soil. Available water capacity is moderate. Runoff is very rapid. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is restricted by the fragipan.

Most areas are used as pasture or hayland. A few areas are used as woodland or cropland.

This soil is suited to trees. Building haul roads and skid trails on the contour will facilitate the use of equipment and help to control erosion. Planting seedlings that have been transplanted once will reduce the seedling mortality rate. Harvesting procedures that do not leave widely spaced or isolated trees will reduce the windthrow hazard. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting.

This soil is moderately suited to pasture and poorly suited to hay. The slope limits the use of some equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Grazing when the soil is too wet compacts the surface and increases the runoff rate and the hazard of erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is poorly suited to corn, soybeans, and winter wheat. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion. The slope limits the use of some farm equipment.

Because of the slope, the seasonal high water table, and a moderate shrink-swell potential, this soil is poorly suited to use as a site for buildings. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Backfilling along foundations with suitable fill material will help to prevent the structural damage caused by shrinking and swelling of the soil. Drains at the base of footings and exterior basement wall coatings will help to keep basements dry.

This soil is poorly suited to use as a site for septic tank absorption fields. The main limitations are the slope, the very slow permeability, and the seasonal high water table. Installing the distribution lines on the contour will minimize seepage of effluent to the surface. Interceptor drains upslope from the absorption field will intercept laterally moving water above the fragipan. Increasing the size of the absorption field or installing the field in suitable fill material will improve the absorption of effluent.

This soil is poorly suited to use as a site for camp and picnic areas. Land shaping is needed. Adding fill material will facilitate the use of camp sites. In areas that are subject to heavy traffic, maintaining an adequate plant cover helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 3R. The pasture and hayland suitability group is F-3.

Po—Pope loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Most areas are long and narrow and range from 20 to several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is dark yellowish brown, friable, stratified loam and silt loam about 29 inches thick. The substratum to a depth of about 80 inches is yellowish brown, very friable sandy loam and loam and dark yellowish brown, loose very gravelly loamy sand. In some places the surface layer and subsoil have more silt. In a few areas the lower part of the subsoil and the substratum are very channery.

Included with this soil in mapping are small areas of Allegheny, Cedarfalls, and Stonelick soils. Allegheny soils have more clay in the subsoil than the Pope soil. They are on stream terraces. Cedarfalls soils are at the base of sandstone cliffs. They have less clay and silt in the subsoil than the Pope soil. Stonelick soils are intermingled with some areas of the Pope soil. They are mildly alkaline or moderately alkaline throughout. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate or moderately rapid in the Pope soil. Available water capacity is moderate. Runoff is slow. The root zone is deep.

Most areas are idle or are used as pasture or hayland. A few areas are used as woodland or cropland.

This soil is well suited to trees. The trees can be harvested and planted during periods when the soil is not flooded. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to hay and pasture; however, sediment from stream overflow lowers the quality of forage. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn and soybeans. In most years the soil is flooded before corn and soybeans are planted in spring. Winter grain crops can be damaged by floodwater. A system of conservation tillage that leaves crop residue on the surface and crop rotations improve tilth. Streambank erosion is a major source of sediment and the resulting water pollution. In most areas stabilizing eroding streambanks is difficult. In some areas, however, clearing the channel of debris and planting willows on the streambanks are effective in controlling streambank erosion. Weed control is a problem on this soil because weed seeds are carried in by floodwater.

Because of the flooding, this soil is generally unsuitable as a site for buildings, septic tank absorption fields, and camp areas. It is well suited to use as a site for picnic areas during periods when flooding is unlikely.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-5.

SaC—Shelocta silt loam, 8 to 15 percent slopes. This deep, strongly sloping, well drained soil is on upland ridgetops. Most areas are long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 38 inches thick. The upper part is strong brown and yellowish brown, firm silt loam, channery silt loam, and channery silty clay loam, and the lower part is strong brown and yellowish brown, mottled, firm channery silty clay loam. The substratum is yellowish brown, firm very channery silty clay loam. Fractured siltstone and sandstone bedrock is at a depth of about 54 inches. In places the sand content is higher in the lower part of the subsoil.

Included with this soil in mapping are small areas of Cruze and Zanesville soils. The moderately well drained Cruze soils are generally in saddles or on the higher parts of ridgetops. Zanesville soils have a fragipan. They are generally on the broader ridgetops. Also included are a few small areas that have a slope of about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability and available water capacity are moderate in the Shelocta soil. Runoff is rapid. The root zone is deep.

Most areas are wooded. Some areas are used as pasture, and a few areas are used as cropland.

This soil is well suited to trees. Mechanical tree planting and mowing for weed control are suitable on this soil. Cutting and filling to a more desirable slope will improve sites for log landings. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that leaves plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. Erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion.

This soil is moderately suited to use as a site for buildings. Because of the bedrock at a depth of 48 to 72 inches, it is better suited to dwellings without basements than to dwellings with basements. The slope also is a limitation. In some areas land shaping is needed. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping.

This soil is moderately suited to use as a site for septic tank absorption fields. Installing the distribution lines on the contour helps to minimize seepage of effluent to the surface. Installing the absorption field in suitable fill material will elevate the field above the bedrock and improve the filtering capacity.

Because of the slope, this soil is only moderately suited to use as a site for camp and picnic areas. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

SaD—Shelocta silt loam, 15 to 25 percent slopes. This deep, moderately steep, well drained soil is on upland ridgetops and hillsides. Most areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is dark yellowish brown, friable silt loam about 7 inches thick. The subsoil is about 30 inches thick. The upper part is strong brown, friable silt loam, and the lower part is yellowish brown, firm channery silty clay loam. The substratum is yellowish brown, firm very channery silty clay loam. Fine grained sandstone and siltstone bedrock is at a depth of about 48 inches.

Included with this soil in mapping are small areas of Berks, Cruze, and Dekalb soils. The moderately deep Berks and Dekalb soils are on the steeper parts of the landscape. The moderately well drained Cruze soils are in saddles and on the middle part of the ridges. Included soils make up about 15 percent of most areas of the map unit.

Permeability and available water capacity are moderate in the Shelocta soil. The root zone is deep. Runoff is rapid.

Most areas are wooded. Some areas are used as pasture, and a few areas are used as cropland.

This soil is well suited to trees on north-facing slopes and moderately suited to trees on south-facing slopes. The north- and east-facing slopes are better sites for woodland than the south- and west-facing slopes because of less evapotranspiration and cooler temperatures. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour helps to control erosion and facilitates the use of equipment. Cutting and filling to a more desirable slope will improve sites for log landings. Special equipment is needed for site preparation and planting. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to pasture and hay. The slope limits the use of some mechanical equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is generally unsuited to corn, soybeans, and winter wheat. Erosion is a very severe hazard. The slope limits the use of equipment.

Because of the slope and the bedrock between depths of 48 and 72 inches, this soil is poorly suited to use as a site for buildings. In most areas land shaping is needed. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping.

This soil is poorly suited to use as a site for septic tank absorption fields. Installing the distribution lines on the contour minimizes seepage of effluent to the surface. Installing the absorption field in suitable fill material will elevate the field above the bedrock and improve the filtering capacity.

This soil is poorly suited to use as a site for camp and picnic areas. The slope is a limitation. In most areas land shaping is needed. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

SbE—Shelocta-Berks complex, 25 to 40 percent slopes. This map unit consists of steep, well drained soils on upland hillsides. It is about 60 percent Shelocta silt loam and 20 percent Berks channery silt loam. The deep Shelocta soil is on the steeper parts of side slopes. The moderately deep Berks soil is on foot slopes and benches. Most areas are irregularly shaped and range from 25 to several hundred acres in size. The two soils are in such narrow, alternating bands on the hillside that they could not be separated at the scale used in mapping.

Typically, the Shelocta soil has a surface layer of very dark grayish brown, friable silt loam about 1 inch thick. The subsurface layer is pale brown, friable silt loam about 4 inches thick. The subsoil is about 50 inches thick. The upper part is yellowish brown and brown, firm gravelly and channery silt loam; the next part is brown and strong brown, mottled, firm channery and very channery silty clay loam; and the lower part is strong brown and light brownish gray, mottled, firm extremely channery silty clay loam. Light brownish gray siltstone bedrock is at a depth of about 55 inches.

Typically, the surface layer of the Berks soil is very dark grayish brown, friable channery silt loam about 2 inches thick. The subsoil is yellowish brown, firm channery and very channery silt loam about 34 inches thick. Light olive brown and yellowish brown, fractured siltstone and sandstone bedrock is at a depth of about 36 inches. In some areas the soil is deeper to bedrock. In other areas the subsoil has more sand.

Included with these soils in mapping are small areas that have a slope of about 50 percent and small areas of Cruze and Lily soils. Cruze soils are moderately well drained and are on the less sloping benches on side slopes. Lily soils typically have fewer coarse fragments than the Shelocta and Berks soils. They are in midslope positions. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Shelocta soil and moderate or moderately rapid in the Berks soil. Available water capacity is moderate in the Shelocta soil and very low in the Berks soil. The root zone is moderately deep in the Berks soil and deep in the Shelocta soil. Runoff is very rapid on both soils.

Most areas are wooded. In a few areas sugar maple trees are tapped for maple syrup (fig. 9). A few areas are used as pasture.

These soils are moderately suited to trees. Trees grow better on the Shelocta soil than on the Berks soil because of the greater soil depth and the higher available water capacity. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds.

Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion in the wooded areas. The less sloping included areas on benches can be used as log landings. Cutting and filling to a more desirable slope will improve sites for log landings. The bedrock can be ripped with construction equipment. Planting seedlings that have been transplanted once and mulching around seedlings will reduce the seedling mortality rate. Plant competition on the Shelocta soil can be controlled by removing vines and the less desirable trees and shrubs. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to corn, soybeans, winter wheat, and hay. They are poorly suited to pasture. The steep slope and a severe erosion hazard in areas of both soils and the very low available water capacity of the Berks soil are severe limitations. The slope severely limits the use of equipment. Proper stocking rates and pasture rotation prevents overgrazing and helps to control erosion.

These soils are generally unsuited to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope of both soils and the depth to bedrock and small stones in the Berks soil severely limit these uses. Maintaining a ground cover and installing water bars help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Shelocta soil is 4R; the one assigned to the Berks soil is 4R on north aspects, 3R on south aspects. The pasture and hayland suitability group is A-3 for the Shelocta soil and F-2 for the Berks soil.

ScD—Shelocta-Cruze silt loams, 15 to 25 percent slopes. This map unit consists of deep, moderately steep soils on upland ridgetops and hillsides. It is about 45 percent Shelocta silt loam and 35 percent Cruze silt loam. The well drained Shelocta soil is in the steeper areas. The moderately well drained Cruze soil is in the less sloping areas. Hillside slips are in areas of the Cruze soil. Most areas are irregularly shaped and range from 10 to 200 acres in size. The two soils are so intricately mixed on the landscape that they could not be separated at the scale used in mapping.

Typically, the Shelocta soil has a surface layer of dark brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 43 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam, and the lower part is yellowish brown, firm channery silt loam. Light olive brown siltstone bedrock is at a depth of about 48 inches. In a few areas the soil is not so deep to bedrock. In some areas the subsoil has a higher content of coarse fragments.

Typically, the Cruze soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown, friable silt loam and firm silty clay loam; the next part is yellowish brown and light brownish gray, firm silty clay and silty clay loam; and the lower part is light brownish gray and brown, firm silty clay loam and silty clay. The subsoil is mottled below a depth of about 13 inches. Light brownish gray and reddish yellow, weathered, soft clay shale bedrock is at a depth of about 53 inches.

Included with these soils in mapping are small areas that have a slope of about 35 percent and areas of Lily, Wellston, and Westmore soils. The moderately deep Lily soils are on the steeper parts of hillsides. Wellston and Westmore soils have fewer coarse fragments in the upper part of the subsoil than the Shelocta and Cruze soils. Wellston soils are on the higher parts of ridgetops. Westmore soils are on the wider parts of ridgetops and benches. Included soils make up about

Figure 9.—Sugar maples tapped for syrup in an area of Shelocta-Berks complex, 25 to 40 percent slopes.

20 percent of most areas of the map unit.

Permeability is moderate in the Shelocta soil and moderately slow or slow in the Cruze soil. Available water capacity is moderate in both soils. Runoff is rapid. The Cruze soil has a seasonal high water table between depths of 18 and 36 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture or cropland.

These soils are well suited to trees on north-facing slopes and moderately suited to trees on south-facing slopes. The north- and east-facing slopes are better sites for woodland than the south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. In areas where the ground cover has been removed, erosion is a hazard. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Active slips should be avoided. In most areas the less sloping benches can be used as log landings. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Planting seedlings that have been transplanted once will reduce the seedling mortality rate on south-facing slopes. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. The slope in the steeper included areas severely limits the use of equipment. Special equipment is needed for site preparation and planting.

These soils are moderately suited to pasture and poorly suited to hay. The slope limits the use of some equipment. If the soils are plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding.

These soils are poorly suited to corn, soybeans, and winter wheat. If the soils are plowed, erosion is a very severe hazard. No-till farming or another system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion. The slope limits the use of some equipment.

These soils are poorly suited to use as sites for buildings. The slope of both soils is a limitation. Also, a high shrink-swell potential, a slippage hazard, and the seasonal high water table are limitations in areas of the Cruze soil. In some areas land shaping is needed. Cutting and filling increase the hazard of hillside slippage. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping in most areas and reduces the hazard of hillside slippage. In areas of the Cruze soil, drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling of the Cruze soil. Landscaping is needed so that surface water drains away from the buildings and does not collect in pockets.

These soils are poorly suited to use as sites for septic tank absorption fields. Perimeter drains around the absorption field will lower the seasonal high water table in the Cruze soil. Installing the distribution lines on the contour minimizes seepage of effluent to the surface. Increasing the size of the absorption field will improve the absorption of effluent, especially on the Cruze soil.

Because of the slope, these soils are poorly suited to use as camp and picnic areas. In most areas land shaping is needed; however, it should be minimized because of the hazard of hillside slippage. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

ScE—Shelocta-Cruze silt loams, 25 to 40 percent slopes. This map unit consists of deep, steep soils on upland hillsides. It is about 55 percent Shelocta silt loam and 30 percent Cruze silt loam. The well drained Shelocta soil is on the steeper parts of the hillsides. The moderately well drained Cruze soil is on benches. Hillside slips are in areas of the Cruze soil. Most areas are irregularly shaped and range from 20 to several hundred acres in size. The two soils are in such narrow, alternating strips on hillsides that they could not be mapped separately at the scale used in mapping.

Typically, the surface layer of the Shelocta soil is very dark grayish brown, friable silt loam about 1 inch thick. The subsurface layer is pale brown, friable silt loam about 3 inches thick. The subsoil is about 39 inches thick. The upper part is brown and pale brown, firm channery silt loam, and the lower part is brown and strong brown, firm channery and very channery silty clay loam. The substratum is strong brown and light brownish gray, firm very channery silty clay loam. Gray, thinly bedded siltstone bedrock is at a depth of about 51 inches.

Typically, the surface layer of the Cruze soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 44 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the next part is yellowish brown and grayish brown, mottled, firm silty clay; and the lower part is grayish brown and yellowish brown, mottled, firm clay. Yellowish brown and light brownish gray, weathered, soft clay shale bedrock is at a depth of about 49 inches.

Included with these soils in mapping are small areas of Berks and Bethesda soils and areas that have a slope of about 50 percent. The moderately deep Berks soils are on shoulder slopes and slope breaks below benches. Bethesda soils are in areas disturbed by mining or drilling. They have a higher content of coarse fragments throughout than the Shelocta and Cruze soils. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Shelocta soil and moderately slow or slow in the Cruze soil. Available water capacity is moderate in both soils. Runoff is very rapid. The Cruze soil has a seasonal high water table between depths of 18 and 36 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture.

These soils are well suited to trees on north-facing slopes and moderately suited to trees on south-facing slopes. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. If the ground cover is removed, erosion is a severe hazard. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Active slips should be avoided. In most areas the less sloping benches can be used for log landings and haul roads. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Planting seedlings that have been transplanted once will reduce the seedling mortality rate on south-facing slopes. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to hay and poorly suited to pasture. The slope limits the use of equipment. Proper stocking rates, deferred grazing during wet periods, pasture rotation, mowing for weed control, and applications of lime and fertilizer help to keep the pasture in good condition.

These soils are generally unsuited to corn, soybeans, and winter wheat and to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope of both soils is a limitation. Also, a high shrink-swell potential, a slippage hazard, and the seasonal high water table are limitations in areas of the Cruze soil. Cutting and filling increase the hazard of hillside slippage. Maintaining a ground cover will help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-3.

ScF—Shelocta-Cruze silt loams, 40 to 70 percent slopes. This map unit consists of deep, very steep soils on hillsides. It is about 55 percent Shelocta silt loam and 30 percent Cruze silt loam. The well drained Shelocta soil is on the steeper parts of the hillsides. The moderately well drained Cruze soil is on benches. Hillside slips are in areas of the Cruze soil. Most areas are irregularly shaped and range from 20 to several hundred acres in size. The two soils are in such narrow, alternating strips on the hillsides that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Shelocta soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 43 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam, and the lower part is brown, firm channery and very channery silty clay loam. The substratum to a depth of about 62 inches is light olive brown, firm extremely channery silty clay loam. Light olive brown siltstone and strong brown sandstone bedrock is at a depth of about 62 inches.

Typically, the surface layer of the Cruze soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 44 inches thick. The upper part is yellowish brown, mottled, firm silt loam and silty clay loam, and the lower part is light brownish gray, mottled, firm silty clay and channery silty clay. The substratum is grayish brown, mottled, firm silty clay. Light olive brown, weathered shale bedrock is at a depth of about 55 inches.

Included with these soils in mapping are small areas of Berks and Bethesda soils and areas that have a slope of about 30 percent. The moderately deep Berks soils are on shoulder slopes and slope breaks below benches. Bethesda soils are in areas disturbed by mining or drilling. They have a higher content of coarse fragments throughout than the Shelocta and Cruze soils. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Shelocta soil and moderately slow or slow in the Cruze soil. Available water capacity is moderate in both soils. Runoff is very rapid. The Cruze soil has a seasonal high water table between depths of 18 and 36 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture.

These soils are well suited to trees on north-facing slopes and moderately suited trees on south-facing slopes. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. If the ground cover is removed, erosion is a very severe hazard. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Active slips should be avoided. In most areas the less sloping benches can be used for log landings and haul roads. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Planting seedlings that have been transplanted once will reduce the seedling mortality rate on south-facing slopes. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to hay, pasture, corn, soybeans, and winter wheat because of the very steep slope and a very severe erosion hazard.

These soils are generally unsuitable as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope of both soils is a limitation. Also, a high shrink-swell potential, a slippage hazard, and the seasonal high water table are limitations in areas of the Cruze soil. Cutting and filling increase the hazard of hillside slippage. Maintaining a ground cover will help to control erosion.

The land capability classification is VIIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is H-1.

St—Stonelick loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Most areas are long and narrow and range from 5 to several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark yellowish brown, friable loam about 6 inches thick. The substratum to a depth of about 66 inches is dark yellowish brown and yellowish brown, friable and very friable, stratified loam, fine sandy loam, and loamy fine sand. In a few areas the root zone is more acid. In some areas the soil has more sand and more silt. In other areas it is moderately well drained. In a few places it has more rock fragments at a depth of about 30 inches.

Included with this soil in mapping are a few small areas of somewhat poorly drained soils in depressions. These soils make up about 15 percent of most areas of the map unit.

Permeability is moderately rapid in the Stonelick soil. Available water capacity is moderate or low. Surface runoff is slow. The root zone is deep.

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

This soil is well suited to trees. The trees can be harvested and planted during periods when flooding is not likely.

This soil is well suited to hay and pasture; however, sediment from stream overflow lowers the quality of forage. Proper stocking rates, deferred grazing during wet periods, pasture rotation, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn and soybeans. In most years flooding occurs before corn and soybeans are planted. Winter grain crops can be damaged by floodwater. A system of conservation tillage that leaves crop residue on the surface, conventional tillage, and crop rotations improve tilth. Streambank erosion is a major source of sediment and the resulting water pollution. In most areas stabilizing eroding streambanks is difficult. In some areas, however, clearing the channel of debris and planting willows on the streambanks are effective in controlling streambank erosion. Weed control is a problem on this soil because weed seeds are carried in by floodwater.

Because of the flooding, this soil is generally unsuited to use as a site for buildings, septic tank absorption fields, and camp areas. It is well suited to use as a site for picnic areas.

The land capability classification is IIw. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-5.

WeB—Wellston silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is mainly on ridgetops. A few areas are on wide benches on residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion and minimize surface crusting.

These soils are moderately suited to use as sites for buildings. The main limitations are the slope of both soils, the bedrock at a depth of 40 to 72 inches in the Wellston soil, and the seasonal high water table and high shrink-swell potential in the Cruze soil. In areas of the Cruze soil, drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the Cruze soil. In some areas bedrock hinders excavations for basements. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping.

The Wellston soil is moderately suited to use as a site for septic tank absorption fields, and the Cruze soil is poorly suited. In areas of the Cruze soil, subsurface drains upslope from the absorption field will intercept seepage water. Also, increasing the size of the absorption field will improve the absorption of effluent. Installing the absorption field in suitable fill material will improve the filtering capacity in areas of the Wellston soil and will improve the absorption of effluent in the Cruze soil. Installing the distribution lines on the contour helps to minimize seepage of effluent to the surface.

These soils are moderately suited to use as camp areas and picnic areas. Subsurface drains can help to remove excess water on the Cruze soil. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WgC—Wellston-Guernsey silt loams, 8 to 15 percent slopes. This map unit consists of deep, strongly sloping soils on upland ridgetops. It is about 50 percent Wellston silt loam and 35 percent Guernsey silt loam. The Wellston soil is well drained, and the Guernsey soil is moderately well drained. Most areas are long and narrow and range from 10 to several hundred acres in size. The two soils are so intricately mixed on the ridgetops that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Wellston soil is very dark grayish brown, friable silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 2 inches thick. The subsoil is yellowish brown, firm silt loam and silty clay loam about 44 inches thick. Strong brown and light olive brown, fine grained sandstone bedrock is at a depth of about 70 inches. In some areas the lower part of the subsoil has a higher clay content. In other areas the soil has a higher content of sand and coarse fragments.

Typically, the surface layer of the Guernsey soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 2 inches thick. The subsoil is about 39 inches thick. The upper part is yellowish brown, firm silt loam; the next part is light yellowish brown and light brownish gray, mottled, firm silty clay; and the lower part is light brownish gray, mottled, firm silty clay. The substratum is light brownish gray, mottled, firm silty clay loam about 9 inches thick. Light brownish gray and light olive brown shale and siltstone bedrock is at a depth of about 53 inches. In some areas shale bedrock is at a depth of about 35 inches.

Included with these soils in mapping are small areas of Zanesville soils and a few areas that have a slope of about 25 percent. Zanesville soils have a fragipan. They are on the broader parts of ridgetops. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Wellston soil and moderately slow or slow in the Guernsey soil. Available water capacity is high in the Wellston soil and moderate in the Guernsey soil. Runoff is rapid on both soils. The root zone is deep. The Guernsey soil has a seasonal high water table between depths of 24 and 42 inches during extended wet periods.

Most areas are wooded. A few areas are used as pasture or cropland.

These soils are well suited to trees. Mechanical planting and mowing for weed control are suitable on these soils. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings. Plant competition on the Guernsey soil can be controlled by removing vines and the less desirable trees and shrubs.

These soils are well suited to pasture and moderately suited to hay. If the soils are plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes will help to control erosion and minimize surface crusting. The soil is well suited to no-till farming.

Because of the slope, the bedrock between depths of 40 and 72 inches, and seepage, this soil is moderately suited to use as a site for buildings and septic tank absorption fields. It is better suited to buildings without basements than to buildings with basements. In some areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. In some areas the bedrock hinders excavations. Installing septic tank absorption fields in suitable fill material will elevate the fields above the bedrock and improve the filtering capacity. Installing the distribution lines on the contour will minimize seepage of effluent to the surface.

This soil is moderately suited to use as a site for camp and picnic areas. The slope is a limitation. In some areas land shaping is needed. In areas that are subject to heavy traffic, maintaining a ground cover helps to control runoff and erosion. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WfC—Wellston-Cruze silt loams, 8 to 15 percent slopes. This map unit consists of deep, strongly sloping soils on upland ridgetops. It is about 50 percent Wellston silt loam and 45 percent Cruze silt loam. The Wellston soil is well drained, and the Cruze soil is moderately well drained. Most areas are long and narrow and range from 30 to several hundred acres in size. The two soils are so intricately mixed on the ridgetops or are in areas so small in size that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Wellston soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 38 inches thick. It is yellowish brown and firm. The upper part is silt loam, and the lower part is gravelly silty clay loam. The substratum is yellowish brown, firm channery silt loam. Strong brown and light olive brown, fine grained sandstone bedrock is at a depth of about 55 inches. In some areas the lower part of the subsoil has more clay. In other areas the upper part of the subsoil has more sand. In a few areas bedrock is at a depth of about 35 inches.

Typically, the surface layer of the Cruze soil is dark grayish brown, friable silt loam about 1 inch thick. The subsurface layer is yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 47 inches thick. The upper part is dark yellowish brown, firm silt loam; the next part is strong brown and light brownish gray, mottled, firm silty clay loam; and the lower part is light brownish gray, mottled, firm silty clay. Weathered, soft clay shale bedrock is at a depth of about 50 inches.

Included with these soils in mapping are small areas of the well drained Lily and Shelocta soils. The moderately deep Lily soils are on shoulder slopes. Shelocta soils have more sand and coarse fragments in the upper part than the Wellston and Cruze soils. They are on the sides of saddles. Also included are a few areas that have a slope of about 25 percent. Included soils make up about 5 percent of most areas of the map unit.

Permeability is moderate in the Wellston soil and moderately slow or slow in the Cruze soil. Available water capacity is high in the Wellston soil and moderate in the Cruze soil. The Cruze soil has a seasonal high water table between depths of 18 and 36 inches during extended wet periods. Runoff is rapid on both soils. The root zone is deep.

Most areas are wooded. A few areas are used as pasture or cropland.

These soils are well suited to trees. Mechanical tree planting and mowing for weed control are suitable on these soils. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

These soils are well suited to pasture and moderately suited to hay. If the soils are plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Pasture rotation, deferred grazing during wet periods, proper stocking rates, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

These soils are moderately suited to corn, soybeans, and winter wheat. In cultivated areas erosion is a severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop hillsides. Most areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 32 inches thick. It is yellowish brown and brown and is firm. The upper part is silty clay loam, and the lower part is loam. The substratum is light olive brown, firm very channery loam. Fractured sandstone and siltstone bedrock is at a depth of about 64 inches. In some areas the upper part of the subsoil has more sand. In other areas the soil is moderately well drained. In a few areas the lower part of the subsoil has a higher clay content. In places bedrock is at a depth of about 35 inches.

Included with this soil in mapping are small areas of Cruze, Guernsey, Lily, and Zanesville soils. The moderately well drained Cruze and Guernsey soils are in saddles on ridgetops. The moderately deep Lily soils are on shoulder slopes. Zanesville soils have a fragipan. They are on the broader parts of ridgetops. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Wellston soil. Available water capacity is high. Runoff is medium. The root zone is deep.

Most areas are used as pasture. Some areas are wooded, and a few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to hay and pasture. The erosion hazard is moderate. During pasture renovation, a system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, crop rotations that include grasses and legumes, and grassed waterways will help to control erosion and minimize crusting.

This soil is well suited to use as a site for buildings without basements and as a site for camp and picnic areas. It is moderately suited to use as a site for buildings with basements and as a site for septic tank absorption fields. The main limitations are the bedrock at a depth of 40 to 72 inches and seepage of effluent. In some areas the bedrock hinders excavations. Installing septic tank absorption fields in suitable fill material will elevate the fields above the bedrock and improve the filtering capacity.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WeC—Wellston silt loam, 6 to 15 percent slopes. This deep, strongly sloping, well drained soil is mainly on ridgetops. A few areas are on benches on hillsides. Most areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown, dark brown, and strong brown, firm silt loam and silty clay loam, and the lower part is yellowish brown, firm channery loam. The substratum is yellowish brown, friable very channery and extremely channery loam. Siltstone and sandstone bedrock is at a depth of about 70 inches. In some areas the subsoil has more sand. In a few areas the soil is moderately well drained. In places the lower part of the subsoil has more clay.

Included with this soil in mapping are small areas of Cruze, Guernsey, Lily, and Zanesville soils. The moderately well drained Cruze and Guernsey soils are in saddles on ridgetops. The moderately deep Lily soils are on shoulder slopes. Zanesville soils have a fragipan. They are on the broader parts of ridgetops. Also included are a few areas where the slope is about 25 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Wellston soil. Available water capacity is high. Runoff is rapid. The root zone is deep.

Most areas are used for pasture or hay. Some areas are wooded, and a few areas are used as cropland.

This soil is well suited to trees. Mechanical tree planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is overgrazed or is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or contour strip seeding will help to control erosion and runoff. Pasture rotation, deferred grazing during wet periods, proper stocking rates, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of mechanized equipment.

These soils are moderately suited to corn, soybeans, and winter wheat. If the soils are plowed, erosion is a very severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion and minimize crusting.

These soils are moderately suited to use as sites for buildings. The Wellston soil is better suited than the Guernsey soil. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. In areas of the Guernsey soil, drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the Guernsey soil. In some areas bedrock hinders the excavations for basements.

The Wellston soil is moderately suited to use as a site for septic tank absorption fields, and the Guernsey soil is poorly suited. Installing the distribution lines on the contour helps to minimize seepage of effluent to the surface. In areas of the Guernsey soil, subsurface drains upslope from the absorption field will intercept seepage water. Also, increasing the size of the absorption field will improve the absorption of effluent. Installing the absorption field in suitable fill material will improve the filtering capacity in areas of the Wellston soil and will improve the absorption of effluent in areas of the Guernsey soil.

These soils are moderately suited to use as camp and picnic areas. Subsurface drains remove excess water on the Guernsey soil. In some areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WmB—Westmore silt loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on upland ridgetops and benches on hillsides. Most areas are long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is yellowish brown and brownish yellow, firm silt loam, and the lower part is yellowish brown, mottled, firm silty clay loam and silty clay. Weathered, fine grained sandstone and shale bedrock is at a depth of about 50 inches, and hard sandstone bedrock is at a depth of about 57 inches. In some areas the lower part of the subsoil has less clay. In other areas the soil has more sand. In a few areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Guernsey soils and areas that have a slope of about 15 percent. The moderately well drained Guernsey soils are near slope breaks and on slight rises. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the upper part of the Westmore soil and slow or moderately slow in the lower part. Runoff is medium. Available water capacity is moderate. The root zone is deep.

Most areas are used as pasture. Some areas are wooded, and a few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and mowing to control weeds are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to pasture and hay. If the soil is plowed during seedbed preparation, erosion is a hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, crop rotations that include grasses and legumes, and grassed waterways help to minimize surface crusting and control erosion.

This soil is moderately suited to use as a site for buildings. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

Because of the slow or moderately slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. The slow or moderately slow permeability is a limitation. Special surfacing material generally is needed in camp areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WmC—Westmore silt loam, 6 to 15 percent slopes. This deep, well drained, strongly sloping soil is on upland ridgetops and benches on hillsides. Most areas are long and narrow and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 39 inches thick. The upper part is yellowish brown, firm silt loam and silty clay loam, and the lower part is yellowish brown and pale brown, mottled, firm silty clay and channery silty clay. The substratum is light brownish gray, mottled, firm channery silty clay loam. Soft shale bedrock is at a depth of about 48 inches, and hard bedrock is at a depth of about 68 inches. In some areas the lower part of the subsoil and the substratum have less clay. In other areas the soil has more sand and less clay. In a few areas it is moderately well drained.

Included with this soil in mapping are small areas of Guernsey soils and areas that have a slope of about 25 percent. The moderately well drained Guernsey soils are generally on slope breaks. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the upper part of the Westmore soil and slow or moderately slow in the lower part. Runoff is rapid. Available water capacity is moderate. The root zone is deep.

Most areas are wooded. A few areas are used as pasture or cropland.

This soil is well suited to trees. Mechanical planting and mowing to control weeds are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition. The slope in some of the steeper included areas limits the use of equipment.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion and minimize surface crusting.

This soil is moderately suited to use as a site for buildings. Backfilling along foundations with material that has a low shrink-swell potential and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the soil.

Because of the slow or moderately slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Increasing the size of the absorption field will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. The main limitations are the slope and the slow or moderately slow permeability. In some areas land shaping is needed. Camp areas generally require special surfacing material. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-6.

WoD—Westmoreland silt loam, 15 to 25 percent slopes. This deep, moderately steep, well drained soil is on upland ridgetops and hillsides. Most areas are long and narrow and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 23 inches thick. The upper part is yellowish brown, friable silt loam, and the lower part is yellowish brown, firm channery silt loam and channery silty clay loam. The substratum is yellowish brown, firm very channery silty clay loam. Light olive brown siltstone and sandstone bedrock is at a depth of about 42 inches. In some areas the bedrock is at a depth of about 30 inches.

Included with this soil in mapping are small areas of Berks, Dekalb, and Guernsey soils. The moderately deep Berks and Dekalb soils are on the steeper parts of the landscape. The moderately well drained Guernsey soils are generally in saddles or on the middle part of the ridgetops. Also included are a few areas that have a slope of about 8 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil. Available water capacity is low or moderate. The root zone is deep. Runoff is rapid.

Most areas are wooded. Some areas are used as pasture, and a few areas are used as cropland.

This soil is well suited to trees on north aspects and moderately suited to trees on south aspects. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of less evapotranspiration and cooler temperatures. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a good vegetative cover also help to control erosion. Cutting and filling to a more desirable slope will improve sites for log landings. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Special equipment is needed for site preparation and planting.

This soil is moderately suited to pasture and poorly suited to hay. The slope limits the use of some mechanized equipment. If the soil is plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is poorly suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a very severe hazard. The slope limits the use of some farm equipment. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion.

Mainly because of the slope, this soil is poorly suited to use as a site for buildings and septic tank absorption fields. In most areas land shaping is needed. Designing buildings so that they conform to the natural slope of the land minimizes the need for cutting and filling. Installing the distribution lines of septic tank absorption fields on the contour will minimize seepage of effluent to the surface.

This soil is poorly suited to use as a site for camp and picnic areas. The slope is a limitation. In most areas land shaping is needed. Adding fill material will facilitate the use of the camp and picnic areas. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

WpE—Westmoreland-Berks complex, 25 to 40 percent slopes. This map unit consists of steep, well drained soils on upland hillsides. In most areas it is about 60 percent Westmoreland silt loam and 20 percent Berks channery silt loam. The deep Westmoreland soil is on the middle parts of side slopes. The moderately deep Berks soil is on shoulder slopes and the steepest parts of the side slopes. Most areas are irregularly shaped and range from 10 to 500 acres in size. The two soils are in such narrow, alternating bands on hillsides that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Westmoreland soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is yellowish brown, friable silt loam about 5 inches thick. The subsoil is about 31 inches thick. It is yellowish brown and firm. The upper part is silt loam, and the lower part is channery silty clay loam. The substratum is yellowish brown, firm channery silt loam. Reddish brown and strong brown siltstone bedrock is at a depth of about 43 inches. In some areas the depth to bedrock is about 35 inches.

Typically, the surface layer of the Berks soil is very dark grayish brown and dark grayish brown, friable channery silt loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part is brown, friable channery silt loam, and the lower part is variegated light olive brown and yellowish brown, firm extremely flaggy silt loam. The substratum is variegated light olive brown and yellowish brown, firm extremely flaggy silt loam. Light olive brown and yellowish brown, fractured siltstone and sandstone bedrock is at a depth of about 30 inches. In some areas the depth to bedrock is about 45 inches. In other areas the soil has more sand.

Included with these soils in mapping are small areas of Guernsey soils and areas that have a slope of about 50 percent. The moderately well drained Guernsey soils are on the less sloping benches on hillsides. Also included are small areas of deep, well drained soils that formed in colluvium on toe slopes. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil and moderate or moderately rapid in the Berks soil.

Available water capacity is low or moderate in the Westmoreland soil and very low in the Berks soil. The root zone is moderately deep in the Berks soil and deep in the Westmoreland soil. Runoff is very rapid on both soils.

Most areas are wooded. A few areas are used as pasture.

The Westmoreland soil is well suited to trees on north-facing slopes and moderately suited to trees on south-facing slopes. The Berks soil is moderately suited to trees. The north- and east-facing slopes are better sites for woodland than the south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour will help to control erosion and facilitate the use of equipment. In some areas the less sloping hillside benches can be used for log landings and haul roads. Cutting and filling to a more desirable slope will improve sites for log landings. The bedrock at a depth of 20 to 40 inches in the Berks soil can be ripped with construction equipment. Special equipment is needed for site preparation and planting. Plant competition on the Westmoreland soil can be controlled by removing vines and the less desirable trees and shrubs. Planting seedlings that have been transplanted once will reduce the seedling mortality rate on the Berks soil.

These soils are generally unsuited to corn, soybeans, winter wheat, and hay. They are poorly suited to pasture. The slope severely limits the use of equipment. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and weed control help to keep the pasture in good condition.

These soils are generally unsuited to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The main limitations are the slope of both soils and the small stones in the surface layer and bedrock between depths of 20 and 40 inches in the Berks soil.

The land capability classification is VIe. The woodland ordination symbol assigned to the Westmoreland soil is 4R; the one assigned to the Berks soil is 4R on north aspects, 3R on south aspects. The pasture and hayland suitability group is A-3 for the Westmoreland soil and F-2 for the Berks soil.

WpF—Westmoreland-Berks complex, 40 to 70 percent slopes. This map unit consists of very steep, well drained soils on upland hillsides. It is about 45 percent Westmoreland silt loam and 40 percent Berks channery silt loam. The deep Westmoreland soil is on the middle part of side slopes, and the moderately deep Berks soil is on shoulder slopes and the steepest parts of the side slopes. Most areas are irregularly shaped and range from 10 to 200 acres in size. The two soils are in such narrow, alternating bands on hillsides that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Westmoreland soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 32 inches thick. It is yellowish brown. It is friable silt loam in the upper part and firm channery silty clay loam in the lower part. The substratum is yellowish brown, firm very channery silt loam. Reddish brown and strong brown siltstone and sandstone bedrock is at a depth of about 46 inches.

Typically, the surface layer of the Berks soil is very dark grayish brown, friable channery silt loam about 1 inch thick. The subsurface layer is dark yellowish brown, friable channery silt loam about 2 inches thick. The subsoil is about 18 inches of yellowish brown, friable channery silt loam and firm very channery silt loam. The substratum is light olive brown, firm very channery silt loam. Light olive brown and yellowish brown, fractured siltstone and sandstone bedrock is at a depth of about 30 inches. In some areas the soil is deeper to bedrock. In other areas it has more sand.

Included with these soils in mapping are small areas of Guernsey soils and areas that have a slope of about 30 percent. The moderately well drained Guernsey soils are on the less sloping benches on hillsides. Also included are small areas of deep, well drained soils that formed in colluvium on toe slopes. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil and moderate or moderately rapid in the Berks soil. Available water capacity is low or moderate in the Westmoreland soil and very low in the Berks soil. The root zone is moderately deep in the Berks soil and deep in the Westmoreland soil. Runoff is very rapid on both soils.

Most areas of these soils are wooded. The Westmoreland soil is well suited to trees on north-facing slopes and moderately suited to trees on south-facing slopes. The Berks soil is moderately suited to trees. The north- and east-facing slopes are better sites for woodland than the south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. If the ground cover is removed from these soils, erosion is a hazard. The slope limits the use of equipment. Building haul roads and skid trails on the contour will help to control erosion and facilitate the use of equipment. In some areas the less sloping hillside benches can be used for log landings and haul roads. Cutting and filling to a more desirable slope will improve sites for log landings. The bedrock at a depth of 20 to 40 inches in the Berks soil can be ripped with construction equipment. Special equipment is needed for site preparation and planting. Plant competition on the Westmoreland soil can be controlled by removing vines and the less desirable trees and shrubs. Planting seedlings that have been transplanted once will reduce the seedling mortality rate on the Berks soil.

These soils are generally unsuited to corn, soybeans, winter wheat, hay, and pasture. The very steep slope and a severe erosion hazard severely limit these uses. The very low available water capacity of the Berks soil also is a severe limitation.

These soils are generally unsuited to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope of both soils and the bedrock between depths of 20 and 40 inches in the Berks soil severely limit these uses.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Westmoreland soil is 4R; the one assigned to the Berks soil is 4R on north aspects, 3R on south aspects. The pasture and hayland suitability group is H-1.

WrD—Westmoreland-Guernsey silt loams, 15 to 25 percent slopes. These deep, moderately steep soils are on upland hillsides and ridgetops. In most areas it is about 50 percent Westmoreland silt loam and 35 percent Guernsey silt loam. The Westmoreland soil is well drained, and the Guernsey soil is moderately well drained. Most areas are irregularly shaped and range from 5 to 300 acres in size. The two soils are in such narrow, alternating bands on the landscape that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Westmoreland soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is light yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 34 inches thick. It is yellowish brown and firm. The upper part is silt loam and silty clay loam, and the lower part is channery silty clay loam. The substratum is yellowish brown, firm extremely channery silty clay loam. Light olive brown siltstone bedrock is at a depth of about 48 inches. In some areas the bedrock is at a depth of less than 40 inches.

Typically, the surface layer of the Guernsey soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 45 inches thick. The upper part is yellowish brown, mottled, firm silt loam; the next part is light brownish gray, firm silty clay; and the lower part is light brownish gray, firm channery silty clay. The substratum is light olive brown, mottled, firm silty clay. Weathered, light olive brown, soft clay shale bedrock is at a depth of about 60 inches.

Included with these soils in mapping are small areas of Wellston and Westmore soils and areas that have a slope of about 35 percent. Wellston and Westmore soils have more silt in the upper part than the Westmoreland and Guernsey soils. Wellston soils are on the higher parts of ridgetops. Westmore soils are on the broader parts of ridgetops and on the wider benches. Also included, on broad benches, are a few areas that have a slope of about 8 percent. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil and moderately slow or slow in the Guernsey soil. Available water capacity is moderate or low in the Westmoreland soil and moderate in the Guernsey soil. Runoff is rapid on both soils. The Guernsey soil has a seasonal high water table between depths of 24 and 42 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture or cropland.

These soils are well suited to trees on north aspects and moderately suited to trees on south aspects. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. In many areas the less sloping benches can be used for haul roads and log landings. Haul roads and log landings should not be established in areas of the Guernsey soil where hillside slips occur. Cutting and filling to a more desirable slope will improve sites for log landings. Applying gravel or crushed stone on haul roads and log landings in areas of the Guernsey soil will improve soil strength. In areas of the Guernsey soil on south-facing slopes, plant competition can be controlled by removing vines and the less desirable trees and shrubs.

These soils are moderately suited to pasture and poorly suited to hay. The slope limits the use of some equipment. If the soils are plowed during seedbed preparation, erosion is a very severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

These soils are poorly suited to corn, soybeans, and winter wheat. If the soils are plowed, erosion is a very severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion. The slope limits the use of some farm equipment.

These soils are poorly suited to use as sites for buildings. The Westmoreland soil is better suited than the Guernsey soil. Water collects in pockets on hillsides and increases the hazard of hillside slippage in areas of the Guernsey soil. Designing the buildings so that they conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping and reduces the hazard of hillside slippage. In areas of the Guernsey soil, drains at the base of footings and exterior basement wall coatings will help to keep basements dry. Backfilling along foundations with suitable fill material and reinforcing foundations and basement walls will help to prevent the structural damage caused by shrinking and swelling of the Guernsey soil.

These soils are poorly suited to use as sites for septic tank absorption fields. The Westmoreland soil is better suited than the Guernsey soil. Installing the distribution lines on the contour minimizes seepage of effluent to the surface. In areas of the Guernsey soil, interceptor drains upslope from the absorption field will help to remove excess water. Also, increasing the size of the absorption field will improve the absorption of effluent.

Because of the slope, these soils are poorly suited to use as camp and picnic areas. In most areas land shaping is needed. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion. Adding fill material will facilitate the use of the camp and picnic areas.

The land capability classification is IVe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-2.

WrE—Westmoreland-Guernsey silt loams, 25 to 40 percent slopes. This map unit consists of deep, steep soils on upland hillsides. In most areas it is about 55 percent Westmoreland silt loam and 30 percent Guernsey silt loam. The Westmoreland soil is well drained. It is on the steeper parts of side slopes. The Guernsey soil is moderately well drained. It is on the less sloping benches. Hillside slips are in areas of the Guernsey soil. Most areas are irregularly shaped and range from 10 to 300 acres in size. The two soils are so narrowly banded on the hillsides that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Westmoreland soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable silt loam, and the lower part is brown and yellowish brown, friable and firm channery and very channery silty clay loam. The subsoil is mottled below a depth of about 21 inches. The substratum is yellowish brown, mottled, firm very channery silty clay loam. Light olive brown siltstone and sandstone bedrock is at a depth of about 43 inches. In some areas the soil is moderately deep to bedrock.

Typically, the surface layer of the Guernsey soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 2 inches thick. The subsoil is about 38 inches thick. The upper part is yellowish brown, firm silty clay loam, and the lower part is light brownish gray and pale brown, mottled, firm silty clay and shaly silty clay. The substratum is light brownish gray, mottled, firm shaly silty clay. Light olive brown shale bedrock is at a depth of about 60 inches. In some areas the depth to bedrock is about 40 inches. In other areas the soil is redder and is well drained.

Included with these soils in mapping are small areas of Berks, Bethesda, and Westmore soils and areas that have a slope of about 50 percent. The moderately deep Berks soils are on shoulder slopes. Bethesda soils are in areas that have been strip-mined for coal. They have a higher content of coarse fragments throughout than the Westmoreland and Guernsey soils. Westmore soils have more silt in the upper part than the Westmoreland and Guernsey soils. They are on some of the wider benches. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil and moderately slow or slow in the Guernsey soil. Available water capacity is moderate or low in the Westmoreland soil and moderate in the Guernsey soil. Runoff is very rapid on both soils. The Guernsey soil has a seasonal high water table at a depth of 24 to 42 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture.

These soils are well suited to trees on north aspects and moderately suited to trees on south aspects. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Planting seedlings that have been transplanted once will reduce the seedling mortality rate in areas of the Guernsey soil on south-facing slopes. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. In most areas the less sloping benches can be used for log landings and haul roads. Haul roads and log landings should not be established in areas of the Guernsey soil where hillside slips occur. Cutting and filling to a more desirable slope will improve sites for log landings. In areas of the Guernsey soil, applying gravel or crushed stone on haul roads and log landings will improve soil strength. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to hay and poorly suited to pasture. The slope limits the use of mechanical equipment. Proper stocking rates, pasture rotation, deferred grazing during wet periods, weed control, and applications of lime and fertilizer help to keep the pasture in good condition.

These soils are generally unsuited to corn, soybeans, and winter wheat and to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope and a very severe erosion hazard limit these uses. The seasonal high water table, high shrink-swell potential, hazard of hillside slippage, and moderately slow or slow permeability in areas of the Guernsey soil also are limitations. Cutting and filling increase the hazard of hillside slippage.

The land capability classification is VIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is A-3.

WrF—Westmoreland-Guernsey silt loams, 40 to 70 percent slopes. This map unit consists of deep, very steep soils on upland hillsides. It is about 60 percent Westmoreland silt loam and 20 percent Guernsey silt loam. The Westmoreland soil is well drained. It is on the steeper parts of side slopes. The Guernsey soil is moderately well drained. It is on the less sloping benches. Hillside slips are in areas of the Guernsey soil. Most areas are irregularly shaped and range from 10 to 150 acres in size. The two soils are so narrowly banded on the hillsides that they could not be separated at the scale used in mapping.

Typically, the surface layer of the Westmoreland soil is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is dark yellowish brown, friable silt loam about 2 inches thick. The subsoil is about 38 inches thick. It is yellowish brown and firm. The upper part is channery silt loam, and the lower part is very channery silty clay loam. The substratum is light olive brown, firm extremely channery silty clay loam. Light olive brown siltstone and strong brown sandstone bedrock is at a depth of about 52 inches.

Typically, the surface layer of the Guernsey soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is pale brown, friable silt loam about 3 inches thick. The subsoil is about 34 inches thick. It is yellowish brown, mottled, and firm. The upper part is silty clay loam, and the lower part is silty clay. The substratum is grayish brown, mottled, firm silty clay. Light olive brown shale bedrock is at a depth of about 53 inches. In some areas the depth to bedrock is about 40 inches. In other areas the soil is redder and is well drained.

Included with these soils in mapping are small areas of Berks, Bethesda, and Westmore soils. The moderately deep Berks soils are on shoulder slopes. Bethesda soils have a higher content of coarse fragments throughout than the Westmoreland and Guernsey soils. They are in areas that have been strip-mined for coal. Westmore soils have more silt in the upper part than the Westmoreland and Guernsey soils. They are on some of the wider benches. Also included are a few areas that have a slope of about 30 percent. Included soils make up about 20 percent of most areas of the map unit.

Permeability is moderate in the Westmoreland soil and moderately slow or slow in the Guernsey soil. Available water capacity is moderate or low in the Westmoreland soil and moderate in the Guernsey soil. Runoff is very rapid on both soils. The Guernsey soil has a seasonal high water table between depths of 24 and 42 inches during extended wet periods. The root zone is deep in both soils.

Most areas are wooded. A few areas are used as pasture.

These soils are moderately suited to trees. North- and east-facing slopes are better sites for woodland than south- and west-facing slopes because of cooler temperatures and less evapotranspiration. These sites are less exposed to the drying effects of the sun and prevailing winds. Building haul roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. In most areas the less sloping benches can be used for log landings and haul roads. Haul roads and log landings should not be established in areas of the Guernsey soil where hillside slips occur. Cutting and filling to a more desirable slope will improve sites for log landings. In areas of the Guernsey soil, applying gravel or crushed stone on haul roads and log landings will improve soil strength. Planting seedlings that have been transplanted once will reduce the seedling mortality rate in areas of the Guernsey soil on south-facing slopes. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Special equipment is needed for site preparation and planting.

These soils are generally unsuited to corn, soybeans, winter wheat, hay, and pasture and to use as sites for buildings, septic tank absorption fields, camp areas, and picnic areas. The slope and a very severe erosion hazard limit these uses. The seasonal high water table, high shrink-swell potential, hazard of hillside slippage, and moderately slow or slow permeability in areas of the Guernsey soil also are limitations. Cutting and filling increase the hazard of hillside slippage.

The land capability classification is VIIe. The woodland ordination symbol is 4R. The pasture and hayland suitability group is H-1.

WtA—Wheeling silt loam, 0 to 3 percent slopes. This deep, nearly level, well drained soil is on outwash terraces. Most areas are irregularly shaped and range from 5 to 250 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 41 inches thick. The upper part is yellowish brown, firm silty clay loam, and the lower part is yellowish brown and brown, firm loam and fine sandy loam. The substratum to a depth of about 80 inches is dark yellowish brown, loose loamy coarse sand. In some areas the soil is moderately well drained. In places the surface layer is darker.

Included with this soil in mapping are small areas of Licking and Otwell soils and areas of Urban land. The moderately well drained Licking soils are in the slightly higher terrace positions. Otwell soils have a fragipan in the subsoil. They are on the slightly higher terraces. The Urban land consists of areas covered by buildings, streets, parking lots, and other structures. Inclusions make up about 20 percent of most areas of the map unit.

Permeability is moderate in the subsoil of the Wheeling soil and rapid in the substratum. Available water capacity is moderate. Runoff is slow. The root zone is deep.

Most areas are used for pasture or hay. A few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and harvesting and mowing for weed control are suitable on this soil. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to hay and pasture. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. It is well suited to a system of conservation tillage that leaves crop residue on the surface and to conventional tillage.

This soil is well suited to use as a site for buildings, septic tank absorption fields, and camp and picnic areas. Building sites should be landscaped so that surface water drains away from foundations. If the distribution lines in septic tank absorption fields are installed too deep in the soil, pollution is a hazard because of a poor filtering capacity. Installing the absorption field in suitable fill material will improve the filtering capacity.

The land capability classification is I. The woodland ordination symbol is 4A. The pasture and hayland suitability group is A-1.

ZnB—Zanesville silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on upland ridgetops. Most areas are irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 46 inches thick. The upper part is dark yellowish brown and dark brown, firm silt loam, and the lower part is a fragipan of dark brown and yellowish brown, very firm and extremely firm, brittle silt loam and loam. The substratum is yellowish brown, very firm loam. Yellowish brown sandstone bedrock is at a depth of about 78 inches. In some areas the fragipan is weakly developed. In places the soil is moderately well drained.

Included with this soil in mapping are small areas of Guernsey and Wellston soils. The moderately well drained Guernsey soils are on slope breaks and in saddles. Wellston soils do not have a fragipan. They are in the higher positions on ridgetops. Also included are a few areas where the slope is about 15 percent.

Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate above the fragipan in the Zanesville soil and slow or moderately slow in the fragipan. The seasonal high water table is between depths of 24 and 36 inches during extended wet periods. Runoff is medium. The root zone is restricted mainly to the part of the profile above the fragipan. Available water capacity of this zone is low.

Most areas are wooded. Some areas are used for pasture or hay. A few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength.

This soil is well suited to hay and pasture. If the soil is plowed during seedbed preparation, erosion is a hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is well suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface and a crop rotation that includes grasses and legumes help to control erosion and minimize surface crusting.

This soil is moderately suited to use as a site for buildings. Because of the seasonal high water table, it is better suited to dwellings without basements than to dwellings with basements. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry. Building sites should be landscaped so that surface water drains away from foundations.

Because of the seasonal high water table and the slow or moderately slow permeability, this soil is poorly suited to use as a site for septic tank absorption fields. Subsurface drains upslope from the absorption field will intercept laterally moving water above the fragipan and will help to lower the seasonal high water table. Increasing the size of the absorption field will improve the absorption of effluent. Installing the absorption field in suitable fill material will elevate the field above the fragipan and thus will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Surface and subsurface drains will remove excess water. Camp sites generally require special surfacing material. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-3.

ZnC—Zanesville silt loam, 6 to 15 percent slopes. This deep, well drained, strongly sloping soil is on upland ridgetops. Most areas are irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 38 inches thick. The upper part is yellowish brown, firm silt loam; the next part is a fragipan of yellowish brown, mottled, very firm, brittle silt loam and loam; and the lower part is yellowish brown, firm loam. The substratum is yellowish brown, firm loam. Yellowish brown and light olive brown siltstone bedrock is at a depth of about 54 inches. In some areas the fragipan is weakly developed.

Included with this soil in mapping are small areas of Guernsey and Wellston soils and areas that have a slope of about 20 percent. The moderately well drained Guernsey soils are commonly near slope breaks or in saddles. Wellston soils do not have a fragipan. They are in the higher positions on ridgetops. Included soils make up about 15 percent of most areas of the map unit.

Permeability is moderate above the fragipan in the Zanesville soil and slow or moderately slow in the fragipan. The root zone is restricted mainly to the part of the profile above the fragipan. Available water capacity of this zone is low. The seasonal high water table is between depths of 24 and 36 inches during extended wet periods. Runoff is rapid.

Most areas are wooded. Some areas are used for pasture or hay. A few areas are used as cropland.

This soil is well suited to trees. Mechanical planting and mowing for weed control are suitable on this soil. Applying gravel or crushed stone on haul roads and log landings will improve soil strength. Cutting and filling to a more desirable slope will improve sites for log landings.

This soil is well suited to pasture and moderately suited to hay. If the soil is plowed during seedbed preparation, erosion is a severe hazard. A system of conservation tillage that keeps plant residue on the surface or strip seeding will help to control erosion during reseeding. Proper stocking rates, pasture rotation, deferred grazing during wet periods, applications of lime and fertilizer, and mowing for weed control help to keep the pasture in good condition.

This soil is moderately suited to corn, soybeans, and winter wheat. If the soil is plowed, erosion is a severe hazard. The surface layer crusts after hard rains. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include grasses and legumes help to control erosion and minimize surface crusting.

This soil is moderately suited to use as a site for buildings. It is better suited to buildings without basements than to buildings with basements. Designing the buildings so that they to conform to the natural slope of the land minimizes the need for cutting, filling, and land shaping. Drains at the base of foundations and exterior basement wall coatings will help to keep basements dry.

Because of the seasonal high water table, the slow or moderately slow permeability, and the slope, this soil is poorly suited to use as a site for septic tank absorption fields. Subsurface drains upslope from the absorption field will intercept laterally moving water above the fragipan and will help to lower the seasonal high water table. Installing distribution lines on the contour will minimize seepage of effluent to the surface. Increasing the size of the absorption field will improve the absorption of effluent. Installing the absorption field in suitable fill material will elevate the field above the fragipan and thus will improve the absorption of effluent.

This soil is moderately suited to use as a site for camp and picnic areas. Subsurface drains will remove excess water. These drains are more effective if they are installed above the slowly permeable or moderately slowly permeable fragipan. Camp sites generally require special surfacing material. In areas that are subject to heavy traffic, maintaining a ground cover helps to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4A. The pasture and hayland suitability group is F-3.

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 inputs 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 40,775 acres in the survey area, or nearly 15 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are on the flood plains and terraces in associations 6 and 7, which are described under the heading "General Soil Map Units." Most of the prime farmland is used for corn, soybeans, wheat, and hay.

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

Use and Management of the Soils

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

Dean E. Weber, district conservationist, Soil Conservation Service, helped to 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 1979, about 68,805 acres in the survey area was used as cropland or pasture *(17)*. Of this total, about 36,753 acres was used for crops, mainly corn, wheat, soybeans, and hay, and about 32,052 acres was used as pasture.

Erosion is the major problem on most of the cropland and on some of the pasture in Hocking County. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced when the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a high clay content in the subsoil and on soils that have a layer in or below the subsoil that restricts roots. Such layers include the fragipan in Cincinnati, Otwell, and Zanesville soils and the bedrock in Lily soils. The second damaging effect of erosion is the sedimentation of streams. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In eroded spots on many fields, preparing a good

Figure 10.—Contour stripcropping in an area of Licking and Otwell soils. Shelocta, Berks, and Cana Variant soils are on the hills in the background.

seedbed and tilling are difficult because much of the original friable surface layer has eroded away. Such spots are common in areas of Alexandria, Cana Variant, and Cardington soils.

Erosion-control measures provide a protective surface cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to amounts that do not reduce the productive capacity of the soil. A system of conservation tillage that leaves crop residue on the surface increases the infiltration rate and helps to control runoff and erosion. It can be adapted to most of the soils used as cropland in the survey area. In areas used for corn, no-till farming, which is being used on an increasing acreage, is very effective in controlling erosion. It can be adapted to most of the soils in the survey area.

Diversions commonly reduce the length of slopes and thus help to control runoff and erosion. On many sites they also intercept concentrated flow. Most of the nearly level to strongly sloping soils in the survey area are suited to diversions.

Contour farming and contour stripcropping are commonly used erosion-control measures in the survey area (fig. 10). They are suited to most of the gently sloping to moderately steep soils.

A drainage system is needed on poorly drained and somewhat poorly drained soils, such as Bennington, Melvin, and Orrville soils. It also is needed in the wetter soils that are included with Otwell, Cardington, and other well drained or moderately well drained soils in mapping.

Fertility is naturally low in some of the soils on uplands, especially the soils that formed in sandstone and siltstone residuum, such as Dekalb soils. All of the soils on uplands that formed in colluvium and residuum derived from sandstone, siltstone, and shale are naturally acid. The soils on flood plains, such as

Chagrin and Orrville soils, are medium or high in natural fertility and typically are strongly acid to neutral throughout. Stonelick soils typically are mildly alkaline throughout.

Upland soils that are naturally acid require applications of lime to raise the pH level sufficiently for such crops as alfalfa to grow well. Available phosphorus and potassium levels are naturally low in many of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer and the amount of lime to be applied.

Tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. Most of the soils used for crops in the survey area have a silt loam surface layer that is light in color and moderately low in organic matter content. Generally, the structure of such soils is moderate or weak. During periods of heavy rainfall, a crust forms on the surface. Because the crust is hard when dry and nearly impervious to water, it reduces the infiltration rate and increases the runoff rate. Regularly adding crop residue, manure, and other organic material help to improve soil structure and minimize crusting.

Fall plowing is not a good practice on light colored soils that have a silt loam surface layer because it can result in crusting in winter and spring. If plowed in the fall, many of these soils are nearly as dense and hard at planting time as they were before they were plowed. Erosion is a severe hazard in fall-plowed areas that have a slope of more than 2 percent.

Field crops suited to the soils and climate of the survey area include many that are not commonly grown. Corn is the chief row crop. Soybeans are grown on a very small acreage. Grain sorghum, sunflowers, potatoes, and similar crops can be grown under favorable economic conditions. Wheat and oats are the most common close-growing crops. Rye, barley, buckwheat, and flax also could be grown.

Specialty crops grown commercially in the survey area are vegetables, small fruits, tree fruits, and nursery plants. A small acreage is used for melons, strawberries, raspberries, sweet corn, tomatoes, peppers, pumpkins, or other vegetables and small fruits. Other specialty crops, such as blueberries and grapes, could be grown. Apples and peaches are the most important tree fruits in the county.

Deep, well drained soils that warm up early in spring are especially well suited to many vegetables and small fruits. Examples are Allegheny, Chili, Wellston, and Wheeling soils that have a slope of less than 8 percent. Crops can generally be planted and harvested earlier on these soils than on the other soils in the survey area.

Most of the nearly level to moderately steep, well drained soils on stream terraces and uplands are suitable for orchards. Soils on low positions, where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Most of the acreage used for pasture and hay in the county is on hillsides adjacent to less sloping soils used for row crops or small grains. The soils used for pasture and hay formed mainly in material weathered from shale, siltstone, or sandstone. These soils are subject to erosion. The dominant forage species are bluegrass, tall fescue, orchardgrass, and timothy. Many pastures are unimproved and require renovation and brush control.

On some pastures and meadows, overgrazing has resulted in weedy, low-producing forage. In these areas the hazard of erosion has increased because of the sparse, short vegetative cover. The soils are typically acid and are low in phosphorus and potassium. Under good management, these soils can in time be restored to a much higher productivity. A current agronomy guide gives recommendations on the proper management of hayland and pasture *(12)*.

If forage crops are to be successfully established, quality seed of species and varieties adapted to the soils should be selected for planting. Reseeding requires proper seedbed preparation, proper seeding methods, timely seeding, and recommended applications of lime and fertilizer. Pasture renovation requires that the existing grasses and weeds be killed or suppressed before the desired species are reseeded. The objective is to kill the existing sod and leave it on or near the surface as a dead mulch to help control erosion. The pasture should be tilled and seeded on the contour.

No-till seeding can be effective on most of the soils in Hocking County, except for those with drainage limitations. In areas where a no-till seeding method is used, the existing vegetation should be suppressed or killed by grazing or by herbicides.

April or August is generally the best time for seeding forage species. Forage can be seeded with small grain. Because of plant competition for light, moisture, and nutrients, however, forage production is reduced.

Seeding mixtures should be based on the soil and the desired pasture management system. Mixtures of legumes and grasses have a higher nutritional value than grasses alone. Also, the legumes provide nitrogen for the growth of grasses. Alfalfa and red clover should be seeded on well drained soils. Ladino clover and alsike clover are better adapted to the wetter soils. Birdsfoot trefoil, bromegrass, lespedeza, warm-season grasses, and vetches are generally not grown as forage species in Hocking County, but they are adapted to the soils in the county and can be included in a forage management system.

Maintenance applications of lime and fertilizer based on the results of soil tests will ensure good productivity and will lengthen the life of the stand. Weed control by mowing, clipping, and spraying is important for continued high production. The weeds should be mowed before they go to seed. Control of insects, such as alfalfa weevil and potato leafhopper, may be needed. When herbicides are used, all label restrictions must be observed.

Pasture and hayland suitability groups are given for every soil at the end of the detailed map unit descriptions. These groups are based primarily on the suitability of the soil for certain plant species, on management needs, and on potential productivity. Soils that have the same suitability group symbol require the same general management and have about the same potential productivity.

Group A soils have few limitations affecting the management and growth of climatically adapted plants.

Group A-1 consists of deep, well drained soils. The surface layer is loam or silt loam. Available water capacity is moderate or high. Slope ranges from 0 to 18 percent. Plants on these soils will respond favorably to additions of lime. Frequent applications may be needed to maintain a favorable pH level. Legumes are gradually lost from the stand because of acidity.

Group A-2 consists of deep, well drained and moderately well drained soils. The surface layer is silt loam. Available water capacity ranges from low to high. Slope ranges from 15 to 25 percent. Plants on these soils will respond favorably to additions of lime. Frequent applications maybe needed to maintain a favorable pH level. Legumes are gradually lost from the stand because of acidity. The slope limits the use of equipment in applying lime and fertilizer and in clipping, mowing, and spraying for weed control. The hazard of erosion is increased if the pasture is overgrazed or is cultivated for reseeding. These soils are suited to no-till reseeding.

Group A-3 consists of deep, well drained and moderately well drained soils. The surface layer is silt loam. Available water capacity is low to high. Slope ranges from 25 to 40 percent. Because of the slope, these soils are generally unsuited or poorly suited to pasture and hay.

Group A-5 consists of deep, well drained soils on flood plains. These soils are frequently or occasionally flooded. The use of these soils for pasture is limited by the periods of stream overflow, and the sediment deposited by floodwater lowers the quality of the forage. The surface layer is loam or silt loam. Available water capacity is low to high. Slope ranges from 0 to 3 percent.

Group A-6 consists of deep, well drained and moderately well drained soils that are subject to frost action. Frost action damages legumes. Including fibrous, deep-rooted grasses in the seeding mixture and applying proper grazing management minimize this damage. The surface layer is silt loam. Available water capacity is moderate or high. Slope ranges from 0 to 18 percent.

Group B consists of soils in areas where forage production is reduced by droughtiness.

Group B-4 consists of deep, well drained soils in areas that have been surface mined for coal. Grading and blanketing the surface with material removed from natural soils have reclaimed these soils. The substratum is high in content of coarse fragments, is massive, and is extremely acid to strongly acid. As a result, it restricts root growth. Available water capacity is low. These soils are moderately suited or poorly suited to hay and pasture because the root zone is restricted to a depth of 20 inches or less. Slope ranges from 0 to 20 percent.

Group C consists of soils that are normally wet because of a seasonal high water table or that are saturated during the growing season.

Group C-1 consists of deep, somewhat poorly drained soils. The surface layer is silt loam. Available water capacity is moderate. Slope ranges from 0 to 3 percent. Frost action damages legumes. Including grasses in the seeding mixture and applying proper grazing management minimize this damage. The seasonal high water table limits the root zone of deep-rooted forage plants. Shallow-rooted species grow well on these soils. Subsurface drains are used to lower the seasonal high water table. Plants on these soils will respond favorably to additions of lime. Frequent applications may be needed to maintain a favorable pH level. Because of acidity, legumes are gradually lost from the stand.

Group C-2 consists of deep, somewhat poorly drained soils. The surface layer is silt loam. Available water capacity is moderate. Slope ranges from 0 to 3 percent. The seasonal high water table limits the root zone of deep-rooted forage plants. Shallow-rooted species grow well on these soils. Drained areas have a deep root zone. Subsurface drains are used to lower the seasonal high water table. The effectiveness of these drains is limited, however, by slow or very slow permeability.

Group C-3 consists of deep, somewhat poorly drained and poorly drained soils on flood plains and low terraces. These soils are subject to frequent, occasional, or rare flooding. The use of these soils for pasture is limited by the periods of stream overflow, and the sediment deposited by floodwater lowers the quality of the forage. The surface layer is silt loam. Available water capacity is high or very high. Frost action damages legumes. Including grasses in the seeding mixture and applying proper grazing management minimize this damage. The seasonal high water table limits the root zone of deep-rooted forage plants. Shallow-rooted species grow well on these soils. Subsurface drains are used to lower the seasonal high water table; however, the effectiveness of these drains is limited by the landscape position.

Group E soils restrict root growth to less than 20 inches. Because of the limited root zone, these soils are better suited to forage species that have a fibrous root system than other species.

Group E-2 consists of deep, well drained soils in areas that have been surface mined for coal. These soils are generally unsuited or poorly suited to pasture and generally unsuited to hay because of the slope, a very severe erosion hazard, droughtiness, extremely acid to strongly acid reaction, and a very shallow root zone. A massive, acid substratum restricts root growth. Stands cannot be easily established or maintained. The surface layer is channery loam or silty clay loam. Slope ranges from 20 to 40 percent.

Group E-3 consists of deep, well drained soils in areas that have been surface mined for coal. A massive, acid substratum restricts root growth. It has a high content of coarse fragments. The surface layer is channery loam. Available water capacity is low. These soils are droughty. Plants on these soils respond to applications of lime. Frequent applications may be needed to maintain a favorable pH level. Establishing or maintaining stands is difficult. Slope ranges from 0 to 20 percent.

Group F consists of soils that restrict the root growth of climatically adapted plants to a depth of less than 40 inches but more than 20 inches. Because of the restricted root zone, forage species that do not have a taproot grow better on these soils than other species.

Group F-1 consists of moderately deep, well drained soils. The surface layer is silt loam. Available water capacity is low. These soils are droughty. Warm-season grasses, such as switchgrass, big bluestem, indiangrass, and Caucasian bluestem, can be grown. They respond favorably to additions of lime. Frequent applications may be needed to maintain a favorable pH level. Legumes are gradually lost from the stand because of acidity. Slope ranges from 8 to 25 percent.

Group F-2 consists of moderately deep, well drained soils. The surface layer is channery silt loam. Available water capacity is very low. Slope ranges from 25 to 40 percent. These soils are generally unsuited to hay and poorly suited to pasture.

Group F-3 consists of deep, well drained and moderately well drained soils that have a fragipan. Because of a restricted root zone, forage species that do not have a taproot grow better on these soils than other species. Plants will respond favorably to additions of lime. Frequent applications may be needed to maintain a favorable pH level. Legumes are gradually lost from the stand because of acidity. The surface layer is silt loam. Available water capacity is moderate or low in the root zone. Slope ranges from 2 to 18 percent.

Group H soils are too steep to be used for forage production.

Group H-1 consists of deep and moderately deep, well drained and moderately well drained soils. Slope ranges from 40 to 70 percent. These soils are generally unsuited to pasture and hay.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification 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 landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(14)*. 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, rangeland, 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.

Use and Management of Disturbed Lands

Surface mining has affected thousands of acres in Hocking County. Consequently, more and more farmers are incorporating reclaimed land into their farming operations. Land being reclaimed under current regulations has greater potential for agricultural production than that mined prior to the 1972 strip mine reclamation law. Some limitations affect the management of this type of land.

Under current law, coal companies are required to replace a minimum of 6 inches of soil material from natural soils on most reclaimed land. In areas identified as prime farmland, the companies are required to save and replace the A, B, and C horizons to a depth of as much as 48 inches. Most soils that are strip-mined do not meet the requirements for prime farmland. As a result, the majority of mined areas are reclaimed by replacing a minimum of 6 inches of soil material over the spoil.

In evaluating the potential of reclaimed mine spoil for agricultural use, it is important to know the physical and chemical properties of the spoil and its suitability for crops. By evaluating these properties against crop needs for air, water, and nutrients, land users will be able to select adapted crops and the best management practices.

Coarse fragments derived from fragmented bedrock make up from about 35 to 60 percent of the volume of most mine spoils. This content of coarse fragments is significantly higher than that in the topsoil removed from the surface to a depth of 18 inches in natural soils. In most natural soils it ranges from 0 to 15 percent in the surface layer and subsoil.

The high content of coarse fragments reduces the effective root zone and the available water capacity. Roots tend to concentrate along the soil-coarse fragment interfaces, and few roots penetrate the compact, massive spoil material.

The organic matter content is considerably lower in mine soils than in natural soils.

High bulk densities are common in mine soils. They occur in both the replaced soil material and the underlying graded spoil. The high bulk density is attributed to the following causes: (1) compacting by heavy wheel-type machinery used in reclamation; (2) increased handling of topsoil material during stockpiling and spreading; (3) performing mining and reclamation operations during unfavorable moisture conditions; and (4) insufficient time for soil-forming processes, such as freezing and thawing, wetting and drying, biological activity, and root action, to decrease the bulk density.

As a result of the high bulk density in both the graded spoil and the replaced soil material, mine soils have less pore space, are less permeable to water and air, and cannot be easily penetrated by roots. These factors retard plant growth and result in reduced yields.

Woodland Management and Productivity

Forest land makes up approximately 171,500 acres, or about 64 percent of the total area, in Hocking County *(16)*. The forests are predominately privately owned. State and federal forests make up approximately 26,500 acres of the woodland.

The woodland cover in Hocking County is extensive. The only areas that have been extensively cleared are the valleys of the Hocking River and Salt Creek and the glaciated parts of Perry and Salt Creek Townships. These are the main agricultural areas of the county. In many areas old pastures or abandoned strip mines are reverting to woodland. Thus, the total acreage of woodland is increasing.

The woodland is mainly a mixed mesophytic forest dominated by oak. Other major types of trees include hickory, maple, yellow-poplar, walnut, and beech. Redmaple and yellow-poplar tend to be the early successional species. Oak, hickory, beech, and maple become the climax species. As such, they are characteristic of mature forests.

In places the woodland shows the result of abuse and neglect. Heavy cutting without planning for future timber crops has resulted in understocked stands of desirable tree species. High grading has continually removed the best trees. Culls and low-value trees grow in many excellent stands. In a few areas grazing by livestock destroys the leaf litter, damages roots, kills young trees, compacts the soil, and increases the hazard of erosion. In time, good management can restore these woodlands to a higher level of production.

Soils differ in their productivity for tree growth. The available water capacity of a soil is an important factor affecting tree growth. It is influenced by soil depth, texture, permeability, and internal drainage. The aspect, direction of exposure, and position of the soil on the landscape also are important factors affecting tree growth. Other important factors are the slope, the degree of past erosion, acidity, and the natural fertility level of the soil.

Aspect is the compass direction toward which a slope faces. North aspects are slopes that have an azimuth of 355 degrees to 95 degrees; south aspects are slopes that have an azimuth of 96 to 354 degrees *(5)*. Trees grow better on the north aspects and in coves because of less exposure to the prevailing winds and the sun. The slower tree growth on the south aspects is caused by a higher soil temperature and a higher evaporation rate.

The position of the soil on the landscape also affects the amount of moisture available for tree growth. The moisture supply tends to be higher in the downslope areas because of the downhill movement of water. On the lower parts of the slopes, the soils are generally deeper, less soil moisture is lost through evaporation, and the soil temperature is generally lower.

The slope is another important management factor. A very steep slope seriously limits the use of equipment. As the percentage of 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 water storage. Severe erosion removes the more porous surface layer and exposes the less porous subsoil, thus increasing the runoff rate and lowering the infiltration rate. As a result, severe erosion adversely affects both tree growth and natural reseeding.

Tables 8 and 9 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for woodcrops are listed. Table 8 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 slow potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 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.

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.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are the depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

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.

Woodland Harvesting and Regeneration Activities

Table 9 gives the degree and kind of limitations that affect the operation of the equipment used in tree harvesting and in the regeneration of woodland. Ratings are given for haul roads, log landings, skid trails and logging areas, and site preparation and planting. The limitations are considered *slight* if the physical site characteristics impose little or no limitations on the kind of equipment or the time of operation. They are considered *moderate* if the site characteristics impose some limitations on the kind of equipment, the time of operation, or both. They are considered *severe* if the site conditions are such that special equipment or special logging techniques are needed or the time of efficient operation is very limited.

Haul roads are access roads leading from log landings to primary or surfaced roads. Generally, these are unpaved and ungraveled roads. The ratings are based on soil properties, site features, and the observed performance of the soils. Wetness, rockiness, depth to hard bedrock, stoniness, soil strength, slope, soil texture, and flooding should be considered in selecting routes for haul roads. Wetness and flooding affect the duration of use. Rock outcrops, stones, and boulders, which are difficult to move, hinder construction when cutting or filling is needed. Soil strength, as inferred from the AASHTO group index and AASHTO group, is a measure of the traffic-supporting capacity of the soil. Slope affects the use of equipment and the cutting and filling requirements of the site.

Log landings are areas where logs are assembled for transportation (fig. 11). The best sites for landings are areas that require little or no surface preparation, which consists of cutting and filling. Considerable soil compaction can be expected in these areas. The ratings are based on soil properties, site features, and the observed performance of the soils. Wetness, flooding, rockiness, stoniness, slope, depth to hard bedrock, soil strength, soil texture, and content of coarse fragments should be considered in selecting sites for log landings. Wetness and flooding affect the duration of use. Rock outcrops, stones, and boulders, which are difficult to move, limit the use of equipment and affect the configuration and location of landings. Depth to hard bedrock is a problem where cutting and filling are required. Slope affects the use of equipment and the cutting and filling requirements of the site. Soil texture affects trafficability. Soil strength, as inferred from the AASHTO group index and AASHTO group, is a measure of the traffic-supporting capacity of the soil.

Skid trails and logging areas include the areas from the stumps to the log landings that are partially or completely logged with rubber-tired equipment. Other types of log-moving equipment can sometimes be used to minimize or overcome the site limitations. The ratings are based on soil properties, site features, and the observed performance of the soils. The seasonal high water table, flooding, rockiness, stoniness, texture, and slope affect the use of logging equipment. Deferring logging activities during periods when the soil is saturated at or near the surface helps to minimize environmental damage. Special equipment is usually required during these periods. Soils that are subject to flooding of long duration should not be logged because logging activities can damage the equipment, the environment, or both. Surface stones, boulders, and rock outcrops limit the safe and efficient use of equipment. As slope gradients increase, traction problems worsen. Traction is a problem on clayey soils during wet periods and on sandy soils during dry periods. Unless frozen, organic soils are severely damaged by the use of rubber-tired or track-type equipment.

Site preparation and planting are mechanized activities. The ratings are based both on the limitations affecting the efficient use of equipment and on the hazards that can result in damage to the site when the equipment is used. It is assumed that the operating techniques used do not displace or remove topsoil from the site or create channels in which storm runoff can concentrate. The seasonal high water table, flooding, rockiness, stoniness, content of coarse fragments, depth to hard bedrock, texture, and slope affect the use of site preparation and planting equipment. Deferring site preparation and planting during periods when the soil is saturated at or near the surface helps to minimize environmental damage. Special equipment is usually required during these periods. Equipment should not be used on soils that are subject to flooding of long duration. Operating equipment on these soils can result in equipment damage, environmental damage, or both. Surface stones, boulders, and rock outcrops limit the safe and efficient use of equipment. Coarse fragments and hard bedrock at very shallow depths can interfere with the equipment used in site

Figure 11.—Loading logs at a log landing.

preparation and planting. As slope gradients increase, traction problems worsen. Traction is a problem on clayey soils during wet periods and on sandy soils during dry periods. Unless frozen, organic soils are severely damaged by the use of rubber-tired or track-type equipment.

Christmas Tree Production

Christmas tree production is increasing in Hocking County, and the potential is good for additional expansion. The county is near highly populated areas of the state and so is in an advantageous position for marketing Christmas trees.

In the past, Christmas trees were grown generally on marginal sites that were too steep, infertile, dry, or eroded for other agricultural purposes. Emphasis has now shifted toward the production of high-quality trees requiring much more intensive cultural practices and higher soil productivity. Thus, the marginal agricultural areas used in the past are no longer suitable for Christmas tree production.

Soils that are nearly level to strongly sloping are best suited to Christmas tree production *(11)*. All operations, from site preparation to harvesting, are accomplished faster, more easily, and with less man power and wear on equipment than on steeper slopes. The steeper slopes are more susceptible to erosion and generally drier and less fertile.

Areas that are relatively free of large rocks, tall trees, fence rows, and brush are preferred for Christmas tree production. Unless these obstructions are removed, production will be hampered. Removing these obstructions can be costly, especially if heavy equipment is used.

In some years harvesting and other operations have to be done during inclement weather. Good roads to the plantation areas are required, especially if trucks are used to remove the trees. Good access also is important for retail operations where consumers choose or cut their own trees.

The choice of species to plant is an important decision. Making a suitable choice saves both time and money. The following considerations may influence this choice: (1) consumer preference; (2) plant characteristics; (3) soil characteristics; and (4) presence of diseases or harmful insects. The combination of soil conditions, topographic factors, and biological agents prevailing in an area constitute the site factors of that area. The combination of these factors, along with the ecological requirements of the species, should be carefully considered in order to ensure the successful establishment, survival, and growth of trees.

The paragraphs that follow describe the most common species selected for planting as Christmas trees in the county.

Scotch pine is the most widely planted Christmas tree species in Hocking County. It grows best in moist, well drained soils. It requires considerable shaping, but it responds well to shearing. Trees 6 to 7 feet tall generally can be produced in 6 to 9 years.

Eastern white pine is native to some parts of Ohio. It grows best in moist, well drained soils but is more water tolerant than Scotch pine. It usually requires heavy shearing to produce high-quality trees. Trees 6 to 7 feet tall generally can be produced in 6 to 9 years.

Blue spruce is extensively planted in Hocking County. It grows best in moist, well drained soils but will survive and grow on somewhat poorly drained soils. It requires some light shearing to produce high-quality trees. It is subject to injury from spring frost and should not be planted on low-lying sites or in frost pockets. Trees 6 to 7 feet tall can generally be produced in 8 to 12 years.

Norway spruce formerly was one of the most widely planted species. Needle retention, however, is very poor when the tree is cut, and sales have declined in recent years. As a result, this species is no longer extensively planted. This is the easiest spruce to establish. In 7 to 11 years, it grows to a height of 6 to 7 feet on good sites. Delaying harvesting as long as possible improves needle retention after the tree is cut.

White spruce, retains its needles better than Norway spruce but not so well as the pines. Harvesting of white spruce should be delayed as long as possible. On relatively good sites, this species grows to a height of 6 to 7 feet in 8 to 11 years.

Fraser fir, like other firs, can be planted on moist, well drained soils throughout the county, but it grows best on the cooler, north- and east-facing slopes. It does not survive or grow well on wet soils and does not grow well during periods of prolonged drought. In 7 to 11 years, it generally grows to a height of 6 to 7 feet.

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 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 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 recreation industry in Hocking County has expanded during the past few decades because several state parks, forests, and wildlife areas and the Wayne National Forest are located in the county. National and state governments and large corporations own about a third of the land in the county. Most of this acreage is available for recreation. In the Wayne National Forest, the public is provided opportunities for hunting, fishing, camping, hiking, picnicking, and other outdoor activities. Hocking State Forest provides opportunities for all of these activities, except for camping. The state parks provide opportunities for all of the activities, except for hunting, which is prohibited for safety reasons. Several coal and oil companies own acreages that the public can use for recreation.

The soils of the survey area are rated in table 11 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 11, 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 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

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

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

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking 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

A wide variety of wildlife inhabits Hocking County. Some common species of birds are bobwhite quail, wild turkey, mourning dove, ruffed grouse, common crow, pileated woodpecker, red-tailed hawk, great horned owl, meadowlark, bobolink, and many other species of songbirds.

Mammals within the county include cottontail rabbit, gray and fox squirrel, gray and red fox, white-tailed deer, raccoon, woodchuck, mink, and beaver.

This diversity of wildlife is supported by a wide variety of wildlife habitat, including cropland, openland, various successional stages of woodland, and riparian areas (borders of rivers and streams).

Upland wildlife habitat consists of cropland, openland, and woodland. The major soils in areas of this habitat are Cruze, Shelocta, Wellston, and Westmoreland soils. Farmland and openland wildlife include deer, rabbit, quail, dove, and woodchuck. Including grasses and legumes in the crop rotation, applying a system of conservation tillage, constructing ponds, and planting trees and shrubs can improve the farmland and openland habitat.

Woodland wildlife includes deer, grouse, turkey, and squirrel. Improving the timber stands, excluding livestock from the wooded areas, and planting trees and shrubs can improve the habitat for woodland wildlife.

The major riparian areas are along the Hocking River, Rush Creek, and Salt Creek. Chagrin, Orrville, and Stonelick are the main soils in these areas. Deer, mink, muskrat, raccoon, woodcock, and wood duck inhabit these areas. Riparian wildlife habitat can be improved by stabilizing stream banks, erecting wood duck nest boxes, and planting trees and shrubs.

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 12, 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 *(1)*. 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, 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 shallow 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, ground hog, meadowlark, field sparrow, cottontail, and red fox.

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

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, 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 13 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 14 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 14 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 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 14 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 15 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 15, 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 16 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 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.

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 17 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 in the fraction of the soil that is less than 2 millimeters in diameter (fig. 12). "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.

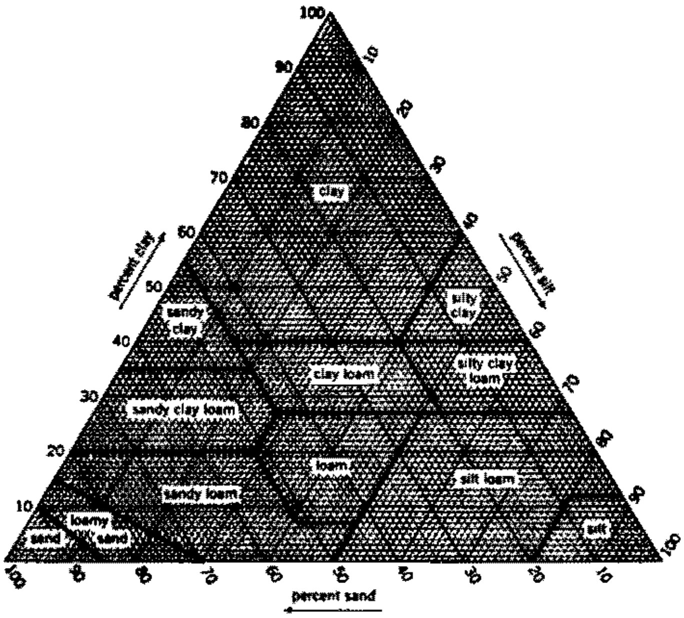

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

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 18 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.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, 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 19 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 19 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 19 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 19. 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

Samples of many of the soils in Hocking County were analyzed by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The data obtained on most samples include those on particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

These data were used in the classifying and correlating the soils and in evaluating their behavior under various land uses. Four of the profiles were selected as representative of their respective soil series and are described under the heading "Soil Series and Their Morphology." The series names and the laboratory identification numbers are Cedarfalls (HO-27), Cruze (HO-24), Dekalb (HO-19), and Zanesville (HO-22).

In addition to the data from Hocking County, laboratory data also are available from nearby counties in the southwestern part of Ohio that have many of the same soils. All data are on file at the Department of Agronomy, Ohio State University; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Soil Conservation Service, State Office, Columbus, Ohio.

Engineering Index Test Data

Some of the soils in Hocking County were analyzed for engineering properties by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section, Columbus, Ohio. Engineering test data also are available from nearby counties that have many of the same soils. These data are on file at the Department of Agronomy, Ohio State University; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Soil Conservation Service, State Office, Columbus, Ohio.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(15)*. 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. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Ultisol.

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 Udult (*Ud*, meaning humid, plus *ult*, from Ultisol).

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 Hapludults (*Hapl*, meaning minimal horizonation, plus *udult*, the suborder of the Ultisols 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 Hapludults.

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-loamy, mixed, mesic Typic Hapludults.

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 (13)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (15)*. 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."

Alexandria Series

The Alexandria series consists of deep, well drained, moderately slowly permeable soils formed in calcareous Wisconsinan glacial till on dissected hillsides on till plains. Slope ranges from 12 to 40 percent.

Alexandria soils are similar to Hickory soils and commonly are adjacent to Bennington and Cardington soils. Bennington soils are somewhat poorly drained, and Cardington soils are moderately well drained. Bennington soils are in swales, depressions, and flats. Cardington soils are on slight rises, knolls, and hillsides. Hickory soils have less clay in the subsoil than the Alexandria soils and formed in Illinoian glacial till.

Typical pedon of Alexandria silt loam, 25 to 40 percent slopes, about 2 miles north of Laurelville, in Perry Township; 2,790 feet south and 1,350 feet east of the northwest corner of sec. 19, T. 12 N., R. 19 W.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure parting to moderate medium granular; friable; many fine and few medium roots; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; 5 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—10 to 16 inches; yellowish brown (10YR 5/4) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; 5 percent coarse fragments; medium acid; clear smooth boundary.

Bt2—16 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; 5 percent coarse fragments; medium acid; clear smooth boundary.

Bt3—26 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; few fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; many distinct olive brown (2.5Y 4/4) clay films on faces of peds; 10 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1—35 to 40 inches; olive brown (2.5Y 4/4) loam; common medium prominent grayish brown (10YR 5/2) and few fine prominent dark brown (7.5YR 4/4) mottles; massive, with some weak structural planes; firm; few faint olive brown (2.5Y 4/4) clay films on vertical planes; 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—40 to 80 inches; olive brown (2.5Y 4/4) clay loam; common medium prominent grayish brown (10YR 5/2) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 26 to 47 inches in thickness. The depth to carbonates ranges from 24 to 40 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has chroma of 3 to 6. It is clay loam, silty clay loam, silty clay, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loam, silty clay loam, or clay loam.

Alford Series

The Alford series consists of deep, well drained, moderately permeable soils formed in loess on uplands and terraces. Slope ranges from 2 to 12 percent.

Alford soils are similar to Wellston and Westmore soils and commonly are adjacent to Cincinnati and Hickory soils. Cincinnati soils have a fragipan. They are on broad ridgetops and dissected hillsides on Illinoian till plains. Hickory soils have more sand and coarse fragments throughout than the Alford soils. They are on hillsides on Illinoian till plains. Wellston soils have more sand and coarse fragments in the lower part than the Alford soils, and Westmore soils have more clay in the lower part.

Typical pedon of Alford silt loam, 6 to 12 percent slopes, about 5 miles north-northeast of Laurelville, in Perry Township; 1,400 feet south and 820 feet west of the center of sec. 5, T. 12 N., R. 19 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, yellowish brown (10YR 5/4) dry; weak medium granular structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

BE—8 to 15 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; firm; few fine roots; many distinct dark yellowish brown (10YR 4/4) silt coatings on faces of peds; medium acid; clear wavy boundary.

Bt1—15 to 25 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

Bt2—25 to 42 inches; yellowish brown (10YR 5/4) silty clay loam; weak very thick platy structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

Bt3—42 to 63 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; firm; few fine roots; few distinct dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; medium acid; clear wavy boundary.

C—63 to 90 inches; dark yellowish brown (10YR 4/4) silt loam; massive; firm; medium acid.

The solum ranges from 45 to 72 inches in thickness. The Ap horizon has chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is silt loam or silty clay loam. The C horizon has value of 4 or 5 and chroma of 4 to 6.

Allegheny Series

The Allegheny series consists of deep, well drained moderately permeable soils formed in loamy old alluvium on stream terraces. Slope ranges from 2 to 12 percent.

These soils have less clay in the subsoil and a higher base saturation in the substratum than is definitive for the Allegheny series. These differences, however, do not alter the use or behavior of the soils.

Allegheny soils are similar to Chili soils and are commonly adjacent to Chagrin and McGary soils. Chagrin soils do not have an argillic horizon. They are on flood plains. Chili soils have more clay in the subsoil than the Allegheny soils. The somewhat poorly drained McGary soils are on lacustrine terraces.

Typical pedon of Allegheny loam, 2 to 6 percent slopes, about 1 mile northeast of Mound Crossing, in Laurel Township; about 1,800 feet south and 1,150 feet west of the northeast corner of sec. 18, T. 12 N., R. 18 W.

Ap—0 to 7 inches; dark yellowish brown (10YR 4/4) loam, light gray (10YR 7/2) dry; moderate fine and medium granular structure; friable; common fine roots; dark brown (10YR 3/3) organic coatings on faces of peds; 2 percent sandstone fragments; very strongly acid; abrupt smooth boundary.

E—7 to 10 inches; light olive brown (2.5Y 5/4) loam, yellowish brown (10YR 5/4) rubbed; weak thick platy structure parting to moderate fine subangular blocky; friable; few fine roots; few fine strong brown (7.5YR 5/8) soft sandstone fragments; 1 percent hard sandstone fragments; very strongly acid; clear wavy boundary.

Bt1—10 to 17 inches; yellowish brown (10YR 5/6) loam; moderate fine and medium subangular blocky structure; firm; few fine roots; dark yellowish brown (10YR 4/4) Ap material in root channels; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; 2 percent quartzite pebbles; very strongly acid; gradual smooth boundary.

Bt2—17 to 24 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine roots; dark yellowish brown (10YR 4/4) Ap material in root channels; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 3 percent quartzite pebbles; strongly acid; gradual smooth boundary.

Bt3—24 to 35 inches; yellowish brown (10YR 5/6) sandy loam; few medium distinct brown (10YR 5/3) mottles; weak coarse and moderate medium subangular blocky structure; firm; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 3 percent quartzite pebbles; strongly acid; clear smooth boundary.

BC—35 to 48 inches; yellowish brown (10YR 5/4) gravelly sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium platy structure; friable; 20 percent quartzite and sandstone pebbles; brown (10YR 5/3) strata of fine sand; strongly acid; clear smooth boundary.

C—48 to 80 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; friable; some thin lenses of strong brown silt loam and fine sandy loam; strong brown (7.5YR 5/6) stains; few dark stains (iron and manganese oxide); 10 percent quartzite and sandstone pebbles; strongly acid.

The solum ranges from 32 to 50 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 to 4. It is commonly loam, but in some pedons it is fine sandy loam. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is loam, sandy loam, or clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is sandy loam, loam, silt loam, or the gravelly analogs of those textures.

Bennington Series

The Bennington series consists of deep, somewhat poorly drained, slowly permeable soils formed in calcareous Wisconsinan glacial till in swales, in depressions, and on flats on till plains. Slope ranges from 0 to 3 percent.

Bennington soils are commonly adjacent to Alexandria and Cardington soils. The well drained Alexandria soils are on dissected hillsides. The moderately well drained Cardington soils are on slight rises, knolls, and hillsides on the dissected parts of till plains.

Typical pedon of Bennington silt loam, 0 to 3 percent slopes, about 4.7 miles north-northeast of Laurelville, in Perry Township; 215 feet south and 2,060 feet west of the northeast corner of sec. 7, T. 12 N., R. 19 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common roots; 2 percent coarse fragments; strongly acid; abrupt smooth boundary.

BE—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; few faint grayish brown (10YR 5/2) silt coatings on faces of peds; 4 percent coarse fragments; strongly acid; clear wavy boundary.

Bt1—14 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct dark gray (10YR 4/1) and yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; common distinct dark gray (10YR 4/1) and dark yellowish brown (10YR 4/4) clay films on faces of peds; 4 percent coarse fragments; strongly acid; gradual wavy boundary.

Bt2—27 to 34 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few roots; common distinct dark gray (10YR 4/1) clay films on faces of peds; 8 percent coarse fragments; neutral; clear wavy boundary.

C1—34 to 55 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct gray (10YR 6/1) mottles; massive; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse wavy boundary.

C2—55 to 80 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 28 to 42 inches. The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y and chroma of 3 or 4. It is clay loam, silty clay loam, or clay. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam or loam.

Berks Series

The Berks series consists of moderately deep, well drained soils formed in shale, siltstone, and sandstone residuum on upland hillsides. Permeability is moderate or moderately rapid. Slope ranges from 25 to 70 percent.

Berks soils are similar to Dekalb soils and commonly are adjacent to Shelocta and Westmoreland soils. Dekalb soils have more sand throughout than the Berks soils. The deep Shelocta and Westmoreland soils are on ridgetops and hillsides.

Typical pedon of Berks channery silt loam, in an area of Westmoreland-Berks complex, 25 to 40 percent slopes; about 1.75 miles southwest of Murray City, in Ward Township; about 369 feet west and 924 feet south of the northeast corner of sec. 8, T. 13 N., R. 15 W.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) channery silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; many fine roots; about 15 percent siltstone and sandstone fragments; medium acid; abrupt wavy boundary.

A2—3 to 7 inches; dark grayish brown (10YR 4/2) channery silt loam; moderate fine and medium granular structure; friable; common fine roots; about 20 percent siltstone and sandstone fragments; strongly acid; gradual wavy boundary.

Bw1—7 to 11 inches; brown (10YR 5/3) channery silt loam; weak fine subangular blocky structure; friable; few coarse roots; about 25 percent siltstone and sandstone fragments; very strongly acid; gradual wavy boundary.

Bw2—11 to 20 inches; about 70 percent variegated light olive brown (2.5Y 5/4) and 30 percent yellowish brown (10YR 5/4) extremely flaggy silt loam; weak fine granular structure; firm; about 65 percent siltstone and sandstone fragments; strongly acid; gradual smooth boundary.

C—20 to 30 inches; about 70 percent variegated light olive brown (2.5Y 5/4) and 30 percent yellowish brown (10YR 5/4) extremely flaggy silt loam; firm;

about 80 percent siltstone and fine grained sandstone fragments; medium acid; abrupt smooth boundary.

R—30 to 40 inches; light olive brown (2.5Y 5/4) and yellowish brown (10YR 5/4), fractured siltstone and fine grained sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The A horizon has chroma of 1 to 4. It is typically channery silt loam, but in some pedons it is silt loam, loam, or channery loam. The B horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. It is silt loam, silty clay loam, or the channery, very channery, extremely channery, flaggy, very flaggy, or extremely flaggy analogs of those textures. The C horizon is very channery, extremely channery, very flaggy, or extremely flaggy silt loam.

Bethesda Series

The Bethesda series consists of deep, well drained, moderately slowly permeable soils formed in partly weathered fine-earth material mixed with fragments of shale, siltstone, and sandstone. These soils are in surface-mined areas on upland ridgetops and hillsides. Slope ranges from 0 to 70 percent.

Bethesda soils commonly are adjacent to Cruze, Guernsey, Shelocta, and Westmoreland soils. The adjacent soils have an argillic horizon. They are in unmined areas.

Typical pedon of Bethesda channery loam, 0 to 8 percent slopes, about 0.5 mile south of Gore, in Falls Township; about 2,600 feet east and 1,800 feet north of the southwest corner of sec. 35, T. 14 N., R. 16 W.

Ap—0 to 4 inches; about 65 percent variegated brown (10YR 5/3) and 35 percent grayish brown (10YR 5/2) channery loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak coarse granular; friable; few roots; 20 percent fragments of siltstone, sandstone, and coal; very strongly acid; clear wavy boundary.

C1—4 to 20 inches; about 70 percent variegated dark grayish brown (10YR 4/2) and 30 percent yellowish brown (10YR 5/4) very channery silty clay loam; massive; firm; 55 percent light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and black (10YR 2/1) fragments of siltstone, sandstone, and coal; extremely acid; gradual wavy boundary.

C2—20 to 60 inches; about 70 percent variegated grayish brown (10YR 5/2) and 30 percent yellowish brown (10YR 5/6) very channery silty clay loam; massive; firm; 35 percent fragments of siltstone and shale and 20 percent fragments of sandstone; extremely acid.

The depth to bedrock is more than 60 inches. The Ap horizon has value of 3 to 6 and chroma of 2 to 6. It is commonly channery loam or silty clay loam, but in some pedons it is the very channery, shaly, or very shaly analogs of silt loam, loam, or silty clay loam. The C horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 6. It is the very channery, extremely channery, very shaly, or extremely shaly analogs of silty clay loam, clay loam, or loam. The content of coarse fragments in this horizon ranges from 35 to 80 percent and averages about 60 percent.

Cana Variant

The Cana Variant consists of deep, moderately well drained soils formed in glacial till and in the underlying shale residuum. These soils are on glaciated foot slopes in the uplands. Permeability is moderate or moderately slow in the upper part of the profile and slow in the lower part. Slope ranges from 8 to 25 percent.

Cana Variant soils are similar to Cardington soils and commonly are adjacent to Alexandria and Dekalb soils. Alexandria soils are well drained and are on dissected hillsides. Cardington soils have more clay in the subsoil than the Cana Variant soils. The moderately deep Dekalb soils are on hillsides.

Typical pedon of Cana Variant silt loam, 15 to 25 percent slopes, eroded, about 6 miles north of Laurelville, in Perry Township; about 2,400 feet north and 1,800 feet east of the southwest corner of sec. 31, T. 13 N., R. 19 W.

Ap—0 to 4 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine roots; about 10 percent dark yellowish brown (10YR 4/4) subsoil material; about 5 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—4 to 8 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine and medium subangular blocky structure; friable; few medium roots; very few faint yellowish brown (10YR 5/4) clay films on faces of peds; about 10 percent coarse fragments of glacial and local origin; medium acid; clear smooth boundary.

Bt2—8 to 23 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; few fine distinct grayish brown

(10YR 5/2) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; few fine roots; common prominent yellowish brown (10YR 5/4) clay films on faces of peds; few prominent very dark brown (10YR 2/2) stains (iron and manganese oxide); about 20 percent coarse fragments; strongly acid; clear smooth boundary.

2Bt3—23 to 38 inches; variegated dark yellowish brown (10YR 4/4) and light brownish gray (10YR 6/2) silty clay loam; common medium distinct grayish brown (10YR 5/2) and light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure in the upper part and platy rock structure in the lower part; firm; few fine roots; common prominent light olive brown (2.5Y 5/4) clay films on faces of peds; about 5 percent coarse fragments; slightly acid; clear smooth boundary.

2C—38 to 45 inches; variegated light olive brown (2.5Y 5/4) and light brownish gray (10YR 6/2) silty clay; massive; firm; few prominent strong brown (7.5YR 5/6) stains on fractures; slightly acid; clear smooth boundary.

2Cr—45 to 50 inches; variegated light olive brown (2.5Y 5/4) and light brownish gray (10YR 6/2), soft shale; platy rock structure; difficult to dig with a spade.

The solum ranges from 35 to 48 inches in thickness. The depth to material weathered from shale ranges from 20 to 40 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, silty clay loam, clay loam, or the gravelly analogs of those textures. The 2Bt horizon has hue of 10YR or 2.5Y. The 2C horizon has value of 4 to 6 and chroma of 2 to 4. It is silty clay loam or silty clay.

Cardington Series

The Cardington series consists of deep, moderately well drained, moderately slowly permeable soils on till plains. These soils formed in calcareous Wisconsinan glacial till. Slope ranges from 2 to 12 percent.

Cardington soils are similar to Cana Variant soils and commonly are adjacent to Alexandria and Bennington soils. Alexandria soils are well drained, and Bennington soils are somewhat poorly drained. Alexandria soils are on hillsides in dissected areas. Bennington soils are in swales, in depressions, and on flats. Cana Variant soils have less clay in the subsoil than the Cardington soils.

Typical pedon of Cardington silt loam, 2 to 6 percent slopes, about 4.75 miles north of Laurelville, in Perry Township; 100 feet east and 225 feet south of the northwest corner of sec. 7, T. 12 N., R. 19 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; common roots; 2 percent coarse fragments; medium acid; abrupt smooth boundary.

Bt1—8 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium and coarse subangular blocky structure; firm; few roots; common distinct brown (10YR 4/3) clay films on faces of peds; 5 percent coarse fragments; medium acid; clear wavy boundary.

Bt2—16 to 21 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; common distinct brown (10YR 5/3) clay films on faces of peds; 5 percent coarse fragments; slightly acid; clear wavy boundary.

Bt3—21 to 30 inches; yellowish brown (10YR 5/4) clay; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; common distinct brown (10YR 5/3) clay films on faces of peds; common fine distinct dark reddish brown (5YR 3/2) stains; 10 percent coarse fragments; neutral; gradual wavy boundary.

Bt4—30 to 35 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few roots; common distinct brown (10YR 5/3) clay films on faces of peds; 10 percent coarse fragments; neutral; gradual wavy boundary.

C1—35 to 55 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; 14 percent coarse fragments; strong effervescence; mildly alkaline; diffuse smooth boundary.

C2—55 to 80 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark grayish brown (10YR 4/2) and common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; 14 percent coarse fragments; strong effervescence; mildly alkaline.

The solum ranges from 30 to 39 inches in thickness.

The depth to carbonates ranges from 26 to 45 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is silty clay loam, clay loam, or clay. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam or loam.

Cedarfalls Series

The Cedarfalls series consists of deep, well drained, rapidly permeable soils on foot slopes below sandstone cliffs. These soils formed in sandy and loamy colluvium derived from acid Blackhand Sandstone bedrock. Slope ranges from 40 to 70 percent.

Cedarfalls soils are commonly adjacent to Dekalb and Shelocta soils on hillsides. Dekalb soils have bedrock between depths of 20 and 40 inches. Shelocta soils have more clay in the subsoil than the Cedarfalls soils.

Typical pedon of Cedarfalls coarse sandy loam, in an area of Cedarfalls-Rock outcrop complex, 40 to 70 percent slopes; about 3 miles north of Gibisonville, in Laurel Township; about 1,600 feet south and 2,000 feet east of the northwest corner of sec. 4, T. 12 N., R. 18 W.

Oi—1 inch to 0; undecomposed leaf litter.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) coarse sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine and medium roots; 5 percent sandstone and quartzite fragments; strongly acid; clear smooth boundary.

C1—5 to 11 inches; yellowish brown (10YR 5/4) coarse sandy loam; massive; very friable; few fine and medium roots; 5 percent quartzite fragments; strongly acid; clear smooth boundary.

C2—11 to 20 inches; yellowish brown (10YR 5/4) loamy coarse sand; single grained; loose; few fine and medium roots; 10 percent quartzite fragments; very strongly acid; gradual smooth boundary.

C3—20 to 57 inches; light yellowish brown (10YR 6/4) coarse sand; single grained; loose; very strongly acid; abrupt irregular boundary.

R—57 to 60 inches; strong brown (7.5YR 5/8), hard sandstone.

The depth to bedrock is more than 40 inches. The A horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3. It is typically coarse sandy loam, but in some pedons it is fine sand, loamy fine sand, loamy coarse sand, sand, or loamy sand. The C horizon has hue of 10YR or 7.5YR, value of 3 to 6, and chroma of 3 to 8. It is coarse sandy loam to sand.

Chagrin Series

The Chagrin series consists of deep, well drained, moderately permeable soils formed in alluvium on flood plains. Slope is 0 to 2 percent.

Chagrin soils are similar to Pope soils and commonly are adjacent to Orrville soils. Pope soils have less clay in the subsoil than the Chagrin soils. The somewhat poorly drained Orrville soils are in the lower positions on the flood plains.

Typical pedon of Chagrin silt loam, frequently flooded, about 2.75 miles southeast of Haydenville, in Starr Township; about 850 feet south and 1,550 feet west of the northeast corner of sec. 5, T. 12 N., R. 16 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine roots; about 2 percent gravel; slightly acid; clear smooth boundary.

A—7 to 16 inches; brown (10YR 4/3) silt loam; weak coarse subangular blocky structure parting to moderate medium granular; friable; common fine roots; about 2 percent gravel; slightly acid; clear smooth boundary.

Bw1—16 to 26 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; few fine roots; common distinct brown (10YR 4/3) organic coatings on vertical faces of peds; about 5 percent gravel; few thin strata of pale brown (10YR 6/3) loam and very fine sandy loam; neutral; gradual smooth boundary.

Bw2—26 to 43 inches; dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

C—43 to 80 inches; yellowish brown (10YR 5/4), stratified loam, fine sandy loam, and loamy fine sand; massive and single grained; friable and loose; about 10 percent gravel; neutral.

The solum ranges from 33 to 47 inches in thickness. The Ap horizon has chroma of 2 to 4. It is typically silt loam, but in some pedons it is loam or sandy loam. The B horizon has value of 4 or 5 and chroma of 3 to 6. It is loam, silt loam, sandy loam, or fine sandy loam. The C horizon has value of 4 or 5 and chroma of 3 to 6. It is silt loam to loamy fine sand and commonly is stratified.

Chili Series

The Chili series consists of deep, well drained, moderately rapidly permeable soils on outwash terraces. These soils formed in stratified outwash deposits. Slope ranges from 0 to 15 percent.

Chili soils are similar to Allegheny soils and commonly are adjacent to Chagrin and McGary soils. Allegheny soils have less clay in the subsoil than the Chili soils. Chagrin soils have less clay movement in the subsoil than the Chili soils. They are on flood plains. The somewhat poorly drained McGary soils are on lacustrine terraces.

Typical pedon of Chili loam, 0 to 3 percent slopes, about 1.2 miles west of South Perry, in Perry Township; about 2,550 feet west and 870 feet north of the southeast corner of sec. 21, T. 12 N., R. 19 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; few fine roots; 2 percent sandstone and granitic coarse fragments; very strongly acid; gradual smooth boundary.

BA—10 to 16 inches; dark yellowish brown (10YR 4/4) loam; weak medium angular blocky structure; friable; very few fine roots; common distinct dark brown (10YR 4/3) organic coatings on faces of peds; 5 percent sandstone and granitic coarse fragments; strongly acid; clear smooth boundary.

Bt1—16 to 24 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; 10 percent sandstone and granitic coarse fragments; strongly acid; clear smooth boundary.

Bt2—24 to 35 inches; brown (7.5YR 4/4) gravelly sandy clay loam; weak medium and fine subangular blocky structure; friable; common faint brown (7.5YR 4/4) clay films on faces of peds; few prominent very dark brown (10YR 2/2) iron and manganese stains; 20 percent sandstone and granitic coarse fragments; strongly acid; clear smooth boundary.

Bt3—35 to 44 inches; brown (7.5YR 4/4) gravelly sandy loam; weak medium and fine subangular blocky structure; very friable; few faint brown (7.5YR 4/4) clay films on pebbles; yellowish brown (10YR 5/4) strata of silt loam and loamy sand; 20 percent sandstone and granitic coarse fragments; strongly acid; abrupt smooth boundary.

C—44 to 80 inches; brown (7.5YR 4/4) very gravelly loamy sand; single grained; loose; 35 percent sandstone and granitic coarse fragments; strongly acid.

The solum ranges from 43 to 78 inches in thickness. The content of coarse fragments is 0 to 15 percent to a depth of 24 inches, 15 to 35 percent from 25 to 44 inches, and 25 to 50 percent from 44 to 60 inches.

The Ap horizon has value of 4 or 5 and chroma of 3 or 4. It is typically loam, but in some pedons it is silt loam. The Bt horizon has chroma of 4 to 6. It is loam, sandy loam, sandy clay loam, clay loam, silty clay loam, or the gravelly analogs of those textures. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is uniform or stratified gravelly or very gravelly loamy sand or sand.

Cincinnati Series

The Cincinnati series consists of deep, well drained soils formed in loess and in the underlying Illinoian glacial till. These soils are on ridgetops and hillsides on till plains. They have a fragipan. Permeability is moderate above the fragipan and moderately slow or slow in and below the fragipan. Slope ranges from 2 to 12 percent.

Cincinnati soils are similar to Otwell and Zanesville soils and commonly are adjacent to Hickory soils. Hickory soils do not have a fragipan. They are on hillsides on dissected parts of the till plains. Otwell soils do not have glacial till in the lower part. Zanesville soils have thin, flat stone fragments in the lower part.

Typical pedon of Cincinnati silt loam, 2 to 6 percent slopes, about 6.25 miles north-northeast of Laurelville, in Perry Township; 1,100 feet east and 100 feet north of the center of sec. 32, T. 13 N., R. 19 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common roots; medium acid; abrupt smooth boundary.

BE—8 to 13 inches; yellowish brown (10YR 5/6) silt loam; moderate medium and coarse subangular blocky structure; friable; few roots; few faint yellowish brown (10YR 5/4) silt coatings on faces of peds; medium acid; gradual wavy boundary.

Bt1—13 to 25 inches; brown (7.5YR 5/4) silt loam; moderate medium and coarse subangular blocky structure; firm; few roots; few distinct brown (7.5YR 5/4) clay films on the vertical faces of peds and in root channels; few distinct yellowish brown (10YR 5/6) coatings on faces of peds; medium acid; gradual wavy boundary.

Bt2—25 to 34 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; strongly acid; clear wavy boundary.

2Btx—34 to 45 inches; yellowish brown (10YR 5/6) loam; common medium distinct light brownish gray (10YR 6/2) mottles on faces of prisms; strong very coarse prismatic structure parting to weak coarse subangular blocky; very firm; brittle; common distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; common distinct brown (7.5YR 5/4) clay films on faces of peds; 5 percent coarse fragments; medium acid; clear wavy boundary.

2Bt—45 to 80 inches; yellowish brown (10YR 5/6) clay loam; weak medium subangular blocky structure; firm; common distinct brown (7.5YR 5/4) clay films on faces of peds; dark reddish brown (5YR 3/2) stains; an average of about 10 percent coarse fragments, increasing in number with increasing depth; medium acid.

The thickness of the solum and the depth to carbonates range from 55 to more than 80 inches. The thickness of the loess mantle ranges from 18 to 40 inches. Depth to the top of the fragipan ranges from 18 to 38 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has value of 4 or 5. It is silt loam or silty clay loam. The 2Btx and 2Bt horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. They are loam, clay loam, silty clay loam, or the gravelly analogs of those textures. The content of coarse fragments in these horizons ranges from 2 to 20 percent.

Cruze Series

The Cruze series consists of deep, moderately well drained, moderately slowly permeable or slowly permeable soils on upland ridgetops and hillsides. These soils formed in colluvium and residuum derived from shale and some siltstone. Slope ranges from 8 to 70 percent.

Cruze soils are similar to Guernsey soils and commonly are adjacent to Shelocta and Wellston soils. Guernsey soils are not so acid in the lower part as the Cruze soils. Shelocta and Wellston soils are well drained. Shelocta soils are in landscape positions similar to those of Cruze soils. Wellston soils are commonly on ridgetops.

Typical pedon of Cruze silt loam, in an area of Shelocta-Cruze silt loams, 15 to 25 percent slopes; about 2.5 miles northeast of Logan, in Green Township; about 2,200 feet east and 700 feet south of the northwest corner of sec. 36, T. 13 N., R. 16 W.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine and few coarse roots; 3 percent sandstone fragments; very strongly acid; clear smooth boundary.

BA—9 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium and fine subangular blocky structure; friable; common fine roots; 3 percent sandstone fragments; very strongly acid; clear smooth boundary.

Bt1—13 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct light brownish gray (10YR 6/2) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 10 percent sandstone fragments; very strongly acid; gradual smooth boundary.

Bt2—17 to 24 inches; yellowish brown (10YR 5/6) silty clay; common medium distinct light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 10 percent sandstone fragments; very strongly acid; gradual smooth boundary.

Bt3—24 to 35 inches; yellowish brown (10YR 5/4) and light brownish gray (10YR 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; firm; few medium roots; many distinct yellowish brown (10YR 5/4) clay films on vertical faces of peds; 10 percent sandstone fragments; extremely acid; gradual smooth boundary.

Bt4—35 to 45 inches; light brownish gray (10YR 6/2) and brown (10YR 5/3) silty clay loam; common fine prominent strong brown (7.5YR 5/8) mottles; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; very few fine roots; common distinct brown (10YR 5/3) clay films on faces of peds; 12 percent sandstone fragments; extremely acid; gradual smooth boundary.

BC—45 to 53 inches; light brownish gray (10YR 6/2) and brown (10YR 5/3) silty clay; many medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak very coarse subangular blocky structure; very few fine roots; platy rock structure evident in ped interiors; 10 percent sandstone fragments; extremely acid; abrupt wavy boundary.

Cr—53 to 80 inches; light brownish gray (10YR 6/2) and reddish yellow (7.5YR 6/8), weathered, soft clay shale.

The solum ranges from 36 to 56 inches in thickness. The depth to bedrock ranges from 48 to 70 inches.

The Ap horizon has value of 3 to 5 and chroma of 2 to 4. It is typically silt loam, but in some pedons it is silty clay loam. The upper part of the Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. The lower part has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. The Bt horizon is silty clay loam, silty clay, clay, or the channery analogs of those textures. The BC horizon has colors and textures similar to those in the lower part of the Bt horizon.

Dekalb Series

The Dekalb series consists of moderately deep, well drained, rapidly permeable soils formed in sandstone and siltstone residuum on upland hillsides. Slope ranges from 40 to 70 percent.

Dekalb soils are similar to Berks soils and commonly are adjacent to Cedarfalls and Shelocta soils. Berks soils have more silt in the subsoil than the Dekalb soils. Cedarfalls and Shelocta soils are deep to bedrock. Cedarfalls soils are below sandstone cliffs. Shelocta soils are on hillsides and ridgetops.

Typical pedon of Dekalb channery fine sandy loam, in an area of Dekalb-Shelocta-Rock outcrop complex, 40 to 70 percent slopes; about 2.5 miles southwest of South Bloomingville, in Salt Creek Township; about 2,050 feet north and 300 feet west of the southeast corner of sec. 25, T. 11 N., R. 19 W.

Oi—1 inch to 0; hardwood leaf litter.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) channery fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine and medium roots; 15 percent sandstone fragments; very strongly acid; abrupt smooth boundary.

Bw1—4 to 12 inches; yellowish brown (10YR 5/6) channery fine sandy loam; weak medium subangular blocky structure; friable; common fine and medium roots; about 25 percent coarse fragments of sandstone and quartzite; very strongly acid; clear smooth boundary.

Bw2—12 to 18 inches; yellowish brown (10YR 5/6) very channery fine sandy loam; weak fine subangular blocky structure; friable; few fine and medium roots; about 50 percent sandstone fragments; very strongly acid; clear smooth boundary.

Bw3—18 to 32 inches; yellowish brown (10YR 5/6) extremely channery fine sandy loam; weak medium subangular blocky structure; friable; few fine roots between sandstone fragments; about 45 percent sandstone channers; 25 percent sandstone flagstones; very strongly acid; abrupt smooth boundary.

R—32 to 35 inches; strong brown (7.5YR 5/6), hard, massive sandstone bedrock; some fractures about 1 foot apart in the upper part.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically channery fine sandy loam, but in some pedons it is gravelly loam or gravelly sandy loam. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. It is fine sandy loam, loam, or the gravelly, channery, very channery, extremely channery, very flaggy, or extremely flaggy analogs of those textures.

Euclid Series

The Euclid series consists of deep, somewhat poorly drained, moderately slowly permeable soils formed in stratified, silty sediments on low terraces. Slope is 0 to 2 percent.

Euclid soils commonly are adjacent to Chagrin and Glenford soils. The well drained Chagrin soils are on the highest parts of the adjacent flood plains. The moderately well drained Glenford soils are on the slightly higher terraces.

Typical pedon of Euclid silt loam, rarely flooded, about 1 mile northeast of Greendale, in Ward Township; about 1,670 feet west and 2,250 feet north of the southeast corner of sec. 36, T. 13 N., R. 15 W.

A1—0 to 2 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many fine and medium roots; strongly acid; clear smooth boundary.

A2—2 to 5 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure; friable; common fine and medium roots; thin brown (10YR 4/3) silt films and organic coatings on faces of peds;

strongly acid; clear smooth boundary.

Bg1—5 to 12 inches; grayish brown (10YR 5/2) silt loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few distinct grayish brown (10YR 5/2) coatings on faces of peds; strongly acid; abrupt smooth boundary.

Bg2—12 to 22 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct grayish brown (10YR 5/2) coatings on faces of peds; strongly acid; clear smooth boundary.

Bw—22 to 37 inches; variegated yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few faint grayish brown (10YR 5/2) coatings on faces of peds; many strong brown (7.5YR 5/6) iron stains; strongly acid; clear smooth boundary.

Cg—37 to 60 inches; grayish brown (10YR 5/2) silt loam; many fine prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; firm; thin strata of loam and silty clay loam; strongly acid.

The solum ranges from 37 to 51 inches in thickness. The A horizon has value of 4 or 5. The B horizon has value of 4 or 5 and chroma of 2 to 6. It is silt loam or silty clay loam. The clay content in this horizon ranges from 18 to 35 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is stratified silty clay loam, loam, or silt loam.

Glenford Series

The Glenford series consists of deep, moderately well drained, moderately slowly permeable soils on lacustrine terraces. These soils formed in stratified, silty glaciolacustrine sediments. Slope ranges from 0 to 6 percent.

Glenford soils are adjacent to Chagrin and Otwell soils. Chagrin soils are well drained and are on flood plains. Otwell soils have a fragipan. They are slightly higher on the terraces than the Glenford soils.

Typical pedon of Glenford silt loam, 2 to 6 percent slopes, about 3.5 miles southwest of Logan, in Falls Township; about 960 feet east and 1,540 feet north of the southwest corner of sec. 22, T. 14 N., R. 17 W.

Ap—0 to 7 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.

BE—7 to 13 inches; yellowish brown (10YR 5/6) silt loam; moderate medium and fine subangular blocky structure; friable; few faint yellowish brown (10YR 5/4) silt coatings on faces of peds; few fine roots; strongly acid; clear wavy boundary.

Bt1—13 to 20 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—20 to 31 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak medium platy structure parting to moderate medium subangular blocky; friable; few fine roots; common prominent brown (7.5YR 5/4) and light brownish gray (10YR 6/2) clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt3—31 to 44 inches; yellowish brown (10YR 5/6) silt loam; common medium prominent gray (10YR 6/1) mottles; weak medium platy structure parting to weak medium subangular blocky; friable; common distinct brown (7.5YR 5/4) and light brownish gray (10YR 6/2) clay films on vertical faces of peds; about 2 percent coarse fragments; strongly acid; gradual wavy boundary.

C—44 to 80 inches; yellowish brown (10YR 5/6) silt loam; few medium distinct light yellowish brown (2.5Y 6/4) mottles; massive; friable; about 2 percent coarse fragments in the upper part and 5 percent in the lower part; medium acid.

The solum ranges from 30 to 44 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silt loam or silty clay loam that has thin lenses of loam in some pedons. The C horizon has hue of 10YR or 7.5YR and chroma of 2 to 6. It is 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 upland ridgetops and hillsides. These soils formed in loess and in the underlying material weathered from shale and some siltstone. Slope ranges from 8 to 70 percent.

Guernsey soils are similar to Cruze soils and commonly are adjacent to Wellston, Westmore, and

Westmoreland soils. Cruze soils are more acid in the lower part than the Guernsey soils. Wellston, Westmore, and Westmoreland soils are well drained. Wellston soils are on the higher parts of ridgetops. Westmore soils are on the broader parts of ridgetops. Westmoreland soils are on hillsides and in saddles on ridgetops.

Typical pedon of Guernsey silt loam, 8 to 15 percent slopes, about 2.75 miles east of Starr, in Starr Township; about 100 feet north and 400 feet west of the southeast corner of sec. 8, T. 12 N., R. 16 W.

Oi—2 inches to 0; hardwood leaf litter.

Ap—0 to 4 inches; yellowish brown (10YR 5/4) silt loam; weak thin platy structure parting to weak very fine granular; friable; common fine roots; very strongly acid; abrupt smooth boundary.

BE—4 to 9 inches; strong brown (7.5YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few fine roots; very strongly acid; clear smooth boundary.

Bt1—9 to 16 inches; strong brown (7.5YR 5/6) silt loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct strong brown (7.5YR 5/6) clay films on vertical faces of peds; strongly acid; clear smooth boundary.

Bt2—16 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium and fine subangular blocky structure; firm; very few fine roots; many distinct light brownish gray (10YR 6/2) clay films on faces of peds; few fine distinct black (10YR 2/1) concretions and stains; strongly acid; clear smooth boundary.

2Bt3—23 to 30 inches; yellowish brown (10YR 5/4) silty clay; few fine distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; very few fine roots; many prominent dark grayish brown (10YR 4/2) clay films on faces of peds; few fine distinct black (10YR 2/1) concretions and stains; about 5 percent siltstone fragments; strongly acid; gradual smooth boundary.

2Bt4—30 to 39 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct grayish brown (10YR 5/2) and many medium distinct brown (7.5YR 5/4) mottles; weak coarse prismatic structure parting to moderate medium subangular; firm; very few fine roots; many distinct brown (10YR 5/3) clay films on faces of peds; few fine distinct black (10YR 2/1) concretions and stains; about 2 percent shale fragments; strongly acid; abrupt smooth boundary.

2C—39 to 51 inches; about 50 percent variegated grayish brown (10YR 5/2) and 50 percent yellowish brown (10YR 5/4) silty clay; weak thick platy structure; very firm; very few fine roots; few fine distinct black (10YR 2/1) concretions and stains; about 10 percent shale and siltstone fragments; strongly acid; abrupt smooth boundary.

2Cr—51 to 80 inches; gray (10YR 6/1), weathered shale and strong brown (7.5YR 5/6), weathered siltstone; very firm; cuts with a spade; very strongly acid.

The solum ranges from 32 to 54 inches in thickness.The depth to bedrock ranges from 50 to 80 inches.

The Ap horizon has value of 3 to 5 and chroma 2 to 4. It is typically silt loam, but in some pedons it is silty clay loam. The Bt horizon has value of 4 to 6 and chroma of 3 to 6. It is silt loam or silty clay loam. The 2Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silty clay loam, silty clay, clay, or the channery or shaly analogs of those textures. The 2C horizon has colors and textures similar to those of the 2Bt horizon.

Hickory Series

The Hickory series consists of deep, well drained, moderately permeable soils formed in Illinoian glacial till on hillsides on the dissected parts of till plains. Slope ranges from 12 to 40 percent.

Hickory soils are similar to Alexandria soils and commonly are adjacent to Alford and Cincinnati soils. Alexandria soils have more clay in the subsoil than the Hickory soils. Alford soils have more silt in the subsoil than the Hickory soils. They are on terraces and broad upland ridges. Cincinnati soils have a fragipan. They are on broad glaciated ridges in the uplands.

Typical pedon of Hickory silt loam, 12 to 18 percent slopes, eroded, about 5.5 miles north-northeast of Laurelville, in Perry Township; about 365 feet west and 1,780 feet north of the center of sec. 5, T. 12 N., R. 19 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common roots; about 5 percent yellowish brown (10YR 5/6) subsoil material mixed throughout; 4 percent coarse fragments; neutral; abrupt smooth boundary.

Bt1—7 to 13 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; common roots; few faint brown

(10YR 4/3) silt coatings on vertical faces of peds; 4 percent coarse fragments; medium acid; gradual wavy boundary.

Bt2—13 to 22 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; 8 percent coarse fragments; medium acid; clear wavy boundary.

Bt3—22 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 10 percent coarse fragments; neutral; gradual wavy boundary.

BC—35 to 45 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few roots; few faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay films on vertical faces of peds; 10 percent coarse fragments; slight effervescence in some zones in the lower part; neutral; gradual wavy boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 40 to 50 inches in thickness. The content of coarse fragments ranges from 0 to 15 percent in the A horizon and in the upper part of the Bt horizon and from 0 to 20 percent in the lower part of the Bt horizon and in the C horizon.

The Ap horizon has value of 4 or 5 and chroma of 3 or 4. It is commonly silt loam, but in some pedons it is clay loam or silty clay loam. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 to 6. It is loam or clay loam in the upper part and loam, clay loam, or the gravelly analogs of those textures in the lower part. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam, loam, or the gravelly analogs of those textures.

Licking Series

The Licking series consists of deep, moderately well drained, slowly permeable soils on lacustrine terraces. These soils formed in loess and in the underlying clayey lakebed sediments. Slope ranges from 2 to 18 percent.

Licking soils are commonly adjacent to Chagrin and Euclid soils. The well drained Chagrin soils are on flood plains. The somewhat poorly drained Euclid soils are on the lower terraces and are subject to rare flooding.

Typical pedon of Licking silt loam, 2 to 6 percent slopes, about 1 mile southwest of Logan, in Falls Township; about 2,350 feet north and 2,150 feet east of the southwest corner of sec. 14, T. 14 N., R. 17 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

Bt1—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; firm; few fine roots; few faint yellowish brown (10YR 5/4) clay films on vertical faces of peds; pale brown (10YR 6/3) streaks between peds; medium acid; clear smooth boundary.

Bt2—13 to 20 inches; brown (10YR 5/3) silty clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct yellowish brown (10YR 5/4) clay films and brown (10YR 5/3) silt coatings on faces of peds; strong brown (7.5YR 5/8) stains; strongly acid; clear smooth boundary.

2Bt3—20 to 38 inches; yellowish brown (10YR 5/6) silty clay; many medium prominent grayish brown (10YR 5/2) mottles; weak coarse and medium subangular blocky structure; firm; few fine roots; yellowish brown (10YR 5/6) clay films on vertical faces of peds; common distinct silt coatings in the upper part; few strong brown (7.5YR 5/8) iron and manganese stains; medium acid; clear smooth boundary.

2BC—38 to 66 inches; yellowish brown (10YR 5/6) silty clay; many coarse prominent grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; firm; some bedding planes; firm; slightly acid; gradual smooth boundary.

2C—66 to 80 inches; brown (10YR 5/3) silty clay; many coarse faint yellowish brown (10YR 5/4) mottles; massive; firm; some bedding planes; slightly acid.

The solum ranges from 36 to 66 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The Bt and 2Bt horizons have value of 4 or 5 and chroma of 3 to 6. The Bt horizon is silt loam or silty clay loam. The 2Bt horizon is silty clay or clay. The 2C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 3 to 6. It is dominantly silty clay or clay. In some pedons, however, it has thin strata of other textures.

Lily Series

The Lily series consists of moderately deep, well drained, moderately rapidly permeable soils on upland ridgetops and hillsides. These soils formed in loess and in the underlying sandstone residuum. Slope ranges from 8 to 25 percent.

Lily soils commonly are adjacent to Cedarfalls, Dekalb, Shelocta, and Wellston soils. Cedarfalls, Shelocta, and Wellston soils are deep to bedrock. Cedarfalls soils are on very steep colluvial slopes below sandstone ledges. Shelocta soils are on upland ridgetops and hillsides. Wellston soils are mainly on upland ridgetops. Dekalb soils have a higher content of coarse fragments and less clay throughout than the Lily soils. They are on upland hillsides.

Typical pedon of Lily silt loam, 15 to 25 percent slopes, about 3 miles north of South Perry, in Perry Township; about 900 feet west and 300 feet north of the southeast corner of sec. 3, T. 12 N., R. 19 W.

A—0 to 2 inches; brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; many fine roots; many distinct very dark grayish brown (10YR 3/2) stains on faces of peds; about 2 percent sandstone fragments; very strongly acid; abrupt smooth boundary.

E—2 to 8 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine and medium roots; about 10 percent sandstone fragments; very strongly acid; gradual smooth boundary.

Bt1—8 to 17 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; few fine and medium roots; common faint yellowish brown (10YR 5/6) clay films on faces of peds; about 10 percent sandstone fragments; strongly acid; clear smooth boundary.

2Bt2—17 to 27 inches; strong brown (7.5YR 5/6) sandy clay loam; moderate medium angular blocky structure; firm; few fine roots; common distinct reddish brown (5YR 5/4) clay films on faces of peds; about 10 percent sandstone fragments; very strongly acid; clear smooth boundary.

2C—27 to 31 inches; yellowish brown (10YR 5/8) gravelly sandy loam; single grained; friable; about 25 percent weathered sandstone fragments; strongly acid; abrupt smooth boundary.

2R—31 to 35 inches; strong brown (7.5YR 5/6) sandstone bedrock; hard; massive; cannot be cut with a spade.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The A horizon has value of 3 or 4 and chroma of 2 to 4. It is typically silt loam, but in some pedons it is loam. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is silt loam, loam, or silty clay loam in the upper part and clay loam, sandy clay loam, or the channery analogs of those textures in the lower part.

McGary Series

The McGary series consists of deep, somewhat poorly drained, slowly permeable or very slowly permeable soils formed in lakebed sediments on lacustrine terraces. Slope ranges from 0 to 3 percent.

McGary soils are commonly adjacent to Chili, Glenford, and Licking soils. The well drained Chili soils are on the higher outwash terraces. The moderately well drained Glenford and Licking soils are on the slightly higher terraces.

Typical pedon of McGary silt loam, 0 to 3 percent slopes, about 1 mile west of South Perry, in Perry Township; about 1,900 feet west and 1,400 feet north of the southeast corner of sec. 21, T. 12 N., R. 19 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) silt loam, very pale brown (10YR 7/3) dry; moderate fine and medium granular structure; friable; few fine roots; few fine very dark grayish brown (10YR 3/2) iron and manganese concretions; neutral; abrupt smooth boundary.

Bt1—9 to 15 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate medium distinct light olive gray (5Y 6/2) and yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure parting to moderate medium and fine subangular blocky; firm; few fine roots; many distinct grayish brown (10YR 5/2) and brown (10YR 5/3) clay films on faces of peds; few fine prominent very dark brown (10YR 2/2) iron and manganese concretions; neutral; clear smooth boundary.

Bt2—15 to 21 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) silty clay loam; common medium faint light brownish gray (10YR 6/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; very few fine roots; many distinct light brownish gray (10YR 6/2) clay films on faces of peds; neutral; clear smooth boundary.

Bt3—21 to 27 inches; grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silty clay; common fine prominent strong brown (7.5YR 5/6) and few fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; very few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine prominent very dark brown (10YR 2/2) iron and manganese accumulations; mildly alkaline; abrupt smooth boundary.

Bt4—27 to 33 inches; light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) silty clay; weak coarse subangular blocky structure parting to moderate medium and fine subangular blocky; very firm; very few fine roots; many distinct grayish brown (2.5Y 5/2) clay films on faces of peds; few light brownish gray (10YR 6/2) streaks and fillings in old root channels; few fine prominent very dark brown (10YR 2/2) iron and manganese stains and accumulations; mildly alkaline; clear smooth boundary.

Bt5—33 to 44 inches; light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) silty clay; moderate medium and coarse subangular blocky structure; very firm; common distinct grayish brown (2.5Y 5/2) clay films on faces of peds; few fine prominent light brownish gray (10YR 6/2) streaks; thin strata of loam; common fine prominent very dark brown (10YR 2/2) iron and manganese stains; few pockets with slight effervescence; mildly alkaline; gradual smooth boundary.

Cg—44 to 80 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct light olive brown (2.5Y 5/6) mottles; massive; very firm; thin strata of silt loam and loam; few fine prominent very dark brown (10YR 2/2) soft accumulations (iron and manganese oxide); strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 44 inches. The depth to carbonates ranges from 20 to 40 inches.

The Ap horizon has value of 4 or 5. It is typically silt loam, but in some pedons it is silty clay loam. The Bt horizon has value of 4 to 6 and chroma of 2 to 4. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is silty clay loam or silty clay.

Melvin Series

The Melvin series consists of deep, poorly drained, moderately permeable soils formed in alluvium in the lowest positions on flood plains. Slope is 0 to 2 percent.

Melvin soils commonly are adjacent to the well drained Chagrin and somewhat poorly drained Orrville soils in the slightly higher positions on the flood plains.

Typical pedon of Melvin silt loam, frequently flooded, about 6.75 miles north-northwest of Logan, in Marion Township; 900 feet east and 1,590 feet south of the northwest corner of sec. 10, T. 15 N., R. 17 W.

Ap—0 to 10 inches; dark grayish brown (2.5Y 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

Bg—10 to 20 inches; gray (5Y 5/1) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; many medium prominent dark brown (7.5YR 4/4) iron stains; dark gray (N 4/0) horizontal streaks; medium acid; gradual smooth boundary.

Cg—20 to 60 inches; gray (5Y 5/1) silt loam; many coarse prominent yellowish brown (10YR 5/6) mottles; massive; firm; few fine dark brown (7.5YR 4/4) iron stains; medium acid.

The thickness of the solum ranges from 20 to 30 inches. The Ap horizon has value of 4 to 6 and chroma of 1 to 3. It is typically silt loam, but in some pedons it is loam. The B and C horizons have hue of 10YR to 5Y or are neutral in hue. They have value of 4 to 7 and chroma of 0 to 2. They are silt loam or silty clay loam.

Negley Series

The Negley series consists of deep, well drained, moderately permeable or moderately rapidly permeable soils formed in glacial outwash on terraces. Slope ranges from 8 to 70 percent.

Negley soils are similar to Allegheny and Chili soils and commonly are adjacent to Chagrin, Licking, and Otwell soils. Allegheny and Chili soils have a subsoil that is thinner than that of the Negley soils. Chagrin soils have less clay movement in the subsoil than the Negley soils. They are on flood plains. Licking soils have a higher clay content throughout than the Negley soils. They are on the lower lacustrine terraces. Otwell soils have a fragipan. They are on the slightly higher terraces.

Typical pedon of Negley silt loam, 40 to 70 percent slopes, about 0.25 mile east-northeast of Enterprise, in Falls Township; about 1,800 feet east and 2,200 feet south of the northwest corner of sec. 5, T. 14 N., R. 17 W.

A—0 to 4 inches; brown (7.5YR 4/4) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

BE—4 to 8 inches; brown (7.5YR 5/4) silt loam; weak fine and very fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; strongly acid; clear smooth boundary.

Bt1—8 to 20 inches; strong brown (7.5YR 5/6) clay loam; weak coarse subangular blocky structure parting to moderate fine angular blocky; firm; few fine roots; common distinct brown (7.5YR 4/4) clay films on faces of peds; 10 percent gravel; strongly acid; clear smooth boundary.

Bt2—20 to 28 inches; brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; common distinct brown (7.5YR 4/4) clay films on faces of peds; brown (10YR 5/3) variegations; 30 percent gravel; strongly acid; clear smooth boundary.

Bt3—28 to 43 inches; brown (7.5YR 5/4) gravelly clay loam; moderate medium subangular blocky structure; firm; few distinct brown (7.5YR 4/4) clay films on faces of peds; brown (10YR 5/3) variegations; 20 percent gravel; medium acid; clear wavy boundary.

Bt4—43 to 68 inches; yellowish red (5YR 5/6) gravelly clay loam; moderate coarse subangular blocky structure; firm; many distinct yellowish red (5YR 5/6) clay films on faces of peds; 30 percent gravel; strongly acid; gradual smooth boundary.

Bt5—68 to 80 inches; brown (7.5YR 4/4) gravelly clay loam; moderate coarse subangular blocky structure; firm; common distinct brown (7.5YR 4/4) clay films on faces of peds; 30 percent gravel; strongly acid.

The A horizon has hue of 10YR or 7.5YR, value of 2 to 5, and chroma of 2 to 4. It is typically silt loam, but in some pedons it is loam, gravelly loam, or gravelly silt loam. The Bt horizon has hue of 7.5YR or 5YR. It is dominantly loam, clay loam, sandy clay loam, or the gravelly or very gravelly analogs of those textures. In some pedons, however, it has thin subhorizons of sandy loam. The content of coarse fragments in this horizon ranges from 5 to 35 percent.

Orrville Series

The Orrville series consists of deep, somewhat poorly drained, moderately permeable soils formed in alluvium on flood plains. Slope is 0 to 2 percent.

Orrville soils commonly are adjacent to Chagrin and Melvin soils. The well drained Chagrin soils are on the slightly higher parts of the flood plains. The poorly drained Melvin soils are in the lowest positions on the flood plains.

Typical pedon of Orrville silt loam, frequently flooded, about 2 miles southeast of Maysville, in Green Township; about 4,400 feet south and 700 feet east of the northwest corner of sec. 5, T. 13 N., R. 16 W.

Ap1—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; strongly acid; clear smooth boundary.

Ap2—7 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; common fine faint dark gray (10YR 4/1) mottles; weak medium subangular blocky structure parting to moderate medium granular; friable; common fine roots; thin patchy dark grayish brown (10YR 4/2) silt coatings on vertical faces of peds; strongly acid; clear smooth boundary.

Bw—10 to 18 inches; brown (10YR 5/3) silt loam; common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; few faint grayish brown (10YR 5/2) silt coatings on faces of peds; strongly acid; gradual smooth boundary.

Bg1—18 to 32 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct yellowish brown (10YR 5/4) and few fine prominent yellowish red (5YR 4/6) mottles; moderate medium and coarse subangular blocky structure; friable; very few fine roots; few faint grayish brown (10YR 5/2) silt coatings on faces of peds; few fine dark iron and manganese oxide concretions and stains; few thin strata of loam; about 2 percent sandstone gravel; strongly acid; gradual smooth boundary.

Bg2—32 to 43 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak coarse and medium subangular blocky structure; friable; few fine dark iron and manganese oxide concretions and stains; thin strata of loam; about 1 percent sandstone gravel; strongly acid; gradual smooth boundary.

Cg1—43 to 60 inches; gray (10YR 6/1) loam; many coarse prominent yellowish red (5YR 4/6) mottles; massive; friable; strongly acid; clear smooth boundary.

Cg2—60 to 80 inches; dark gray (N 4/0) silt loam; many coarse prominent yellowish red (5YR 4/6) mottles; massive; friable; strongly acid.

The solum ranges from 35 to 43 inches in thickness. The Ap horizon has value of 3 or 4. It is typically silt loam but in some pedons is loam. The B horizon has chroma of 2 to 6. It is typically silt loam, but most pedons have strata of loam or sandy loam. The C horizon has chroma of 0 to 6. It is loam, sandy loam, or silt loam within a depth of 40 inches and loam, sandy loam, silt loam, or the gravelly analogs of those textures below that depth.

Otwell Series

The Otwell series consists of deep, well drained and moderately well drained, very slowly permeable soils on terraces. These soils formed dominantly in loess and the underlying lacustrine deposits. In some areas, however, the lower part of the soils formed in outwash deposits. Slope ranges from 2 to 18 percent.

Otwell soils are similar to Cincinnati and Zanesville soils and commonly are adjacent to Chagrin, Cruze, and Shelocta soils. Cincinnati and Zanesville soils do not have lacustrine or outwash sediments in the lower part. Chagrin, Cruze, and Shelocta soils do not have a fragipan. Chagrin soils are on flood plains. Cruze and Shelocta soils are on hillsides and ridgetops in the uplands.

Typical pedon of Otwell silt loam, 2 to 6 percent slopes, about 1.5 miles southeast of Monday, in Ward Township; about 600 feet north and 1,700 feet east of the southwest corner of sec. 7, T. 13 N., R. 15 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 17 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; common fine roots; few faint yellowish brown (10YR 5/6) clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—17 to 26 inches; yellowish brown (10YR 5/6) silty clay loam; common medium faint yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct brownish yellow (10YR 6/6) clay films on faces of peds; few black (10YR 2/1) iron and manganese concretions; very strongly acid; clear smooth boundary.

Btx1—26 to 38 inches; yellowish brown (10YR 5/6) silty clay loam; many medium prominent grayish brown (10YR 5/2) mottles; moderate very coarse prismatic structure; very firm; brittle; few fine roots between prisms; many prominent grayish brown (10YR 5/2) clay films on faces of prisms; very few black (10YR 2/1) iron and manganese concretions and stains; strongly acid; gradual smooth boundary.

Btx2—38 to 60 inches; yellowish brown (10YR 5/6) silty clay loam; common medium prominent grayish brown (10YR 5/2) mottles; moderate very coarse prismatic structure; very firm; brittle; many prominent grayish brown (10YR 5/2) clay films on faces of prisms; very few black (10YR 2/1) iron and manganese concretions; strongly acid; gradual smooth boundary.

2BC—60 to 72 inches; yellowish brown (10YR 5/6) silty clay loam; common medium prominent grayish brown (10YR 5/2) mottles; weak very coarse prismatic structure parting to weak coarse subangular blocky; firm; very few faint yellowish brown (10YR 5/4) clay films on vertical faces of peds; few black (10YR 2/1) iron and manganese concretions; about 5 percent coarse fragments of sandstone; medium acid; gradual smooth boundary.

2C—72 to 90 inches; yellowish brown (10YR 5/6) silty clay loam; many medium prominent gray (10YR 6/1) and many medium faint yellowish brown (10YR 5/8) mottles; massive; firm; about 20 percent dark reddish brown (5YR 3/2) iron and manganese concretions; about 5 percent weathered sandstone fragments; mildly alkaline.

The solum ranges from 33 to 70 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 to 8. The Btx horizon has value of 4 to 6 and chroma of 3 to 6. It is silt loam or silty clay loam. The 2BC and 2C horizons have value of 4 to 6 and chroma of 2 to 6. The 2C horizon ranges from clay to gravelly sandy loam.

Pope Series

The Pope series consists of deep, well drained, moderately permeable or moderately rapidly permeable soils formed in alluvium on flood plains. Slope is 0 to 2 percent.

Pope soils are similar to Chagrin soils and commonly are adjacent to Chagrin, Glenford, and Orrville soils. Chagrin soils have more clay in the subsoil than the Pope soils. The moderately well drained Glenford soils are on terraces. The somewhat poorly drained Orrville soils are in the lower positions on flood plains.

Typical pedon of Pope loam, occasionally flooded, about 0.75 mile northeast of South Bloomingville, in Benton Township; about 2,200 feet south and 850 feet east of the northwest corner of sec. 16, T. 11 N., R. 18 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine roots; strongly acid; clear smooth boundary.

Bw1—8 to 17 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; pockets of brown (10YR 4/3) silt loam; very strongly acid; gradual smooth boundary.

Bw2—17 to 26 inches; dark yellowish brown (10YR 4/4), stratified loam and silt loam; weak coarse and medium subangular blocky structure; friable; few fine roots; very strongly acid; gradual smooth boundary.

Bw3—26 to 37 inches; dark yellowish brown (10YR 4/4), stratified loam and silt loam; weak coarse subangular blocky structure; friable; very strongly acid; gradual smooth boundary.

C1—37 to 46 inches; yellowish brown (10YR 5/4), stratified sandy loam and loam; massive; very friable; few fine black (10YR 2/1) iron and manganese stains; strongly acid; abrupt smooth boundary.

C2—46 to 80 inches; dark yellowish brown (10YR 4/4) very gravelly loamy sand; single grained; loose; about 40 percent quartzite and sandstone gravel and 10 percent sandstone channers; strongly acid.

The solum ranges from 30 to 50 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 to 4. It is typically loam, but in some pedons it is sandy loam or silt loam. The Bw horizon has value of 4 or 5 and chroma of 4 to 6. It is loam, silt loam, sandy loam, or the gravelly analogs of those textures. The C horizon has colors similar to those of the Bw horizon. It is sandy loam, loam, loamy sand, or the gravelly or very gravelly analogs of those textures.

Shelocta Series

The Shelocta series consists of deep, well drained, moderately permeable soils on upland hillsides and ridgetops. These soils formed in colluvium and residuum derived from sandstone, siltstone, and shale. Slope ranges from 8 to 70 percent.

Shelocta soils are similar to Westmoreland soils and are commonly adjacent to Berks, Cruze, and Dekalb soils. The moderately deep Berks and Dekalb soils are on upland hillsides. The moderately well drained Cruze soils are on upland ridgetops and hillside benches. The base saturation directly above bedrock is higher in Westmoreland soils than in the Shelocta soils.

Typical pedon of Shelocta silt loam, in an area of Shelocta-Berks complex, 25 to 40 percent slopes, about 0.25 mile east of Cedar Falls, in Benton Township; about 2,600 feet west and 600 feet north of the southeast corner of sec. 13, T. 11 N., R. 18 W.

Oi—2 inches to 0; leaf litter of pine needles and oak leaves.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; mixed organic material and silt loam at the interface of the O and A horizons; 10 percent siltstone fragments; very strongly acid; abrupt smooth boundary.

E—1 to 5 inches; pale brown (10YR 6/3) silt loam; weak thin platy structure; friable; common fine and medium roots; 10 percent siltstone fragments; very strongly acid; clear smooth boundary.

BE—5 to 10 inches; yellowish brown (10YR 5/4) gravelly silt loam; moderate medium subangular blocky structure; firm; many medium and few fine roots; many faint pale brown (10YR 6/3) clay films on faces of peds; 15 percent siltstone fragments; very strongly acid; clear smooth boundary.

Bt1—10 to 17 inches; brown (7.5YR 5/4) channery silt loam; moderate medium and fine subangular blocky structure; firm; few fine and medium roots; common faint brown (7.5YR 5/4) clay films on faces of peds; 25 percent siltstone fragments; very strongly acid; clear smooth boundary.

Bt2—17 to 28 inches; brown (7.5YR 5/4) very channery silty clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; common faint brown (7.5YR 5/4) clay films on faces of peds; 40 percent siltstone fragments; very strongly acid; abrupt smooth boundary.

Bt3—28 to 43 inches; strong brown (7.5YR 5/6) channery silty clay loam; common fine prominent reddish brown (5YR 5/4) and few fine prominent light brownish gray (2.5Y 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; many distinct brown (7.5YR 5/4) clay films on faces of peds; 15 percent siltstone fragments; very strongly acid; abrupt smooth boundary.

BC—43 to 55 inches; about 50 percent variegated strong brown (7.5YR 5/6) and 50 percent light brownish gray (2.5Y 6/2) extremely channery silty clay loam; few fine distinct reddish brown (5YR 5/4) mottles; weak fine and medium subangular blocky structure; firm; 60 percent siltstone fragments; very strongly acid; abrupt smooth boundary.

2R—55 to 60 inches; light brownish gray (2.5Y 6/2) siltstone bedrock; hard; massive.

The solum ranges from 37 to 60 inches in thickness. The depth to bedrock ranges from 48 to 72 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3. It is typically silt loam or channery silt loam, but in some pedons it is loam or channery loam. The E horizon has value of 5 or 6 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR and chroma of 4 to 8. It is silt loam, silty clay loam, or the gravelly, channery, or very channery analogs of those textures. The BC horizon has hue of 7.5YR to 2.5Y and chroma of 2 to 6. It is the channery, very channery, or extremely channery analogs of silt loam or silty clay loam. Some pedons have a C horizon. This horizon has hue of 7.5YR to 2.5Y, value of 5 or 6, and chroma of 2 to 6. It is very channery or extremely channery silty clay loam.

Stonelick Series

The Stonelick series consists of deep, well drained, moderately rapidly permeable soils formed in alluvium on flood plains. Slope is 0 to 2 percent.

Stonelick soils are commonly adjacent to Chili soils. Chili soils have more clay movement in the subsoil than the Stonelick soils. They are on outwash terraces.

Typical pedon of Stonelick loam, occasionally flooded, about 0.6 mile south-southeast of Laurelville, in Salt Creek Township; about 2,000 feet east and 1,600 feet south of northwest corner of sec. 6, T. 11 N., R. 19 W.

Ap—0 to 6 inches; dark yellowish brown (10YR 4/4) loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure parting to moderate medium granular; friable; many fine roots; thin patchy very dark grayish brown (10YR 3/2) organic coatings in the upper part; slight effervescence; mildly alkaline; gradual smooth boundary.

C1—6 to 22 inches; dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure parting to moderate medium granular; friable; common fine roots; thin strata of sandy loam; about 2 percent gravel; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—22 to 33 inches; yellowish brown (10YR 5/4) fine sandy loam; weak coarse subangular blocky structure parting to moderate medium granular; friable; thin strata of loam; slight effervescence; mildly alkaline; clear smooth boundary.

C3—33 to 66 inches; yellowish brown (10YR 5/4), stratified fine sandy loam and loamy fine sand; massive; very friable; slight effervescence; mildly alkaline.

The Ap horizon has value of 4 or 5 and chroma of 3 or 4. It is typically loam, but in some pedons it is silt loam. The C horizon has chroma of 3 or 4. It is loamy sand, sandy loam, fine sandy loam, loamy fine sand, loam, or silt loam.

Wellston Series

The Wellston series consists of deep, well drained, moderately permeable soils formed in loess and in the underlying siltstone and sandstone residuum. These soils are on upland ridgetops and on a few benches on hillsides. Slope ranges from 2 to 15 percent.

Wellston soils are similar to Alford and Westmore soils and commonly are adjacent to Cruze, Guernsey, and Zanesville soils. Alford soils have fewer coarse fragments in the lower part of the subsoil than the Wellston soils. Cruze and Guernsey soils are moderately well drained and are on upland ridgetops and hillsides. Westmore soils have more clay in the lower part of the subsoil than the Wellston soils. Zanesville soils have a fragipan. They are on the broader upland ridgetops.

Typical pedon of Wellston silt loam, 6 to 15 percent slopes, about 2 miles north of Logan, in Falls Township; about 200 feet south and 2,100 feet east of the northwest corner of sec. 2, T. 14 N., R. 17 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine and medium roots; about 1 percent siltstone fragments; strongly acid; abrupt smooth boundary.

Bt1—7 to 17 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and fine subangular blocky structure; firm; common fine roots; common faint dark yellowish brown (10YR 4/4) clay films on faces of peds; few faint brown (10YR 4/3) silt coatings on vertical faces of peds; medium acid; clear smooth boundary.

Bt2—17 to 28 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; common faint dark brown (7.5YR 4/4) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—28 to 34 inches; strong brown (7.5YR 5/6) silt loam; moderate medium and fine subangular blocky structure; firm; common distinct dark brown (7.5YR 4/4) clay films on faces of peds; few very dark brown (10YR 2/2) concretions (iron and manganese oxide); strongly acid; gradual smooth boundary.

2BC—34 to 45 inches; yellowish brown (10YR 5/4) channery loam; moderate medium platy structure parting to moderate very fine subangular blocky; firm; few distinct dark yellowish brown (10YR 4/4) clay films on coarse fragments; few very dark brown (10YR 2/2) concretions (iron and manganese oxide); about 15 percent sandstone and siltstone fragments; very strongly acid; clear smooth boundary.

2C1—45 to 52 inches; yellowish brown (10YR 5/4) very channery loam; massive; friable; about 55 percent sandstone fragments; very strongly acid; clear smooth boundary.

2C2—52 to 70 inches; yellowish brown (10YR 5/4) extremely channery loam; massive; friable; about 85 percent strong brown (7.5YR 5/6) sandstone and light olive brown (2.5Y 5/6) siltstone fragments; very strongly acid; clear smooth boundary.

2R—70 to 72 inches; strong brown (7.5YR 5/6) and light olive brown (2.5Y 5/6), thinly bedded sandstone and siltstone bedrock.

The solum ranges from 32 to 50 inches in thickness. The depth to bedrock ranges from 40 to 72 inches. The loess mantle ranges from 5 to 40 inches in thickness.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has chroma of 3 to 6. The 2BC horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, silt loam, silty clay loam, or the gravelly or channery analogs of those textures. The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is silt loam, loam, sandy loam, or the gravelly, very gravelly, channery, very channery, or extremely channery analogs of those textures.

Westmore Series

The Westmore series consists of deep, well drained soils formed in loess and in the underlying material weathered from interbedded shale and siltstone. These soils are on upland ridgetops and benches. Permeability is moderate in the upper part of the profile and slow or moderately slow in the lower part. Slope ranges from 2 to 15 percent.

Westmore soils are similar to Alford and Wellston soils and commonly are adjacent to Cruze, Guernsey, and Zanesville soils. Alford and Wellston soils have less clay in the lower part of the subsoil than the Westmore soils. Cruze and Guernsey soils are moderately well drained and are on upland ridgetops and hillside benches. Zanesville soils have a fragipan. They are on broad upland ridgetops.

Typical pedon of Westmore silt loam, 2 to 6 percent slopes, about 2 miles southwest of Murray City, in Ward Township; about 550 feet west and 2,100 feet south of the northeast corner of sec. 8, T. 13 N., R. 15 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; many fine and medium roots; strongly acid; abrupt smooth boundary.

E—2 to 8 inches; yellowish brown (10YR 5/4) silt loam; moderate thin platy structure; friable; many medium roots; strongly acid; clear smooth boundary.

Bt1—8 to 22 inches; yellowish brown (10YR 5/6) silt loam; moderate medium and fine angular and subangular blocky structure; firm; common fine roots; common distinct strong brown (7.5YR 5/6) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2—22 to 27 inches; about 70 percent variegated yellowish brown (10YR 5/6) and 30 percent brownish yellow (10YR 6/6) silt loam; moderate fine subangular blocky structure; firm; few fine roots; many distinct strong brown (7.5YR 5/6) clay films on faces of peds; strongly acid; abrupt smooth boundary.

2Bt3—27 to 37 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct pale brown (10YR 6/3) and few fine prominent light olive brown (2.5Y 5/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common distinct pale brown (10YR 6/3) clay films on faces of peds; about 10 percent sandstone and fine grained sandstone fragments; strongly acid; gradual wavy boundary.

2Bt4—37 to 50 inches; yellowish brown (10YR 5/6) silty clay; common medium distinct light olive brown (2.5Y 5/6) mottles; moderate coarse prismatic structure parting to moderate fine and medium angular blocky; firm; many prominent pale brown (10YR 6/3) and brown (10YR 4/3) clay films on faces of peds; about 5 percent sandstone fragments; medium acid; clear smooth boundary.

2Cr1—50 to 53 inches; yellowish brown (10YR 5/4) and dark brown (7.5YR 4/4), weathered, fine grained sandstone; massive; firm; can be cut with a spade.

2Cr2—53 to 57 inches; light olive brown (2.5Y 5/6) and gray (10YR 6/1), weathered shale bedrock; soft; can be cut with a spade.

2R—57 to 60 inches; yellowish red (5YR 4/6) sandstone bedrock; hard; massive; cannot be cut with a spade.

The solum ranges from 40 to 60 inches in thickness. The loess ranges from 20 to 36 inches in thickness. The depth to bedrock is more than 48 inches.

The A horizon has value of 2 to 4 and chroma of 1 to 3. The E horizon has value of 4 or 5 and chroma of 2 to 4. 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 or silty clay loam. The 2Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. It is silty clay loam, silty clay, clay, or the channery analogs of those textures.

Westmoreland Series

The Westmoreland series consists of deep, well drained, moderately permeable soils formed in colluvium and residuum derived from siltstone, sandstone, and shale on upland ridgetops and hillsides. Slope ranges from 15 to 70 percent.

Westmoreland soils are similar to Shelocta soils and are commonly adjacent to Berks, Guernsey, Wellston, and Zanesville soils. The moderately deep Berks soils are on upland hillsides. The moderately well drained Guernsey soils are on upland ridgetops and hillside benches. The base saturation directly above bedrock is lower in Shelocta soils than in the Westmoreland soils. Wellston soils have more silt in the upper part of the subsoil than the Westmoreland soils. They are commonly on ridgetops. Zanesville soils have a fragipan. They are on broad upland ridgetops.

Typical pedon of Westmoreland silt loam, in an area of Westmoreland-Guernsey silt loams, 25 to 40 percent slopes; about 2 miles southeast of Murray City, in Ward Township; about 2,100 feet north and 100 feet east of the southwest corner of sec. 2, T. 13 N., R. 15 W.

Oi—1 inch to 0; hardwood leaf litter.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; 5 percent siltstone fragments; strongly acid; abrupt smooth boundary.

BE—3 to 7 inches; brown (7.5YR 5/4) silt loam; moderate medium and fine subangular blocky structure; friable; common fine and few medium roots; few faint yellowish brown (10YR 5/4) silt coatings on faces of peds; 3 percent siltstone fragments; strongly acid; clear smooth boundary.

Bt1—7 to 12 inches; brown (7.5YR 5/4) silt loam; moderate medium subangular blocky structure; friable; few fine roots; few faint strong brown (7.5YR 5/6) clay films on faces of peds; 10 percent siltstone fragments; strongly acid; clear smooth boundary.

Bt2—12 to 16 inches; brown (7.5YR 5/4) channery silty clay loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; 15 percent siltstone fragments; strongly acid; clear smooth boundary.

Bt3—16 to 21 inches; yellowish brown (10YR 5/4) channery silty clay loam; moderate medium and fine subangular blocky structure; friable; few fine roots; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 15 percent siltstone fragments; strongly acid; clear smooth boundary.

Bt4—21 to 29 inches; yellowish brown (10YR 5/4) channery silty clay loam; few fine faint light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; very few fine roots; many distinct yellowish brown (10YR 5/4) clay films on faces of peds; 20 percent siltstone fragments; very strongly acid; clear smooth boundary.

BC—29 to 36 inches; yellowish brown (10YR 5/4) very channery silty clay loam; few fine faint light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few faint yellowish brown (10YR 5/4) clay films on faces of peds; 45 percent siltstone fragments; very strongly acid; clear smooth boundary.

C—36 to 43 inches; yellowish brown (10YR 5/4) very channery silty clay loam; few coarse faint light olive brown (2.5Y 5/4) mottles; massive; firm; 45 percent siltstone fragments; strongly acid; abrupt smooth boundary.

R—43 to 50 inches; light olive brown (2.5Y 5/4) sandstone and siltstone; about 5 percent fine-earth material in vertical fractures.

The solum ranges from 24 to 40 inches in thickness. The depth to bedrock ranges from 40 to 52 inches.

Some pedons have an Ap horizon, which has hue of 10YR, value of 4, and chroma of 3 or 4. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is silty clay loam, loam, clay loam, silt loam, or the channery or very channery analogs of those textures. The C horizon has colors similar to those of the Bt horizon. It is very channery or extremely channery silty clay loam, loam, clay loam, or silt loam. The R horizon consists of interbedded layers of siltstone, sandstone, or shale.

Wheeling Series

The Wheeling series consists of deep, well drained soils formed in silty alluvium and in the underlying glacial outwash. These soils are on outwash terraces. Permeability is moderate in the solum and rapid in the underlying material. Slope ranges from 0 to 3 percent.

These soils have more silt in the upper part of the subsoil and are more acid throughout the subsoil than is definitive for the Wheeling series. These differences, however, do not alter the use or behavior of the soils.

Wheeling soils commonly are adjacent to Chagrin, Euclid, and Glenford soils. Chagrin soils have less clay movement in the subsoil than the Wheeling soils. They are on flood plains. The somewhat poorly drained Euclid soils are in swales and other low-lying areas on low terraces. The moderately well drained Glenford soils are on lacustrine terraces.

Typical pedon of Wheeling silt loam, 0 to 3 percent slopes, about 1 mile north of Haydenville, in Green Township; about 1,600 feet north and 1,050 feet east of the southwest corner of sec. 14, T. 13 N., R. 16 W.

Ap—0 to 5 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; moderate medium granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

Bt1—5 to 10 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; common fine roots; few faint brown (10YR 5/3) silt coatings on faces of peds; common faint dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; few fine distinct black (10YR 2/1) iron and manganese stains; strongly acid; clear smooth boundary.

Bt2—10 to 18 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct brown (10YR 5/3) mottles; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; common fine roots; few faint brown (10YR 5/3) silt coatings on faces on peds; many faint dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine distinct very dark brown (10YR 2/2) iron and manganese stains; very strongly acid; clear smooth boundary.

Bt3—18 to 24 inches; yellowish brown (10YR 5/6) silty clay loam; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few fine roots; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt4—24 to 32 inches; yellowish brown (10YR 5/4) loam; weak coarse prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine distinct very dark brown (10YR 2/2) iron and manganese stains; very strongly acid; clear smooth boundary.

2Bt5—32 to 40 inches; brown (7.5YR 5/4) fine sandy loam; weak coarse and medium subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; few faint brown (10YR 5/3) silt coatings on faces of peds; common fine prominent very dark brown (10YR 2/2) iron and manganese stains; very strongly acid; clear smooth boundary.

2BC—40 to 46 inches; brown (7.5YR 4/4) fine sandy loam; weak very coarse subangular blocky structure; firm; very few fine roots; few faint dark yellowish brown (10YR 4/6) clay bridges in the soil matrix; common fine prominent very dark brown (10YR 2/2) iron and manganese stains; strongly acid; clear smooth boundary.

2C—46 to 80 inches; dark yellowish brown (10YR 4/6) loamy coarse sand; single grained; loose; 12 percent gravel; sand becomes coarser with increasing depth; the amount and coarseness of the gravel increases with depth; strongly acid.

The solum ranges from 40 to 60 inches in thickness. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is typically silt loam, but in some pedons it is loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silt loam or silty clay loam. The 2Bt horizon has value of 4 or 5 and chroma of 3 to 6. The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The content of sand and gravel in this horizon increases with increasing depth.

Zanesville Series

The Zanesville series consists of deep, well drained soils formed in loess and in the underlying siltstone and sandstone residuum. These soils are on upland ridgetops. They have a fragipan. Permeability is moderate above the fragipan and slow or moderately slow in the fragipan. Slope ranges from 2 to 15 percent.

Zanesville soils are similar to Cincinnati and Otwell soils and commonly are adjacent to Shelocta, Wellston, and Westmoreland soils. Cincinnati soils have glacial till pebbles in the lower part. Otwell soils have lacustrine or outwash sediments in the lower part. Shelocta, Wellston, and Westmoreland soils do not have a fragipan. Shelocta and Westmoreland soils are on ridgetops and hillsides. Wellston soils are mainly on ridgetops.

Typical pedon of Zanesville silt loam, 2 to 6 percent slopes, about 3.5 miles southeast of Haydenville, in Starr Township; about 2,200 feet west and 1,280 feet south of the northeast corner of sec. 4, T. 12 N., R. 16 W.

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

Bt1—6 to 15 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and coarse subangular blocky structure; firm; common fine roots; few faint dark yellowish brown (10YR 4/4) clay films on faces of peds; thin patchy brown (10YR 5/3) silt coatings on vertical faces of peds; strongly acid; clear smooth boundary.

Bt2—15 to 22 inches; dark brown (7.5YR 4/4) silt loam; moderate coarse and medium subangular blocky structure; firm; few medium roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—22 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; moderate coarse and medium angular blocky structure parting to strong fine subangular blocky; firm; very few fine roots; many distinct dark brown (7.5YR 4/4) clay films on faces of peds; few distinct pale brown (10YR 6/3) silt coatings on vertical faces of peds; very strongly acid; abrupt smooth boundary.

2Btx1—28 to 41 inches; dark brown (7.5YR 4/4) silt loam; moderate very coarse prismatic structure parting to moderate medium platy; very firm; brittle; very few fine roots between prisms; common faint dark brown (7.5YR 4/4) clay films on faces of plates; many prominent grayish brown (10YR 5/2) silt coatings between prisms and on the top of prisms; very strongly acid; gradual smooth boundary.

2Btx2—41 to 52 inches; yellowish brown (10YR 5/6) loam; moderate very coarse prismatic structure parting to weak thin platy; extremely firm; brittle; very few fine roots between prisms; few faint dark brown (7.5YR 4/4) clay films on faces of plates; many prominent light brownish gray (10YR 6/2) silt coatings between prisms; common black (10YR 2/1) iron and manganese concretions; very strongly acid; abrupt smooth boundary.

2C—52 to 78 inches; yellowish brown (10YR 5/6) loam; massive; very firm; about 10 percent sandstone fragments; very strongly acid; clear smooth boundary.

2R—78 to 80 inches; yellowish brown (10YR 5/6) sandstone.

The solum ranges from 42 to 60 inches in thickness. The depth to bedrock is 40 to 80 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is silt loam or silty clay loam. The 2Btx horizon is silt loam, loam, or silty clay loam. The 2C horizon has colors similar to those of the 2Btx horizon. The 2R horizon is yellowish brown or light olive brown siltstone or sandstone bedrock.

Formation of the Soils

This section relates the factors of soil formation to the soils in Hocking County and explains some of the processes of soil formation.

Factors of Soil Formation

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 of soil formation. Their effect on parent material is modified by relief and by the length of time that the parent material has been acted upon. The relative importance of each factor differs from place to place. In places one factor may dominate and, in extreme cases, may determine most of the soil properties. Normally, however, the interaction of all five factors determines the kind of soil that forms.

Parent Material

Parent material is the unconsolidated mass in which the soils formed. In Hocking County, this material can be divided into six groups: residual material, which developed in place by the weathering of underlying bedrock; colluvial material, which weathered from bedrock strata that are at higher elevations and which has been transported by water and gravity to the lower slopes; alluvium, lacustrine sediments, and glacial outwash deposited by water; loess deposited by wind; glacial till deposited by ice; and mine spoil in areas that have been strip-mined for coal.

Most of the soils in the county formed in residual material derived from two or more different kinds of rock strata. These bedrock strata are nearly horizontal, vary in thickness, and generally are not consistent over any given large area. Consequently, several different rock strata are commonly exposed within short distances on the dissected landscape. Thus, the soils on the sloping landscape normally have layers that formed in mixed residuum derived from two or more kinds of rock.

Sandstone, siltstone, and shale are the dominant kinds of bedrock in the county. Berks soils formed in material weathered from interbedded shale, siltstone, and sandstone. Dekalb soils formed mainly in material weathered from interbedded sandstone and siltstone.

Colluvial deposits are at the foot of steep or very steep slopes. They vary in thickness. These deposits consist of sediments moved downslope from the soils and the weathering bedrock above. Cedarfalls soils formed in colluvial deposits.

Some of the upland soils formed in both colluvium and residuum. Westmoreland soils, for example, formed in colluvium and residuum derived from siltstone, sandstone, and shale.

Some soils formed in loess and in the underlying bedrock residuum. Other soils, for example Alford soils, formed in deep loess. Wellston soils formed in loess and in the underlying siltstone and sandstone residuum.

Several soils formed in unconsolidated parent material transported by water, gravity, or wind. Most low-lying valley areas have thick layers of silt, sand, gravel, and clay deposited by glacial meltwater or by more recent floodwater. Chagrin, Stonelick, Melvin, Orrville, and Pope soils formed in alluvium. Glenford and McGary soils formed in lacustrine deposits on lacustrine terraces. Chili and Negley soils formed in glacial outwash on terraces.

Glacial till is the least extensive of the kinds of parent material in Hocking County. Glaciers generally transported debris for only short distances; therefore, the source of the till in the county is the area to the north and west, that is, Pickaway and Fairfield Counties. Only about 10 to 15 percent of the rock fragments in glacial till are igneous rocks that have their source in Canada or the northeastern part of the United States.

Illinoian glacial till is the oldest recognized till in the county. The Illinoian glacier retreated from Hocking County about 300,000 years ago. Hickory soils formed in Illinoian glacial till.

Wisconsinan glacial till is the only other recognized till in Hocking County. The Wisconsinan glacier retreated from Hocking County about 25,000 years ago.

Alexandria, Bennington, and Cardington soils formed in Wisconsinan glacial till.

The thin solum of Bethesda soils formed in mine spoil in areas that were surface mined. This parent material is shale, siltstone, and sandstone mixed with lesser amounts of partly weathered fine-earth material.

Climate

The climate throughout Hocking County is uniform. As a result, climatic differences have not greatly contributed to differences among the soils. During the period of soil formation, the climate favored physical and chemical weathering of the parent material and biological activity.

Rainfall has been adequate for the percolation of water, which contributes to the translocation of clay and the development of soil structure. Allegheny, Wellston, and Wheeling are examples of soils in which clay has been translocated and soil structure has developed.

The range in temperature has favored both physical change and chemical weathering of the parent material. Freezing and thawing cycles have favored the formation of soil structure. Warm summer temperatures have favored chemical reactions in the weathering of primary minerals.

Both rainfall and temperature have favored plant growth and the subsequent accumulation of organic matter in all soils.

Relief

Because of the effect of relief, different soils may form in the same kind of parent material. Cardington and Bennington soils, for example, both formed in Wisconsinan glacial till, but relief has affected their formation in different ways. Cardington soils formed in areas where water could run off the surface and thus are moderately well drained. Bennington soils formed in nearly level areas where runoff was slow and thus are somewhat poorly drained.

Living Organisms

Living organisms, including vegetation, animals, bacteria, and fungi, play a role in soil formation. When Hocking County was settled, the vegetation was dominantly hardwood forest. The main species were beech, maple, oak, yellow-poplar, and ash. The soils that formed in these forested areas are generally acid and are moderate or low in natural fertility.

Small animals, insects, earthworms, and burrowing animals make channels in the soil and make the soil more permeable to water. Animals also mix soil material and contribute organic matter. Worm channels or casts are most common in the surface layer of soils that have been limed or in soils on flood plains, such as Chagrin soils. Crayfish channels are evident in the poorly drained Melvin soils.

Human activities also affect soil formation. They include plowing the soil, planting seeds, introducing vegetation, draining wet soils, irrigating droughty soils, flooding some areas, and adding or removing soil material on construction sites and in surface-mined areas. Additions of lime and fertilizer neutralize acid soil reaction and change the chemical composition of the soil.

Time

Time is needed for the other soil-forming factors to produce their effects. The age of a soil is indicated, to some extent, by the degree of profile development.

The oldest parent material is the residuum derived from sedimentary bedrock. The soils that formed in this material show various degrees of development because of the influence of parent material, hilly topography, and other soil-forming factors. Berks and Dekalb are examples of soils that formed in residuum.

The youngest parent material in the county was deposited on flood plains that receive fresh alluvium from periodic flooding. Chagrin, Pope, and other alluvial soils are so young they show little or no differentiation of horizons.

Processes of Soil Formation

Most of the soils in Hocking County have a relatively strong profile development. The processes of soil formation have produced distinct changes in the material in which the soils formed. These soils are on uplands and on terraces along the major valleys. A few other soils, mainly on flood plains, have been only slightly modified by these processes.

The transfer of clay from the A horizon to the B horizon takes place because of the seasonal wetting and drying of the soil profile. Fine clay becomes suspended in percolating water moving down through the surface layer and is carried downward to the subsoil, where it is deposited on the faces of peds. Because of this transfer of fine clay, many distinct or prominent clay films are on the faces of peds in the B horizon of Guernsey and other soils.

The transformation of mineral compounds takes place in most soils. The results of this process are most apparent if the development of horizons is not affected by rapid erosion or by the accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly those of the layer-lattice silicate clays. Most of these clays remain in the subsoil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.
AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.
Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.
Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.
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 commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.
Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.
Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.
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 typography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.
Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.
Bottom land. The normal flood plain of a stream, subject to flooding.
Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.
Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.
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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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 to bedrock. Deep soils are more than 40 inches to 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.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

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.

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

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 the soil is wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

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.

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 coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

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.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

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 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

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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

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.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
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.

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

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts 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-size 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.

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

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the 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.

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.

Sinkhole. A depression in the landscape where limestone has been dissolved.

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.

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.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

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).

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.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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 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.