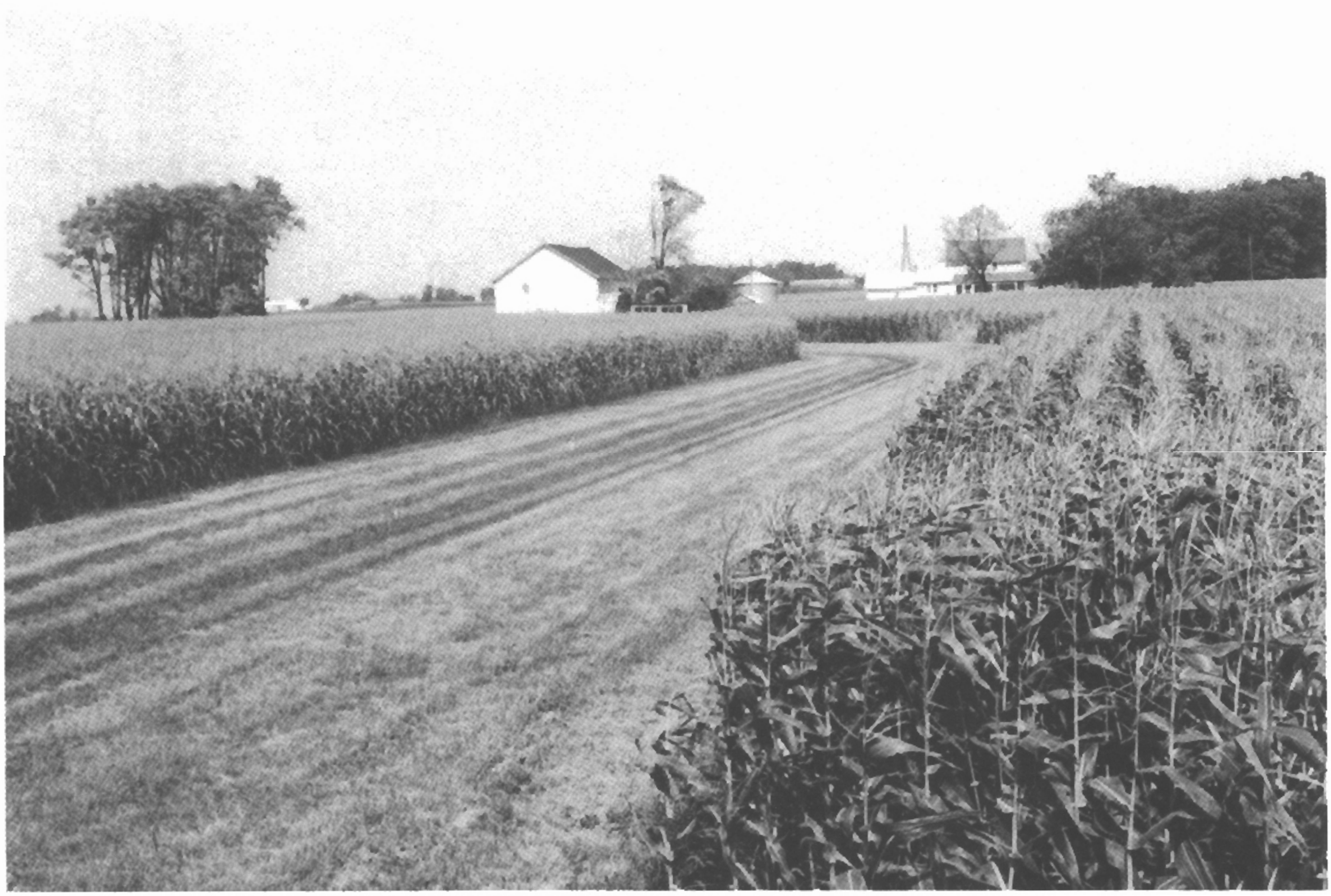
United States
Department of
Agriculture

Soil
Conservation
Service

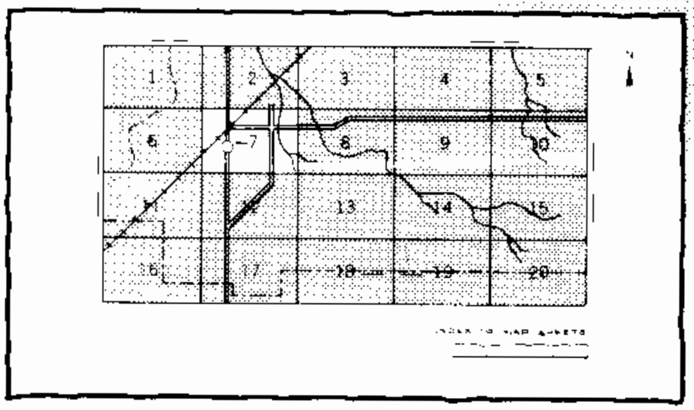
In cooperation with
Ohio Department of Natural
Resources, Division of Soil
and Water Conservation, and
Ohio Agricultural Research
and Development Center

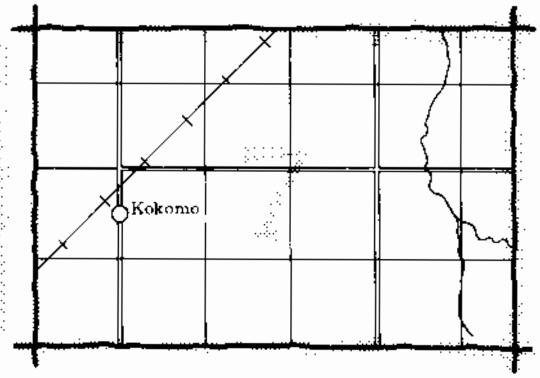
Soil Survey of Darke County, Ohio



HOW TO USE

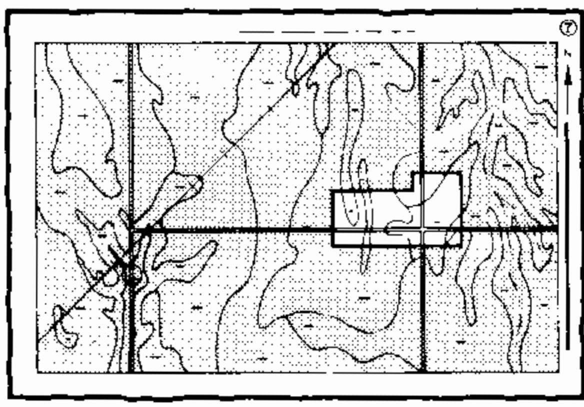
1. Locate your area of interest on the "Index to Map Sheets"

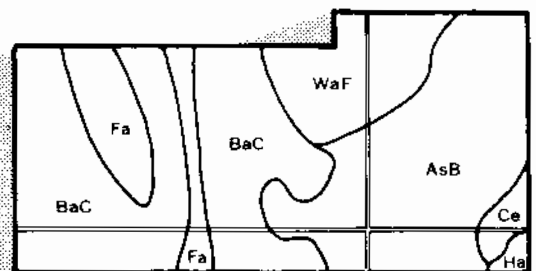




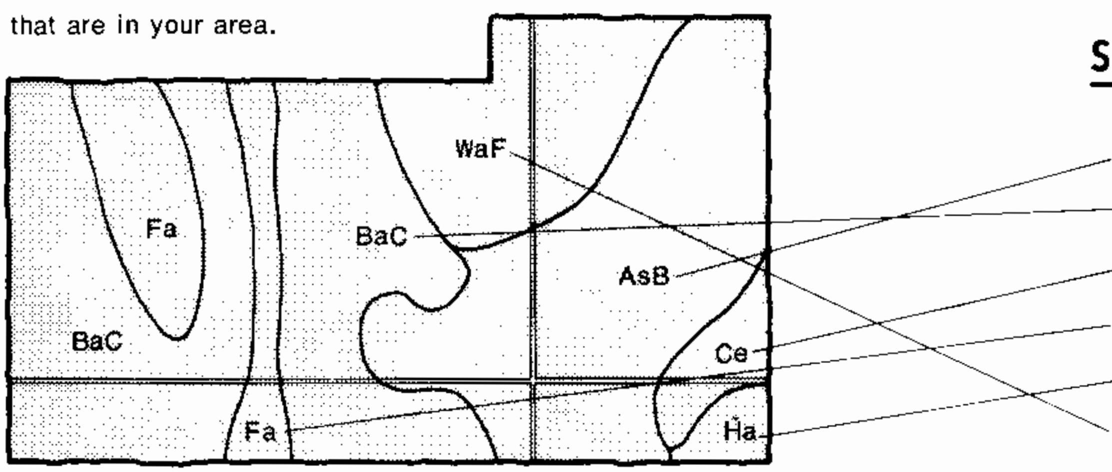
2. Note the number of the map sheet and turn to that sheet.

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





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



Symbols

AsB
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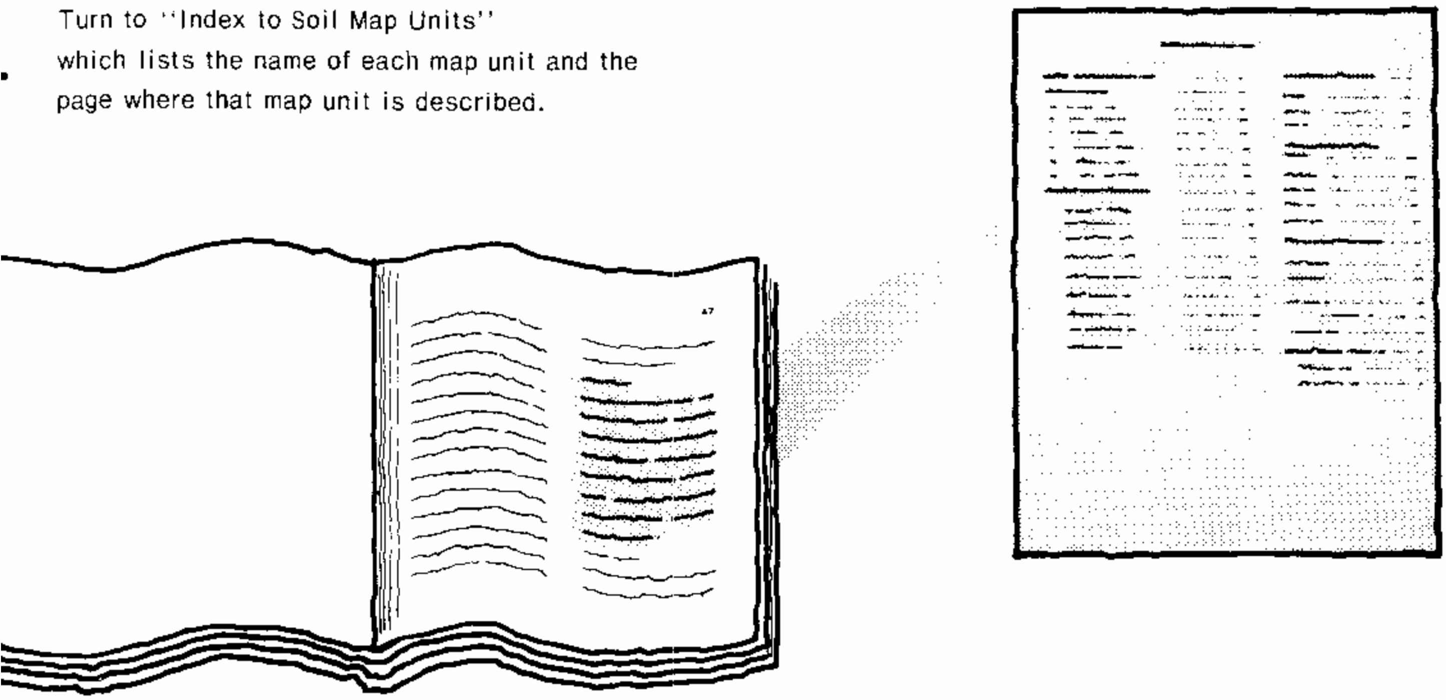
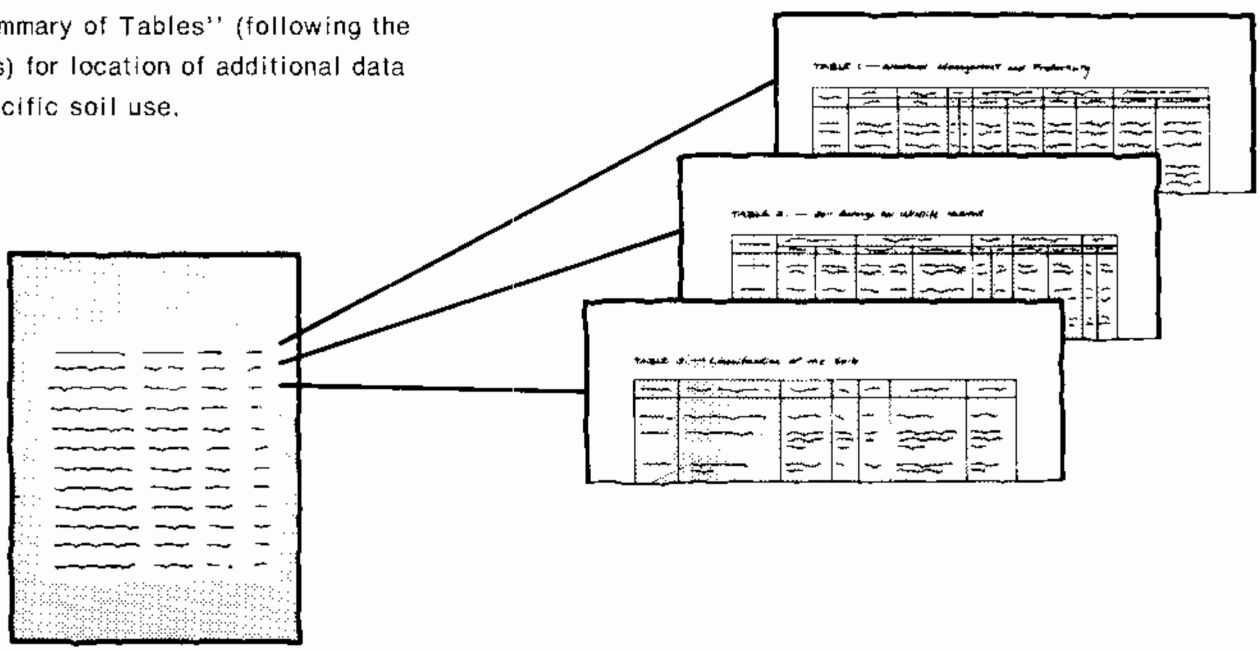
IIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Darke Soil and Water Conservation District. Financial assistance was provided by the Darke County Commissioners.

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

Cover: A grassed waterway in an area of Blount and Pewamo soils.

Contents

Soil Series

Issued August 1987

Index to Map Units

Summary of Tables

Foreword

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

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

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

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

Harry W. Oneth
State Conservationist
Soil Conservation Service

Soil Survey of Darke County, Ohio

By Samuel F. Lehman and George D. Bottrell, Soil Conservation Service

Fieldwork by Samuel F. Lehman, George D. Bottrell,
Michael L. Wigginton, and Don N. McClure, Soil Conservation Service

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

General Nature of the County

DARKE COUNTY is in the west-central part of Ohio (fig. 1). It has a total area of approximately 387,136 acres, or 605 square miles. It has 20 townships.

The population of the county was 55,096 in 1980. Greenville, the county seat and the largest town, is near the center of the county. It had a population of 12,999 in 1980. The villages in the county include Ansonia, Arcanum, Bradford, Burkettsville, Castine, Gettysburg, Gordon, Hollansburg, Ithaca, New Madison, New Weston, North Star, Osgood, Palestine, Pitsburg, Rossburg, Union City, Versailles, and Yorkshire.

The county is in the region of Ohio that was glaciated during the Wisconsin age. Most of the soils formed in calcareous glacial material or in alluvium derived from this material. In a large part of the county, mainly south of the Stillwater River, the till deposits are loam or silt loam, whereas they are clay loam or silty clay loam north of the river. Elevation ranges from 930 to 1,240 feet above sea level.

Because it has large areas of fertile land, Darke County is well suited to farming. Livestock production and cash-grain farming are the chief farm enterprises. The main cash crops are corn, soybeans, wheat, and hay. In a few areas truck crops, nursery crops, and other specialty crops are grown. An increasing acreage is being converted to nonfarm uses, particularly around Greenville and along highways in the southern part of the county.

Poor natural drainage is the major limitation affecting farming in the more nearly level areas of the county.

Figure 1.—Location of Darke County in Ohio.

Erosion is a hazard in the gently sloping to steep areas. Most of the soils are highly productive if an adequate drainage system is installed in the wet areas, erosion is controlled in the steeper areas, and the soils are otherwise well managed.

Climate

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

Darke County is cold in winter and fairly warm in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring and minimizes drought during summer on most soils. The normal annual precipitation is adequate for all of the crops that are suited to the temperature and growing season in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Greenville in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Greenville on January 18, 1977, is -23 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 7, 1977, 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 36 inches. Of this, 21 inches, or nearly 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 5.19 inches at Greenville on August 10, 1969. Thunderstorms occur on about 41 days each year. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local in extent and of short duration and cause damage in scattered areas.

The average seasonal snowfall is about 26 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 10 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in spring.

Farming

Darke County is a leading agricultural county in Ohio (*4*). In 1982, it was second in Ohio in total farm receipts; first in the production of hogs and soybeans; fifth in wheat production; sixth in corn production; seventh in income from the sale of cattle and calves; tenth in dairy products; and second in income from all other types of livestock and livestock products.

In 1978, the county had 2,352 farms, which made up a total of 350,008 acres, or 90.4 percent of the total land area in the county (*17*). The average size of the farms was 149 acres. Owners or part owners operated 85.6 percent of the farms.

In 1978, more than half of the agricultural income in the county was derived from the sale of livestock and livestock products. Nearly half was derived from the sale of crops, including nursery crops, greenhouse products, and hay. The chief livestock enterprises, ranged in order of income, were poultry and poultry products, hogs and pigs, dairy products, and cattle and calves. On commercial farms, about 101,310 acres was used for corn, 133,201 acres for soybeans, 25,505 acres for wheat, and 5,970 acres for oats.

History and Development

When they signed the Treaty of Greenville in 1795, the Indians surrendered all lands east and south of the Greenville Treaty Line to the United States. For the first time, the area between the Ohio River and the Great Lakes was solely under the jurisdiction of the United States (*9*). After this treaty was signed, Darke County was settled. It was at first part of Miami County. It was established as a separate county in 1817. The seat of government was established at Greenville. By 1820, the population of the county was 3,717. By 1830, it had grown to 6,204 and Greenville had 30 buildings and a population of 204.

The pattern of settlement concentrated along the rivers and creeks and the military roads. Most of the county was a swampy forest (*19*). Farmers trapped in the swamps for barter at the stores. They bartered with raccoon, mink, muskrat, and deer skins. The land was gradually developed for agricultural uses as roads were constructed and the forest was drained and cleared. Currently, only a small percentage of the acreage in the county is wooded.

The county has modern transportation facilities in both rural and urban areas. The county airport is located between Versailles and Greenville. A network of state and federal highways links all parts of the county with adjoining areas. Two federal and five state highways converge at Greenville. The county has nine other state highways and a total of about 1,325 miles of county and township roads, nearly all of which are paved. Heavy freight is moved by rail and truck lines. Two railroads cross the county. Truck lines serve several rural grain elevators and much of the small industry in the county.

The area of highest population is in Greenville Township, around the town of Greenville. The major industries are concentrated around Greenville, although some small industries operate in many of the villages. Darke County is a leading producer of pyrex glass, steel containers, athletic clothing, plant food and chemicals, plumbing supplies, electric motors, filters, and retreaded tires. Sand and gravel obtained from several gravel pits and limestone from one quarry are used as road-building and construction material.

Physiography, Relief, and Drainage

Darke County is in the Till Plains section of the Central Lowlands physiographic province. Slopes range from level in broad areas on ground moraines to steep on parts of end moraines and on dissected parts of ground moraines. In a few areas, mainly along streams and on kames and end moraines, the slopes are steep and irregular.

Maximum relief in the county is 310 feet. The highest point, about 1,240 feet above sea level, is on top of a knoll about 2 miles southwest of New Madison. The lowest point, about 930 feet above sea level, is on a flood plain about 2 miles north of Bradford, where the Stillwater River flows out of the county. The elevation in most of the county is 1,000 to 1,100 feet above sea level.

The county is drained mainly by the Stillwater River, Greenville Creek, and the tributaries of these streams. The northwestern part of the county, however, is drained by the Mississinewa and Wabash Rivers. A small area in the northeastern part is drained by tributaries of Loramie Creek, which flows into Shelby County. The southernmost part of the county is drained by tributaries of larger streams flowing into Preble County and the state of Indiana.

Geology

Darke County was glaciated more than once, but the earlier glacial deposits were covered by till and outwash during the Wisconsin Glaciation, the last glacial advance (*5*). The glacial material overlying bedrock is a few feet thick near bedrock exposures to more than 300 feet thick in areas where it fills preglacial stream valleys.

Glacial till is the dominant geologic parent material of the soils in the county. It is a mixture of boulders, gravel, sand, silt, and clay that was carried southward by the advancing glacier and deposited directly on the surface. End moraines are wide, low, slightly hummocky ridges of till. They were built up at the edge of the glacier when advancement stopped or slowed. They generally are gently sloping to steep. Parts of the Mississinewa, Bloomer, Union City, and Farmersville end moraines extend across Darke County (*6*). Ground moraines are nearly level to undulating areas of till between the end moraines. The till in these extensive areas was deposited underneath the advancing or melting glacier. Some major streams formed along the end moraines. They flow along the southern edge of the end moraines and then southward across the ground moraines.

In certain parts of the county, a unique sorting action of the glacier resulted in a deposit of large boulders in the till. This deposit, known as the boulder belt, is shown on the general soil map at the back of this publication. These bouldery areas are most common in the southern half of the county. They are concentrated on the Farmersville and Union City end moraines and on the ground moraine near Arcanum and Pitsburg. These boulders can hinder both farming and construction activities. In many areas they have been placed along fence lines and woodlots and piled in fields and along roads.

Glacial meltwater washed sand and gravel out of the glacial till, filling the major streams with outwash deposits. Sand and gravel also occur as kames in areas where they were deposited within subglacial streams. Some outwash areas are capped with silty sediments.

A few deposits in the county are lake-laid sediments. These sediments are mostly silt and clay particles deposited in temporarily ponded areas during the glacial period. The largest area of lake deposits is in the northeastern part of the county, but scattered small areas are throughout the county.

The uppermost layers in many of the upland soils formed in loess, a windblown deposit of silty material. In Darke County this silty material is less than 12 inches thick in nearly all areas where it has been deposited. It was deposited mainly during extremely dry periods shortly after the main ice mass of the glacier receded northward, about 15,000 years ago.

The bedrock in the county is Cedarville Dolomite of the Middle Silurian age (*10*). It has a northeast dip of about 6 feet per mile because of the effects of the Cincinnati Arch (*13*). Bedrock is exposed in the quarry at Ft. Jefferson. In a 1878 report, geologists identified bedrock exposures in the valleys of Greenville Creek and the Stillwater River (*8*).

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, acidity, 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 mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

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

Survey Procedures

The general procedures followed in making this survey are described in the National Soils Handbook of the Soil Conservation Service. An 1878 report on the geology of Darke County (*8*) and the soil survey maps made for conservation planning on individual farms from 1955 to 1977, prior to the start of the project soil survey, were among the first references used.

Recent soil surveys were available for the six Ohio counties surrounding Darke County, and fieldwork for three Indiana surveys directly adjacent to Darke County was in progress. The survey party used the soil maps, soil descriptions, and laboratory data from these counties as guidance in preparing the Darke County soil survey. The glacial geology of the county was mapped during the first two summers of the survey (*10*).

At the beginning of the survey, the soil scientists studied USGS topographic maps at a scale of 1:24,000. After this study, they made a reconnaissance by pickup truck. They then traversed the land surface on foot, examining the soils. In areas of the Westland-Eldean-Lippincott association and other areas where the soil pattern is very complex, the interval between traverses was as close as 200 yards. In areas of the Crosby-Brookston association and other areas where the soil pattern is relatively simple, the interval was about 0.25 mile.

As the traverses were made, the soil scientist divided the landscape into segments in which land use and management are different. For example, a hillside was separated from a swale and a gently sloping ridgetop from a very steep side slope. In most areas soil examinations along the traverses were made at intervals of 100 to 800 yards, depending on the landscape and soil pattern. Observations of some items were made without regard to spacing. These items include landforms, blown down trees, boulders, the direction and amount of drainage flow, wild and cultivated vegetation, roadbank exposures, railroad cuts, the sides and berms of drainage ditches, basement excavations, spots of accelerated erosion, and animal burrows.

Documentary photographs were made to illustrate survey findings. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a hand auger or a spade to a depth of 5 or 6 feet. The pedons described as typical were observed and studied in pits dug with shovels.

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 remainder of the county. Extensive notes were taken on the composition of the map units in these preliminary study areas. As mapping progressed, these preliminary notes were modified and a final assessment of the composition of the individual map units was made.

Some transects were made to determine the composition of the Eldean-Miamian complexes, which are in the steeper parts of the county. Transects made with the aid of a truck-mounted power probe were used to determine the depth to and thickness of sand and gravel layers.

After completion of the soil mapping on aerial photographs, map unit delineations were transferred by hand to another set of the same photographs. Cultural features were recorded from visual observations made during the traverses.

Samples for physical analysis, chemical analysis, and engineering properties were taken from representative sites of five of the soils in the county. Extensive tests were run on these samples. The chemical and physical analyses were made by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The results of these analyses are stored in a computerized data file at the laboratory. The results of laboratory analysis are also available for 24 different soils that were analyzed prior to the start of the project soil survey. These data relate mainly to particle size, pH, and calcium carbonate equivalent. Eleven special soil samples were analyzed during the course of the fieldwork to determine certain soil family criteria and bulk density. The analysis for engineering properties was 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 respective laboratories. The results of laboratory analysis can be obtained from the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the 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 also shows a glacial boulder belt. This is an area where melting glaciers left numerous boulders on the surface and in the soils during the last glacial period.

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.

Soil Descriptions

Level to Steep Soils Formed in Glacial Till, Loess, and Glacial Outwash; on Uplands

These soils make up about 62 percent of the county. They are very poorly drained to well drained. The landscape is characterized dominantly by broad flats, depressions, and slight rises on ground moraines; however, many areas consist of knolls, ridges, and side slopes on end moraines and kames. The soils formed in medium textured glacial till and loess and in medium textured to coarse textured glacial outwash. They are used dominantly as cropland, pasture, or woodland. The erosion hazard, ponding, seasonal wetness, droughtiness, moderately slow or slow permeability, and a moderate shrink-swell potential are the major limitations.

1. Crosby-Brookston Association

Level and nearly level, somewhat poorly drained and very poorly drained soils formed in glacial till

This association is in extensive areas on broad flats and in slight depressions. Slopes are 0 to 2 percent. The association makes up about 34 percent of the county. It is about 55 percent Crosby soils, 35 percent Brookston soils, and 10 percent minor soils (fig. 2).

The somewhat poorly drained Crosby soils are on broad flats and slight rises surrounded by the very poorly drained Brookston soils in broad, level and depressional areas. In cultivated areas the two soils form a striking light and dark pattern on the landscape. Crosby soils have a surface layer of silt loam. They are slowly permeable. They have a seasonal high water table at a depth of 12 to 36 inches. Brookston soils have a surface layer of silty clay loam. They are moderately permeable. They have a seasonal high water table near or above the surface and are subject to ponding.

Among the minor soils in this association are the moderately well drained Celina soils and the well drained Miamian soils. These soils are on the crests of the higher knolls in the uplands.

Most of the acreage is farmed intensively. A few areas are used as permanent pasture or woodland. The main farm enterprise is cash-grain farming. Corn and soybeans are the dominant crops. Hogs and beef cattle are raised on some farms. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited to trees. Ponding and seasonal wetness are the major limitations in farmed areas. Many areas are drained by surface and subsurface drains. Drained areas dry out more quickly in spring than undrained areas. In the boulder belt glacial boulders on and below the surface interfere with cultivation and excavation.

The major soils are moderately well suited or poorly suited to buildings and septic tank absorption fields. The Crosby soils are better suited to these uses than the Brookston soils. Seasonal wetness, ponding, and slow permeability are limitations.

2. Miamian-Celina-Crosby Association

Level to moderately sloping, well drained to somewhat poorly drained soils formed in glacial till

This association is in convex areas that parallel the major streams. Slopes range from 0 to 12 percent. The association makes up about 21 percent of the county. It is about 45 percent Miamian soils, 15 percent Celina soils, 15 percent Crosby soils, and 25 percent minor soils.

Miamian soils are commonly on the steeper parts of hillsides. They are well drained and are level to moderately sloping. They are moderately slowly

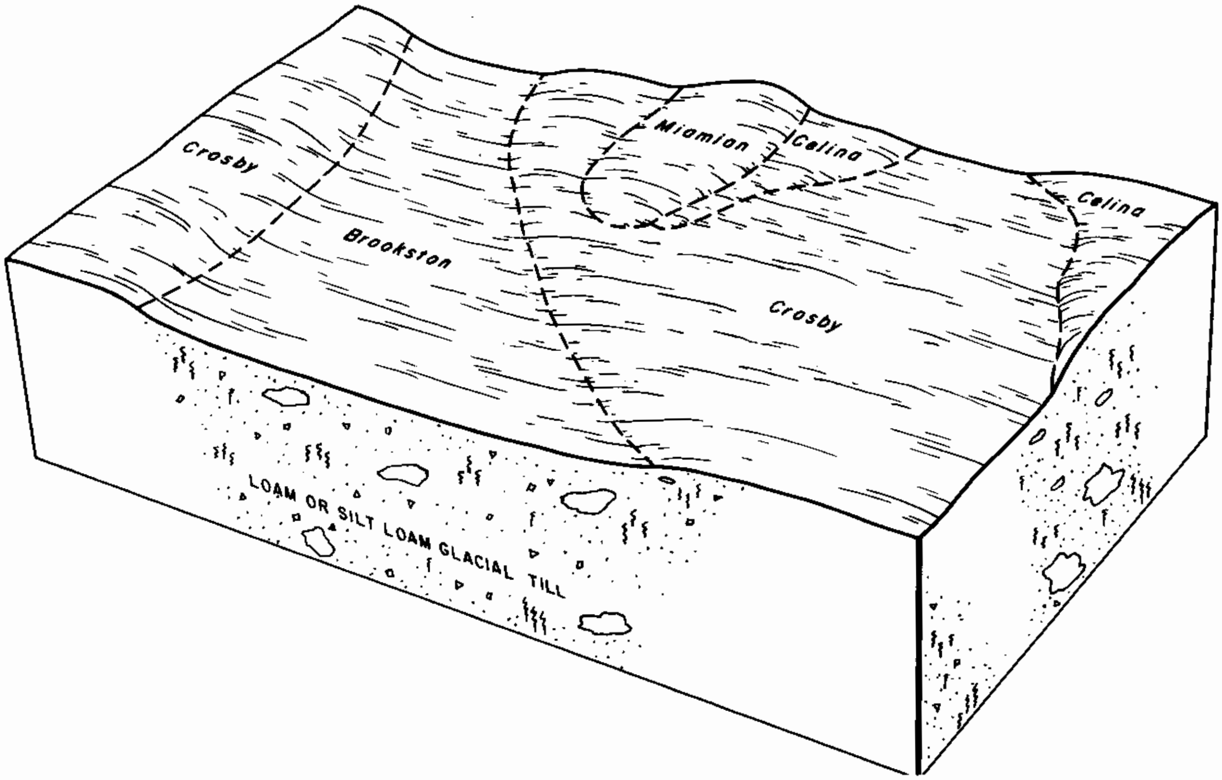


Figure 2.—Typical pattern of soils and parent material in the Crosby-Brookston association.

permeable. Typically, the surface layer is silt loam, but in severely eroded areas it is clay loam.

Celina soils are moderately well drained and are level to gently sloping. They are moderately slowly permeable. Typically, the surface layer is silt loam. A seasonal high water table is at a depth of 24 to 42 inches.

Crosby soils are somewhat poorly drained and are gently sloping. They are slowly permeable. Typically, the surface layer is silt loam. A seasonal high water table is at a depth of 12 to 36 inches.

Among the minor soils in this association are the Brookston and Eldean soils. The very poorly drained Brookston soils are in depressions and narrow drainageways. Eldean soils have sand and gravel in the substratum. They are on the more sloping side slopes.

Most of the acreage is farmed. Some of the more sloping areas are used as permanent pasture or woodland. The main farm enterprises are raising hogs and beef cattle and growing corn and soybeans for cash. Nearly all of the soils are well suited to row crops, small grain, hay, and pasture; however, the more sloping Miamian soils are less well suited to farming. All of the major soils are well suited or moderately well suited to trees and to plantings that enhance wildlife habitat.

The slope and the erosion hazard on the more sloping Miamian soils are severe limitations in the farmed areas. The seasonal wetness in the Crosby soils and a moderate erosion hazard on both the Crosby and Celina soils are additional management concerns. Much of the acreage of the Crosby soils is drained by subsurface drains. These drained areas dry out more quickly in the spring than undrained areas. Glacial boulders on and below the surface commonly interfere with cultivation. They also interfere with excavation and other construction activities.

The major soils are well suited or moderately well suited to buildings and septic tank absorption fields. The Miamian soils are better suited to buildings than the Crosby and Celina soils. Restricted permeability and a moderate shrink-swell potential in all the major soils, the seasonal wetness of the Crosby and Celina soils, and the slope of the Miamian soils are the main limitations affecting urban uses.

3. Miamian-Eldean-Celina Association

Gently sloping to steep, well drained and moderately well drained soils formed in glacial till and outwash

This association is on ridges, knolls, and side slopes on end moraines and kames and on side slopes that parallel streams and drainageways. Slopes range from 2 to 25 percent. The association makes up about 4 percent of the county. It is about 65 percent Miamian soils, 15 percent Eldean soils, 10 percent Celina soils, and 10 percent minor soils.

Miamian and Eldean soils are on side slopes and the top of ridges and knolls. Miamian soils are well drained and are gently sloping to steep. They are moderately slowly permeable. Typically, the surface layer is silt loam, but in severely eroded areas it is clay loam. Eldean soils are well drained and are gently sloping to moderately steep. They are moderately permeable or moderately slowly permeable in the subsoil and rapidly permeable or very rapidly permeable in the substratum. Typically, the surface layer is loam.

Celina soils are on the lower part of the slopes. They are moderately well drained and generally are gently sloping. They are moderately slowly permeable. Typically, the surface layer is silt loam. A seasonal high water table is at a depth of 24 to 42 inches.

Among the minor soils in this association are the Eel, Medway, and Ockley soils. Eel and Medway soils formed in alluvium on flood plains. Ockley soils have a subsoil that is thicker than that of the Eldean soils. They are on outwash terraces.

A large acreage is used as permanent pasture or woodland, especially on the steeper slopes. Many of the less sloping areas are used as cropland. Some areas are used as meadows. The gently sloping soils are well suited to cropland, but the moderately sloping and steep soils are poorly suited or generally unsuited. All of the major soils are well suited or moderately well suited to trees.

The slope and the erosion hazard are the main management concerns in the farmed areas. The Eldean soils are only moderately deep over sand and gravel and are somewhat droughty. Using the moderately sloping and steep areas as permanent pasture reduces the risk of erosion. Glacial boulders on and below the surface commonly interfere with farming. They also interfere with excavation and other construction activities.

The steeper major soils are poorly suited to urban uses because of the slope and moderately slow permeability. The less sloping Miamian and Celina soils are well suited or moderately well suited to buildings and are moderately well suited to septic tank absorption fields. The restricted permeability and moderate shrink-swell potential in both soils and the seasonal wetness in the Celina soils are the main limitations. The less sloping Eldean soils are well suited to buildings and septic tank absorption fields. They readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water supplies.

4. Crosby-Treaty Association

Level to gently sloping, somewhat poorly drained and very poorly drained soils formed in loess and glacial till

This association is on broad flats characterized by low knolls and slight depressions. Slopes range from 0 to 6 percent. The association makes up about 2 percent of the county. It is about 55 percent Crosby soils, 20 percent Treaty soils, and 25 percent minor soils.

The somewhat poorly drained, level to gently sloping Crosby soils are on broad flats and low knolls surrounded by the very poorly drained, level and nearly level Treaty soils in broad depressions. In cultivated areas the two soils form a striking light and dark pattern on the landscape. Crosby soils have a surface layer of silt loam. They are slowly permeable. They have a seasonal high water table at a depth of 12 to 36 inches. Treaty soils have a surface layer of silty clay loam. They are moderately slowly permeable. They have a seasonal high water table near or above the surface and are subject to ponding.

Among the minor soils in this association are the moderately well drained Celina and well drained Miamian soils. These soils are on the crests of the higher knolls in the uplands.

Most of the acreage is farmed intensively. A few areas are used as permanent pasture or woodland. The main farm enterprise is cash-grain farming. Corn and soybeans are the dominant crops. Hogs and beef cattle are raised on some farms. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited to trees. Ponding, seasonal wetness, and the erosion hazard are the major management concerns in the farmed areas. Many areas are drained by surface and subsurface drains. Drained areas dry out more quickly in spring than undrained areas. In the boulder belt glacial boulders on and below the surface interfere with cultivation and excavation.

The major soils are moderately well suited or poorly suited to buildings and septic tank absorption fields. The Crosby soils are better suited to these uses than the Treaty soils. Seasonal wetness, ponding, and moderately slow or slow permeability are limitations.

5. Pyrmont-Brookston-Lewisburg Association

Level to gently sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till

This association is in depressions and convex areas. Slopes range from 0 to 6 percent. The association makes up less than 1 percent of the county. It is about 50 percent Pyrmont soils, 25 percent Brookston soils, 15 percent Lewisburg soils, and 10 percent minor soils.

The level and nearly level, somewhat poorly drained Pyrmont soils are on slight rises surrounded by the level and nearly level, very poorly drained Brookston soils in depressions and drainageways. The gently sloping, moderately well drained Lewisburg soils are on the higher, more convex ridges and knolls. Pyrmont and Lewisburg soils have a surface layer of silt loam. They are moderately permeable or moderately slowly permeable in the subsoil and slowly permeable in the substratum. A seasonal high water table is at a depth of 6 to 18 inches in the Pyrmont soils and 18 to 42 inches in the Lewisburg soils. Brookston soils have a surface layer of silty clay loam. They are moderately permeable. They have a seasonal high water table near or above the surface and are subject to ponding.

Among the minor soils in this association are the Miamian and Westland soils. The well drained Miamian soils are in the more sloping areas. Westland soils have sand and gravel in the substratum. They are in depressions.

Most areas are farmed intensively. A few are wooded. The main farm enterprise is cash-grain farming. Corn and soybeans are the dominant crops. Hogs and beef cattle are raised on some farms. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited or well suited to trees. Seasonal wetness in the Pyrmont soils, ponding on the Brookston soils, and the erosion hazard on the Lewisburg soils are the principal management concerns in the farmed areas. Much of the acreage of Pyrmont and Brookston soils is drained by surface and subsurface drains. Drained areas dry out more quickly in spring than undrained areas.

The major soils are moderately well suited or poorly suited to buildings and septic tank absorption fields. The Lewisburg soils are better suited to these uses than the Brookston and Pyrmont soils. Seasonal wetness, ponding, and slow permeability are limitations.

Level to Moderately Steep Soils Formed in Glacial Till; on Uplands

These soils make up about 33 percent of the county. They are very poorly drained to moderately well drained. The landscape is characterized by depressions and broad flats on ground moraines and moderately steep areas on end moraines. The soils formed in moderately fine textured glacial till. They are used dominantly as cropland, pasture, or woodland. The erosion hazard, seasonal wetness, ponding, slope, moderately slow or slow permeability, and a moderate shrink-swell potential are the major limitations.

6. Blount-Pewamo Association

Level to gently sloping, somewhat poorly drained and very poorly drained soils formed in glacial till

This association is in scattered areas on broad flats, on knolls, and in depressions. It makes up about 21 percent of the county. It is about 60 percent Blount soils, 25 percent Pewamo soils, and 15 percent minor soils.

The level to gently sloping, somewhat poorly drained Blount soils are on slight rises and low knolls surrounded by the level and nearly level, very poorly drained Pewamo soils in depressions and along drainageways. Blount soils typically have a surface layer of silt loam. They are slowly permeable. They have a seasonal high water table at a depth of 12 to 36 inches. Pewamo soils typically have a surface layer of silty clay loam. They are moderately slowly permeable. They have a seasonal high water table near or above the surface and are subject to ponding.

Among the minor soils in this association are the moderately well drained Glynwood soils on the crests of the higher knolls.

Most areas are farmed intensively. A small acreage is wooded. The main farm enterprises are growing corn and soybeans for cash, dairying, and raising hogs and beef cattle. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited to trees. Seasonal wetness and ponding are the major limitations in the farmed areas. Much of the acreage is drained by surface and subsurface drains. Drained areas dry out more quickly in spring than undrained areas. Erosion is a hazard in the gently sloping areas.

The major soils are moderately well suited or poorly suited to buildings and are poorly suited to septic tank absorption fields. The Blount soils are better suited to buildings than the Pewamo soils. Seasonal wetness, ponding, and slow or moderately slow permeability limit urban development.

7. Blount-Glynwood-Pewamo Association

Level to moderately steep, somewhat poorly drained, moderately well drained, and very poorly drained soils formed in glacial till

This association is on flats, knolls, and side slopes; along drainageways; and in depressions. It makes up about 12 percent of the county. It is about 45 percent Blount soils, 30 percent Glynwood soils, 15 percent Pewamo soils, and 10 percent minor soils (fig. 3).

Blount soils are on slight rises, on low knolls, and on low ridges along drainageways. They are somewhat poorly drained and are level to gently sloping. They are slowly permeable. Typically, the surface layer is silt loam. A seasonal high water table is at a depth of 12 to 36 inches.

Glynwood soils are on knolls, ridges, and side slopes along drainageways. They are moderately well drained and are gently sloping to moderately steep. They are slowly permeable. Typically, the surface layer is silt loam, but in severely eroded areas it is clay loam. A seasonal high water table is at a depth of 24 to 42 inches.

Pewamo soils are in depressions and along drainageways. They are very poorly drained and are level and nearly level. They are moderately slowly permeable.

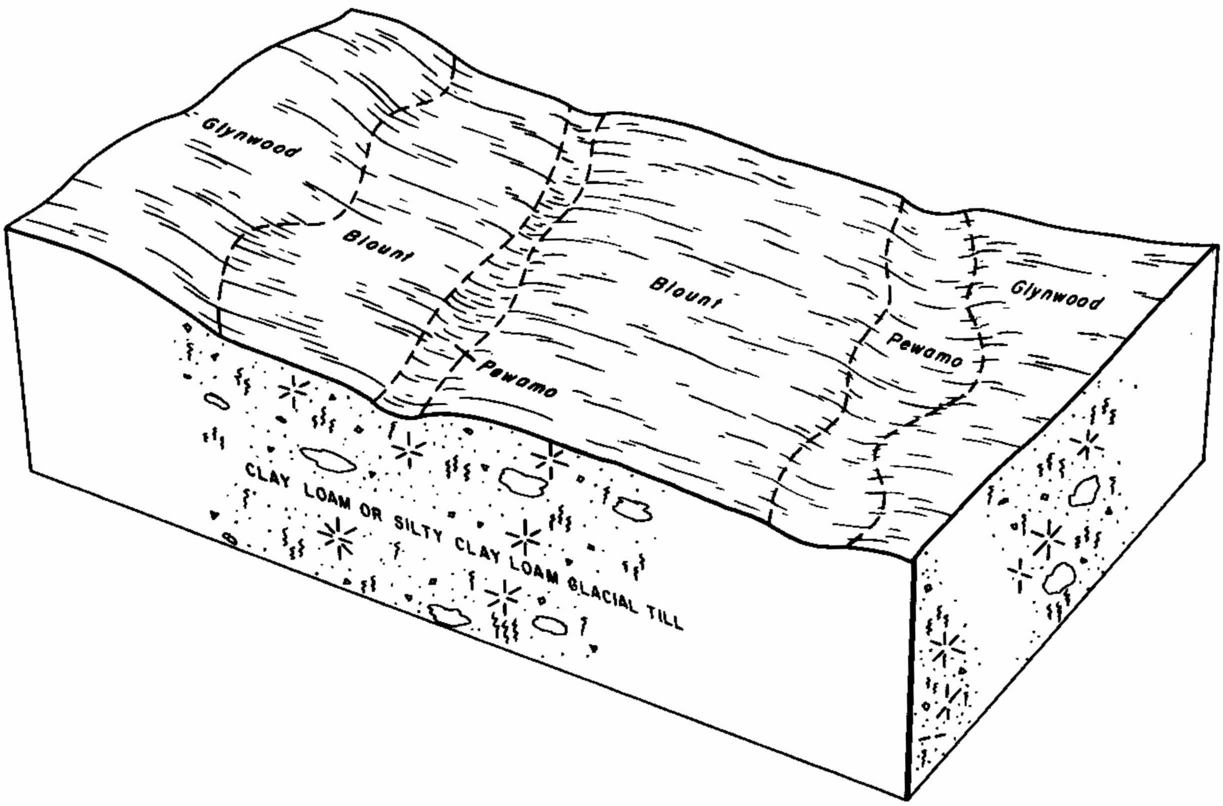


Figure 3.—Typical pattern of soils and parent material in the Blount-Glynwood-Pewamo association.

Typically, the surface layer is silty clay loam. A seasonal high water is near or above the surface, and the soils are subject to ponding.

Among the minor soils in this association are the Montgomery and Westland soils. The clayey Montgomery soils formed in lacustrine sediments in depressions in lakebeds and on uplands. Westland soils formed in glacial outwash on outwash terraces and stream terraces. They have less clay in the subsoil than the Pewamo soils.

Most areas are used as cropland or pasture. A few are wooded. The main farm enterprises are dairying and raising hogs and beef cattle. In some areas corn, soybeans, and wheat are grown for cash. The less sloping soils are well suited to row crops, small grain, hay, and pasture. The moderately sloping and moderately steep Glynwood soils are poorly suited or generally unsuited to cropland. All of the major soils are well suited or moderately well suited to trees.

Seasonal wetness and ponding in areas of the less sloping soils and the erosion hazard on the more sloping soils are the principal management concerns in the farmed areas. Much of the acreage of Blount and Pewamo soils is drained by surface and subsurface drains. Erosion-control practices are needed, especially on the severely eroded Glynwood soils.

The major soils are moderately well suited or poorly suited to buildings and septic tank absorption fields. The Glynwood and Blount soils are better building sites than the Pewamo soils. Ponding, seasonal wetness, a moderate shrink-swell potential, slope, and moderately slow or slow permeability are the main limitations affecting urban uses.

Level to Gently Sloping Soils Formed in Glacial Outwash and Alluvium; on Terraces and Flood Plains

These soils make up more than 4 percent of the county. They are very poorly drained, moderately well drained, and well drained soils on outwash terraces, stream terraces, and flood plains. They formed in medium textured to coarse textured glacial outwash and moderately fine textured to moderately coarse textured alluvium. They are used chiefly for row crops or small grain. Flooding, ponding, seasonal wetness, droughtiness, a moderate shrink-swell potential, a poor filtering capacity, and moderately slow permeability are the major limitations.

8. Westland-Eldean-Lippincott Association

Level to gently sloping, very poorly drained and well drained soils formed in glacial outwash

This association is in broad areas in valleys. It makes up about 3 percent of the county. It is about 25 percent Westland soils, 20 percent Eldean soils, 15 percent Lippincott soils, and 40 percent minor soils.

Westland and Lippincott soils are in low areas on outwash terraces and stream terraces. They are very poorly drained and are level and nearly level. They typically have a surface layer of silty clay loam. They have a seasonal high water table near or above the surface. Westland soils are moderately permeable in the subsoil and very rapidly permeable in the substratum. Lippincott soils are moderately permeable in the subsoil and rapidly permeable in the substratum.

Eldean soils are on flats, slight rises, and slope breaks on outwash terraces. They are well drained and are level to gently sloping. They typically have a surface layer of loam. They are moderately permeable or moderately slowly permeable in the subsoil and rapidly permeable or very rapidly permeable in the substratum.

Among the minor soils in this association are the Patton, Linwood, and Savona soils. Patton and Linwood soils have less gravel in the lower part than the major soils. They are in depressions on stream terraces and in old lake basins. Savona soils are somewhat poorly drained and are on flats and slight rises on outwash terraces.

A large part of the acreage is farmed intensively. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited to trees. Ponding on the Westland and Lippincott soils and droughtiness and the erosion hazard in areas of the Eldean soils are the principal management concerns if the major soils are farmed. Much of the acreage of Westland and Lippincott soils is drained by open ditches and subsurface drains. Drained areas dry out more quickly in spring than undrained areas. A good supply of underground water is generally available for irrigation.

The Westland and Lippincott soils are poorly suited to buildings and septic tank absorption fields because of ponding. The Eldean soils are well suited to these uses. The Eldean and Lippincott soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water supplies. All three soils are a good source of sand and gravel.

9. Eldean-Eel-Medway Association

Level to gently sloping, well drained and moderately well drained soils formed in glacial outwash and alluvium

This association is in areas along the major streams. It makes up about 1 percent of the county. It is about 35 percent Eldean soils, 15 percent Eel soils, 10 percent Medway soils, and 40 percent minor soils (fig. 4).

Eldean soils are on outwash terraces. They are well drained and are level to gently sloping. They typically have a surface layer of loam. They are moderately permeable or moderately slowly permeable in the subsoil and rapidly permeable or very rapidly permeable in the substratum.

Eel and Medway soils are on flood plains and are occasionally flooded. They are moderately well drained and are level and nearly level. They are moderately permeable. They typically have a surface layer of silt loam. They have a seasonal high water table at a depth of 18 to 36 inches.

Among the minor soils in this association are the Ockley, Savona, and Westland soils on outwash terraces and the Montgomery and Patton soils in low lying areas in old lakebeds. Ockley soils have a solum that is thicker than that of the Eldean soils and are not so droughty. Savona soils are somewhat poorly drained, and Westland, Montgomery, and Patton soils are very poorly drained.

Most of the acreage is farmed intensively. Some areas are farmed less intensively because of the hazard of flooding. The major soils are well suited to row crops, hay, pasture, and woodland. The Eel and Medway soils are not so well suited to winter wheat because of the flooding hazard in winter and spring. They are protected by levees in some areas. Drought and erosion are hazards in farmed areas of the Eldean soils. These soils are well suited to irrigation. They generally have a good supply of underground water.

The Eel and Medway soils are generally unsuited to buildings and septic tank absorption fields because of the flooding and seasonal wetness. Although a moderate shrink-swell potential and a poor filtering capacity are limitations, the Eldean soils are well suited to building site development and septic tank absorption fields. They readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water supplies. The Eldean soils are a good source of sand and gravel.

Level and Nearly Level Soils Formed in Lacustrine Sediments; on Lake Plains

These soils make up less than 1 percent of the county. They are very poorly drained and somewhat poorly drained soils mainly in glacial lake basins. They formed in medium textured to fine textured lacustrine sediments. They are used chiefly for row crops. Ponding, seasonal wetness, slow or very slow permeability, a moderate or high shrink-swell potential, and poor tilth are the major limitations.

10. Montgomery-Del Rey Association

Level and nearly level, very poorly drained and somewhat poorly drained soils formed in lacustrine sediments

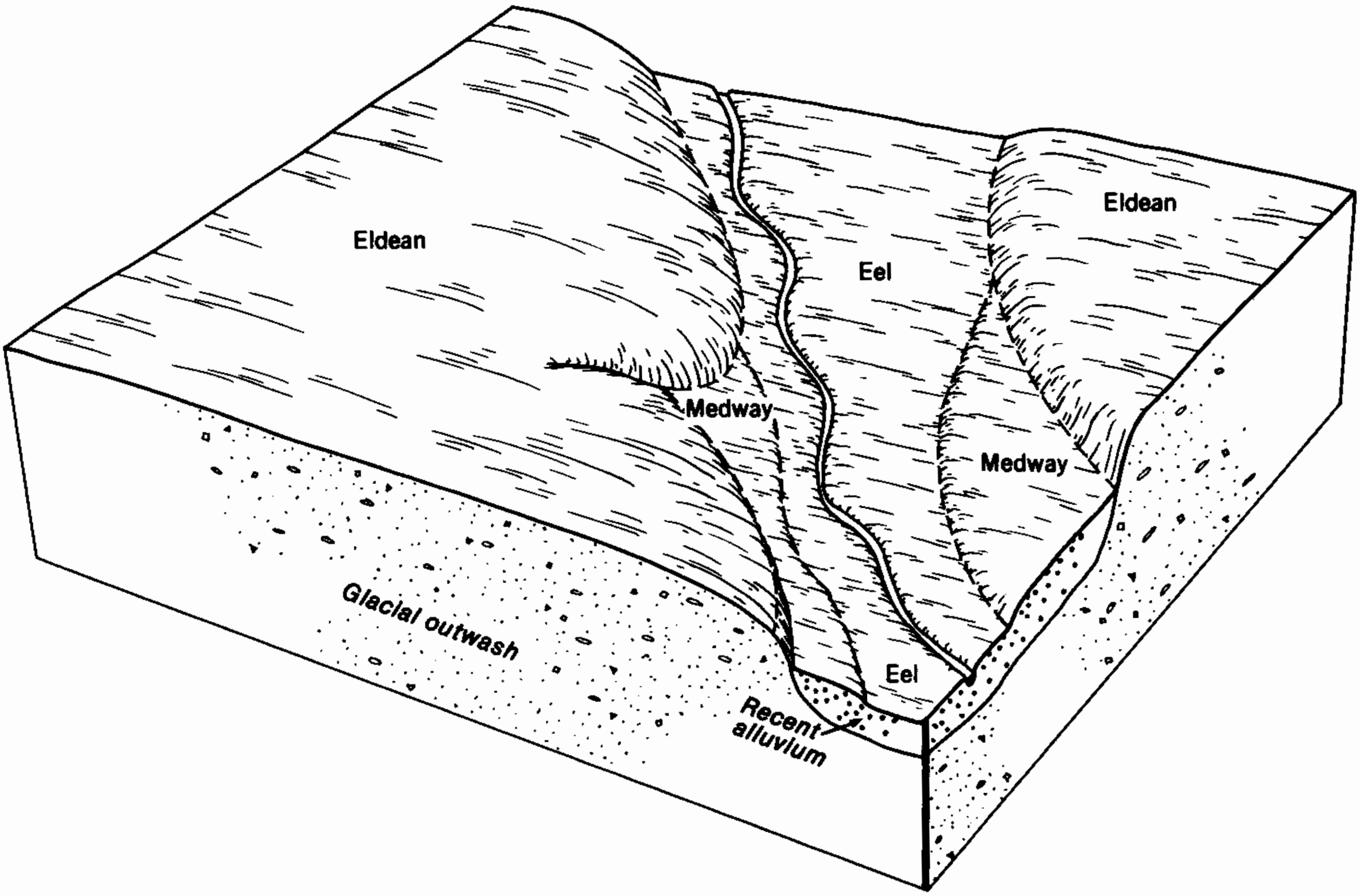


Figure 4.—Typical pattern of soils and parent material in the Eldean-Eel-Medway association.

This association is in broad depressions and on flats, mainly in the basins of glacial lakes. A few scattered areas are in depressions on till plains. The association makes up less than 1 percent of the county. It is about 80 percent Montgomery soils, 15 percent Del Rey soils, and 5 percent minor soils.

Montgomery soils are in the lowest areas on the landscape. They are very poorly drained and are slowly permeable or very slowly permeable. They have a seasonal high water table near or above the surface and are subject to ponding. They have a surface layer of silty clay. Tilth is poor.

Del Rey soils are in the slightly higher landscape positions. They are somewhat poorly drained and are slowly permeable. They have a seasonal high water table at a depth of 12 to 36 inches. They have a surface layer of silt loam. Tilth is good.

Among the minor soils in this association are the Pewamo soils. These soils formed in glacial till in areas where the lakebeds grade to till plains.

Most of the acreage is farmed intensively. The main farm enterprises are growing corn and soybeans for cash, dairying, and raising hogs and beef cattle. The major soils are well suited to row crops, small grain, hay, and pasture. They are moderately well suited to trees. Seasonal wetness and ponding are the major limitations in the farmed areas. Also, improving tilth in the surface layer of the Montgomery soils is a major management need. Much of the acreage is drained by open ditches and subsurface drains. Drained areas dry out more quickly in spring than undrained areas.

The major soils are moderately well suited or poorly suited to buildings and are poorly suited to septic tank absorption fields. The Del Rey soils are better suited to buildings than the Montgomery soils. Ponding, seasonal wetness, restricted permeability, and a moderate or high shrink-swell potential are the main limitations affecting urban development.

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, Glynwood silt loam, 2 to 6 percent slopes, is a phase in the Glynwood 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. Eldean-Miamian complex, 6 to 12 percent slopes, eroded, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Miscellaneous areas are identified by a special symbol on the soil maps.

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

Soil Descriptions

Ag—Algiers silt loam, occasionally flooded. This level and nearly level, somewhat poorly drained soil is on flood plains and stream terraces. Areas are 2 to 10 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is brown, friable silt loam about 9 inches thick. The next layer also is brown, friable silt loam. It is about 12 inches thick. Between depths of about 21 and 50 inches is a buried soil of very dark gray and dark gray, firm silty clay loam. The substratum to a depth of about 60 inches is gray, firm silty clay loam. The soil is mottled below a depth of about 28 inches.

Included with this soil in mapping are small areas of the very poorly drained Brookston and Pewamo soils. These soils are near the edges of the mapped areas. They make up about 10 percent of the unit.

If drained, the Algiers soil has a deep root zone. It has a high nutrient-holding capacity. Available water capacity is high. Permeability is moderate. A seasonal high water table is at a depth of 12 to 24 inches during extended wet periods. Surface runoff is slow. The surface layer is moderate in organic matter content. The root zone is slightly acid or neutral in the upper part and mildly alkaline or moderately alkaline in the lower part.

Most of the acreage is cropland or pasture. If drained, this soil is well suited to corn and soybeans. If a high level of management is applied, row crops can be grown year after year. The seasonal wetness and the occasional flooding are the main concerns in managing cropland. A subsurface drainage system and open ditches are needed. Diversion terraces may be needed to intercept runoff from the higher, sloping areas. If the soil is tilled during periods when it is wet and soft, tilth is a problem. It can be maintained or improved by deferring tillage during these periods and by returning crop residue to the soil.

This soil is well suited to grasses and legumes for hay and pasture. The silt loam surface layer compacts easily and is in poor tilth after the pasture is overgrazed or is grazed when wet. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the flooding and the seasonal wetness.

The land capability classification is IIw; the woodland ordination symbol is 2a.

BnA—Blount silt loam, 0 to 2 percent slopes. This level and nearly level, somewhat poorly drained soil is in broad areas on ground moraines and end moraines in the uplands. Areas generally are 5 to 42 acres in size. Most are convex, but a few are concave. Water collects and ponds in the concave areas.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 17 inches thick. It is mostly yellowish brown, mottled, firm silty clay loam, clay, and clay loam. The substratum to a depth of about 60 inches is yellowish brown mottled, firm clay loam till. In a few areas the surface layer is loam.

Included with this soil in mapping are small areas of the very poorly drained Pewamo soils in drainageways and depressions. Also included are small areas of the moderately well drained, sloping Glynwood soils at the head of drainageways. Included soils make up about 15 percent of the unit.

The root zone of the Blount soil is moderately deep. It is restricted by compact glacial till. Available water capacity is moderate. Permeability is slow. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. Surface runoff is slow. The soil has a medium nutrient-holding capacity. The subsoil is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. Cultivated crops can be grown frequently if a high level of management is applied. The seasonal wetness is the principal limitation. Most areas of cropland have been artificially drained. A subsurface drainage system, which is commonly used, is supplemented by a surface drainage system in many areas. Compaction is a problem if the soil is tilled when soft and wet. Cover crops, crop residue management, or additions of other organic material help to maintain good tilth and prevent excessive surface crusting.

This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when wet, the silt loam surface layer compacts easily and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is moderately well suited to trees. The species selected for planting should be those that are tolerant of wetness and a high clay content in the subsoil. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of the seasonal high water table and the slow permeability, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. In many areas the water table can be lowered by subsurface drains. Onsite investigation is needed to determine whether or not drainage outlets are available. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. If the surface is bare, erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

In some areas the performance of septic tank absorption fields can be improved by installing perimeter drains and by increasing the size of the absorption area. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 3c.

BnB—Blount silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on low knolls and ridges along small drainageways in the uplands. Most areas are 5 to more than 100 acres in size. Slopes commonly are convex and are 60 to 100 feet long.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 17 inches thick. It is mostly yellowish brown, mottled, firm silty clay loam, clay, and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam. In a few areas the surface layer is loam. Some areas on knolls are eroded. In these eroded areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the moderately well drained Glynwood soils on the crest of knolls and the very poorly drained Pewamo soils in drainageways and depressions. Also included are some areas where the slope is more than 8 percent. Included soils make up about 15 percent of the unit.

The root zone in the Blount soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Available water capacity is moderate. Permeability is slow. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. Surface runoff is medium. The subsoil is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. The seasonal wetness, a moderate erosion hazard, and tilth are the main management concerns if the soil is cropped. In most areas of cropland, some type of drainage system has been installed. A subsurface drainage system is commonly supplemented by a surface drainage system. Because of the uneven topography of the knolls and ridges, designing a drainage system is more difficult on this soil than on nearly level Blount soils. Compaction is a problem if this soil is tilled when wet and soft. A system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration, reduces the hazard of erosion, and helps to maintain tilth. Including grasses and legumes in the cropping sequence helps to control erosion and improves tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet can result in compaction and can damage the plant cover. The soil compacts easily. If the plant cover is damaged, the runoff rate and the erosion hazard increase. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is moderately well suited to trees. The species selected for planting should be those that are tolerant of wetness and a high clay content in the subsoil. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the seasonal wetness and the slow permeability, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. In most areas the water table can be lowered by subsurface drains. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. If the surface is bare, erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

In some areas the performance of septic tank absorption fields can be improved by installing perimeter drains and by increasing the size of the absorption areas. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIe; the woodland ordination symbol is 3c.

Br—Brookston silty clay loam. This level and nearly level, very poorly drained soil generally is in irregularly shaped upland depressions 10 to 200 acres in size. In some areas it occurs as narrow bands along drainageways. These areas commonly are less than 10 acres in size. The soil receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark gray, friable silty clay loam about 11 inches thick. The subsoil is about 36 inches thick. It is dark gray and grayish brown, mottled, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable loam glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby, moderately well drained Celina, and well drained Miamian soils in the slightly higher landscape positions. These soils make up about 15 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface throughout the soil.

If drained, the Brookston soil has a deep root zone. It has a high nutrient-holding capacity. Permeability is moderate. Available water capacity is high. A seasonal high water table is near or above the surface for long periods. Surface runoff is very slow, and water often collects or ponds on the surface. The subsoil is neutral or slightly acid in the upper part and mildly alkaline in the lower part. The surface layer is high in organic matter content. It becomes hard and cloddy if tilled when wet and soft.

Most of the acreage is used for intertilled crops or small grain. If drained, this soil is well suited to corn, soybeans, and small grain. If the soil is well managed, row crops can be grown year after year. Most areas of cropland have been drained. Surface and subsurface drains are effective in removing excess water. Diversion terraces may be needed to intercept and divert excess runoff from the higher adjacent areas. Tilth can be maintained or improved by returning crop residue to the soil and by deferring tillage when the soil is wet and soft. Boulders and stones interfere with tillage and excavation in included areas in the boulder belt.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when the soil is soft and wet, the silty clay loam surface layer compacts easily and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is moderately well suited to trees. Vines and the less desirable trees and shrubs should be removed. Competing vegetation can be controlled by good site preparation, by prescribed spraying, and by cutting or girdling. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent light, thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. The trees can be logged during the drier parts of the year.

This soil is poorly suited to buildings and septic tank absorption fields because of the ponding. In some areas the water table can be lowered by a subsurface drainage system. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Installing septic tank absorption fields in suitable fill material raises the field above normal ponding levels. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 2w.

Ca—Carlisle muck. This level and nearly level, very poorly drained soil is in bogs and swales on stream terraces and moraines in the uplands. It receives runoff from the higher adjacent soils and is frequently ponded. Areas generally are circular and are about 3 to 30 acres in size. Slope is 0 to 2 percent.

In a typical profile, the upper 15 inches is black, friable muck. Below this to a depth of about 66 inches is dark reddish brown and dark brown, friable, nonsticky muck. In a few areas the upper 6 inches is mainly mineral material.

Included with this soil in mapping are small areas of Linwood, Edwards, and Wallkill soils. These soils are near the edges of the mapped areas. They have mineral material or marl in part of the profile. They make up about 10 percent of the unit.

If drained, the Carlisle soil has a deep root zone. It has a very high available water capacity and a high nutrient-holding capacity. Permeability is moderately slow to moderately rapid. A seasonal water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water collects or ponds on the surface after periods of rainfall. The surface layer is very high in organic matter content. The soil is neutral or mildly alkaline throughout. It is highly compressible and unstable and is subject to subsidence or shrinkage if drained.

Most of the acreage is used as cropland or pasture. A few areas are idle or are used as habitat for wildlife. If drained, this soil is well suited to corn and soybeans. It is poorly suited to small grain, which lodges easily and is subject to frost heaving. Cultivated crops can be grown year after year if a high level of management is applied. Subsurface drains and open ditches are needed. Draining some areas is difficult because drainage outlets are inadequate. Ditchbanks are unstable. After the soil is drained, subsidence or shrinkage occurs as a result of oxidation of the organic material. Under these conditions, the subsurface drains are displaced. Unless the soil is protected by a plant cover, the soil blowing is a hazard during dry periods. It can be controlled by maintaining a plant cover and returning crop residue to the soil.

This soil is poorly suited to grasses for hay or pasture. Legumes, such as alfalfa, are subject to frost heaving in winter and spring. Water-tolerant grasses, especially reed canarygrass, grow well. Overgrazing or grazing when the soil is soft and wet damages the pasture.

Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. This soil is poorly suited to trees. The species selected for planting should be those that can withstand the wetness. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition. The trees can be logged during periods when the ground is frozen.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of ponding, low strength, and the moderately slow permeability.

The land capability classification is IIIw; the woodland ordination symbol is 4w.

CeA—Celina silt loam, 0 to 2 percent slopes. This level and nearly level, moderately well drained soil occurs as scattered areas on low, smooth ridgetops and along streams in the uplands. Most areas are 2 to 10 acres in size.

In a typical profile, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 7 inches of dark yellowish brown and yellowish brown, firm clay loam and clay. It is mottled below a depth of about 15 inches. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm loam glacial till. In some areas the soil is well drained.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils on foot slopes and soils that have a slope of 4 to 6 percent. Included soils make up about 10 percent of the unit.

The root zone in the Celina soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is slow. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. Cultivated crops can be grown frequently if a high level of management is applied. The major management concern is maintaining good tilth and a high level of fertility. Compaction is a problem if the soil is tilled when wet and soft. Returning crop residue to the soil and adding other organic material help to maintain good tilth and prevent excessive surface crusting.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. It is compacted and is in poor tilth after the pasture is overgrazed or is grazed when wet. Under these conditions, establishing plants is difficult. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is well suited to trees. Good site preparation is needed in areas where seedlings are to be planted.

This soil is moderately well suited to buildings and septic tank absorption fields. The moderately slow permeability, a moderate shrink-swell potential, and the seasonal wetness are limitations. Drains at the base of footings and exterior basement wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. Strengthening foundations and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling of the subsoil.

Perimeter drains around septic tank absorption fields lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Enlarging the absorption fields helps to overcome the moderately slow permeability. Local roads can be improved by additions of suitable base material and by a drainage system.

The land capability classification is I; the woodland ordination symbol is 1a.

CeB—Celina silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on low knolls and ridges on uplands dissected by many drainageways. Most areas are 2 to 30 acres in size. Slope are convex and are 60 to 80 feet long.

In a typical profile, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 17 inches of dark yellowish brown and yellowish brown, firm clay and clay loam. It is mottled below a depth of about 15 inches. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm loam glacial till. In some areas the soil is well drained. In other areas it is eroded. In these eroded areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby and Odell soils near and in drainageways and some spots where the soil is less than 12 inches deep over compact glacial till, tilth is poor, and productivity is lower. These included soils make up about 10 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone in the Celina soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is medium. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. Erosion is a moderate hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Crop residue management and additions of other organic material improve tilth and fertility, help to prevent excessive surface crusting, and increase the rate of water intake. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when wet, the silt loam surface layer becomes compacted and tilth deteriorates. Under these conditions, the runoff rate and the erosion hazard increase. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few small areas are wooded. This soil is well suited to trees. Good site preparation is needed in areas where seedlings are to be planted.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the moderately slow permeability, a moderate shrink-swell potential, and the seasonal wetness. Drains at the base of footings and exterior wall coatings help to keep basements dry. Strengthening foundations and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling of the subsoil. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

Perimeter drains around septic tank absorption fields lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Enlarging the absorption fields helps to overcome the moderately slow permeability. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIe; the woodland ordination symbol is 1a.

CrA—Crosby silt loam, 0 to 2 percent slopes. This level and nearly level, somewhat poorly drained soil is in broad areas on uplands. Most areas are 5 to more than 100 acres in size. Slopes are mainly convex, but a few are slightly concave.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 3 inches thick. The subsoil is about 26 inches thick. It is mostly yellowish brown and grayish brown, mottled, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm loam glacial till. In some areas the depth to the substratum is less than 20 inches.

Included with this soil in mapping are small, narrow areas of Brookston and Odell soils in drainageways and depressions and small areas of the moderately well drained Celina soils at the head of drainageways. These included soils make up about 10 percent of the unit. The surface layer of Brookston and Odell soils is darker than that of the Crosby soil. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone in the Crosby soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is slow. Surface runoff also is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. The subsoil is medium acid to neutral in the upper part and mildly alkaline or moderately alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. Cultivated crops can be grown frequently if a high level of management is applied. The seasonal wetness is the principal limitation. A subsurface drainage system is commonly supplemented by a surface drainage system. Compaction is a problem if the soil is tilled when soft and wet. Crop residue management or additions of other organic material help to maintain good tilth and prevent excessive surface crusting. Boulders and stones in included areas in the boulder belt interfere with tillage, excavation, and the installation of subsurface drains.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is well suited to trees. The species selected for planting should be those that can withstand some wetness.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the seasonal wetness and the slow permeability. The water table can be lowered by subsurface drains in some areas. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

Perimeter drains around septic tank absorption fields lower the water table. Installing the absorption field in suitable fill material raises the field above the seasonal high water table and increases the absorption rate. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 3a.

CrB—Crosby silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on low knolls and along many small drainageways in the uplands. Most areas are about 4 to 50 acres in size. Slopes are convex and are generally 75 to 100 feet long.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 3 inches thick. The subsoil is about 26 inches thick. It is mostly grayish brown and yellowish brown, mottled, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm loam glacial till. In some areas the depth to the substratum is less than 20 inches. Some areas on knolls are eroded. In these eroded areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of Brookston and Odell soils in and near drainageways and areas of the moderately well drained Celina soils on the slightly higher parts of the landscape. These included soils make up about 15 percent of the unit. The surface layer of Brookston and Odell soils is darker than that of the Crosby soil. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone in the Crosby soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. Surface runoff is medium. The subsoil is medium acid to neutral in the upper part and mildly alkaline or moderately alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. The seasonal wetness, a moderate erosion hazard, and tilth are the principal management concerns. Row crops can be grown frequently if erosion is controlled and the soil is adequately drained. In most areas of cropland, some type of drainage system has been installed. A subsurface drainage system is common. Because of the uneven topography of the knolls and ridges, designing a drainage system is more difficult on this soil than on level and nearly level Crosby soils. Compaction is a problem if the soil is tilled when soft and wet. Including grasses and legumes in the cropping sequence helps to control erosion and improves tilth. Cover crops, crop residue management, and additions of other organic material also improve tilth and help to control erosion. Boulders and stones in included areas in the boulder belt interfere with tillage, excavation, and the installation of subsurface drains.

If this soil is used for pasture, overgrazing or grazing when the soil is soft and wet can result in compaction of the silt loam surface layer and in poor tilth. If the plant cover is damaged, the runoff rate and the erosion hazard increase. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is moderately well suited to trees. The species selected for planting should be those that can withstand some wetness.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the seasonal wetness and the slow permeability. The water table can be lowered by subsurface drains if drainage outlets are available. Onsite investigation is needed to determine the availability of outlets. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

Perimeter drains around septic tank absorption fields lower the seasonal high water table. Installing the absorption field in suitable fill material raises the field above the water table and increases the absorption rate. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIe; the woodland ordination symbol is 3a.

DeA—Del Rey silt loam, 0 to 3 percent slopes. This level and nearly level, somewhat poorly drained soil generally is on broad flats at the edges of the basins of former glacial lakes. In a few scattered areas, it is on uplands. Most areas are irregularly shaped and are 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is light brownish gray, yellowish brown, and grayish brown, mottled, firm silty clay loam about 20 inches thick. The substratum to a depth of about 60 inches is light olive brown, mottled, stratified silty clay loam and silt loam. In some areas the soil formed in glacial till or is underlain by clay loam glacial till at a depth of about 5 feet.

Included with this soil in mapping are small areas of the very poorly drained Montgomery soils in depressions. These soils make up about 15 percent of most areas.

The Del Rey soil has a deep root zone and a medium nutrient-holding capacity. Permeability is slow. Surface runoff also is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated or bare areas, it tends to crust after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. Row crops can be grown frequently if a high level of management is applied. The seasonal wetness and surface crusting are the principal limitations. In most areas subsurface and surface drains remove excess surface water and lower the seasonal high water table. Compaction is a problem if the soil is tilled when soft and wet. Planting cover crops, returning crop residue to the soil, and applying other organic material help to maintain good tilth and prevent excessive surface crusting.

This soil is well suited to grasses and legumes for hay or pasture. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of the seasonal wetness and the slow permeability, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. Because of the wetness, it is better suited to houses without basements than to houses with basements. The water table can be lowered by a drainage system in some areas. Onsite investigation is needed to determine whether or not drainage outlets are available. Drains at the base of footings and exterior wall coatings help to keep crawl spaces or basements dry. Properly shaping building sites helps to keep surface water away from foundations. Installing septic tank absorption fields in suitable fill material increases the absorption rate and elevates the fields above the seasonal high water table. Perimeter drains lower the water table.

Low strength and frost action are limitations on sites for local roads. The roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 3c.

Ed—Edwards muck. This level and nearly level, very poorly drained soil is in low bogs and swales on stream terraces and moraines in the uplands. It receives runoff from the higher adjacent soils and is subject to ponding. Areas are mainly elongated and are about 3 to 20 acres in size. Slope is 0 to 2 percent.

In a typical profile, the upper 27 inches is black, friable muck. The substratum to a depth of about 60 inches is gray and light gray, mottled, friable marl.

Included with this soil in mapping are small areas of Carlisle, Linwood, and Wallkill soils. These soils are not underlain by marl. They are on the edges of the mapped areas. They make up about 10 percent of the unit.

If drained, the Edwards soil has a root zone that is mainly 16 to 48 inches deep over marl. The nutrient-holding capacity ranges from low to high, depending on the depth to marl. Available water capacity is high. Permeability is moderately slow to moderately rapid in the muck and varies in the underlying marl. A seasonal high water table is near or above the surface for long periods. Surface runoff is very slow, and water collects or ponds on the surface after periods of rainfall. The surface layer is very high in organic matter content. The muck is neutral or mildly alkaline, and the underlying marl is mildly alkaline or moderately alkaline. The soil is highly compressible and unstable and is subject to subsidence or shrinkage if drained.

Most areas are used as cropland or pasture. A few are used as habitat for wildlife. If drained, this soil is moderately well suited to corn and soybeans. It is poorly suited to small grain, which lodges easily and is subject to frost heaving. Cultivated crops can be grown year after year if a high level of management is applied. Subsurface drains and open ditches are needed. Draining some areas is difficult because drainage outlets are inadequate. The effectiveness of subsurface drainage systems is reduced by the oxidation and uneven settlement of the organic material after the soil is drained. Unless the soil is protected by a plant cover, soil blowing is a hazard. It can be controlled by maintaining a plant cover and returning crop residue to the soil.

This soil is poorly suited to grasses for hay or pasture. Legumes, such as alfalfa, are subject to frost heaving in winter and spring. Water-tolerant grasses, especially reed canarygrass, grow well. Overgrazing or grazing when the soil is soft and wet damages the pasture.

Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. This soil is poorly suited to trees. The species selected for planting should be those that can withstand the wetness. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition. The trees can be logged during periods when the ground is frozen.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of ponding, low strength, and the moderately slow permeability.

The land capability classification is IVw; the woodland ordination symbol is 4w.

Ee—Eel silt loam, occasionally flooded. This level and nearly level, moderately well drained soil is on flood plains along the major streams. It is the dominant soil on many of the narrow flood plains (fig. 5). In some areas it is extensively dissected by braided flood channels. Areas are commonly long and narrow and are 5 to 30 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The upper part of the substratum is dark grayish brown and yellowish brown, mottled, friable silt loam and loam. The lower part to a depth of about 60 inches is yellowish brown, very friable, stratified very gravelly loam and gravelly sandy loam. In some areas stratified, loose sand and gravel are below a depth of about 48 inches. In other areas the surface layer is loam. In places the soil is well drained and does not have mottles in the upper 20 inches. In a few areas the surface layer is darker.

Included with this soil in mapping are small areas of the somewhat poorly drained Shoals soils next to the uplands. These soils make up about 10 percent of the unit.

The Eel soil has a deep root zone and a medium nutrient-holding capacity. Permeability is moderate, and available water capacity is high. A seasonal high water table is at a depth of 18 to 36 inches. Surface runoff is slow. The surface layer is moderate in organic matter content. The root zone is neutral or mildly alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part. Tilth commonly is good.

Most of the acreage is used for row crops, small grain, or meadow crops. This soil is well suited to corn and soybeans. If the soil is protected against flooding, row

Figure 5.—A pastured area of Eel silt loam, occasionally flooded, on a narrow flood plain.

crops can be grown year after year. Flooding is most common in winter and spring. It often damages winter grain crops in unprotected fields. Internal drainage is generally good, but a drainage system is needed in some wet spots. Subsurface drains are effective in removing excess water.

Some areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

Some areas are wooded. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the flooding and the seasonal wetness. A few areas are protected by levees.

The land capability classification is IIw; the woodland ordination symbol is 1a.

EnA—Eldean loam, 0 to 2 percent slopes. This level and nearly level, well drained soil is in broad areas in outwash terraces near the major streams. Most areas are 3 to 40 acres in size.

In a typical profile, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 28 inches thick. It is dark yellowish brown, dark brown, and brown, firm clay loam, clay, and gravelly clay loam. The substratum to a depth of about 60 inches is yellowish brown, loose very gravelly loamy sand. In some areas the surface layer is silt loam. In a few areas the soil is moderately well drained and has mottles in the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Savona soils in swales and along drainageways and a few small areas at the head of drainageways where the slope is 4 to 6 percent. Also included are scattered small areas of Ockley soils, which have a subsoil that is thicker than that of the Eldean soil. Included soils make up about 10 percent of the unit.

The root zone in the Eldean soil is moderately deep. It is restricted by the sand and gravel. The nutrient-holding capacity is medium. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Available water capacity is low. Surface runoff is slow. The surface layer is moderate in organic matter content. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. Tilth is good throughout a wide range of moisture content.

Most of the acreage is cropland. A few areas are used for nursery or truck crops. This soil is well suited to corn, soybeans, and small grain and to specialty crops, such as nursery and truck crops. Drought is the main hazard. Crops can be seeded early in the year because the soil warms up and dries out early in spring. Returning crop residue to the soil and adding other organic material help to maintain good tilth and conserve moisture. The soil is well suited to irrigation. A good source of underground water is generally available.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet commonly causes compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is well suited to buildings and septic tank absorption fields. Extending the foundations of buildings into the substratum and backfilling along the foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling of the subsoil. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Installing the absorption field in suitable fill material improves the filtering capacity. Newly seeded lawns should be mulched and watered because the soil is droughty. The soil is a good source of sand and gravel.

The land capability classification is IIs; the woodland ordination symbol is 2a.

EnB—Eldean loam, 2 to 6 percent slopes. This gently sloping, well drained soil generally is along drainageways on outwash terraces near the major streams and their larger tributaries. In a few areas it is on knolls and ridges in the uplands. Most areas are 4 to 50 acres in size. Slopes are commonly 60 to 75 feet long.

In a typical profile, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 28 inches thick. It is mostly dark yellowish brown and reddish brown, firm clay loam, clay, and gravelly clay loam. The substratum to a depth of about 60 inches is yellowish brown, loose very gravelly loamy sand. In some areas the surface layer is silt loam. In a few areas the soil is moderately well drained and has mottles in the upper part of the subsoil. In places it is eroded.

Included with this soil in mapping are small areas of the somewhat poorly drained Savona soils along drainageways. Also included are scattered small areas of Ockley soils and small areas where the slope is 8 to 12 percent. Ockley soils have a subsoil that is thicker than that of the Eldean soil. Included soils make up about 10 percent of the unit.

The root zone of the Eldean soil is moderately deep. It is restricted by the sand and gravel. The nutrient-holding capacity is medium. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Available water capacity is low. Surface runoff is medium. The subsoil is medium acid to neutral in the upper part and mildly acid or neutral in the lower part. The surface layer is moderate in organic matter content. Tilth is good throughout a wide range of moisture content.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, small grain, and nursery and truck crops. If a high level of management is applied, row crops can be grown intensively in areas where the slope is 4 percent or less. Droughtiness and a moderate erosion hazard are the main management concerns. Crops can be seeded early in the year because the soil warms up and dries out early in spring. The cropping sequence commonly should include small grain and sod crops. Returning crop residue to the soil or adding other organic material helps to maintain tilth, helps to control erosion, and conserves moisture. The soil is suited to irrigation. A good source of underground water is generally available.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

A few scattered areas are wooded. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is well suited to buildings and septic tank absorption fields. Extending the foundations of buildings into the substratum and backfilling along the foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling of the subsoil. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Installing the absorption field in suitable fill material improves the filtering capacity. Newly seeded lawns should be mulched and watered because the soil is droughty. The soil is a good source of sand and gravel.

The land capability classification is IIe; the woodland ordination symbol is 2a.

ErC2—Eldean-Miamian complex, 6 to 12 percent slopes, eroded. These moderately sloping, well drained soils are on long, narrow ridges and knolls on moraines and kames dissected by many small drainageways. Areas are 3 to 30 acres in size. Slopes are mainly convex and are 60 to 150 feet long. In most areas the surface layer is a mixture of the original surface soil and the upper part of the subsoil.

This unit is about 40 percent Eldean loam, 35 percent Miamian silt loam, and 25 percent other soils. The Eldean soil is commonly on the tops and upper side slopes of knolls and ridges. The Miamian soil is on the middle and lower parts of the side slopes. The two soils occur as areas so intricately mixed that mapping them separately is not practical.

In a typical profile of the Eldean soil, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 18 inches thick. It is mostly dark yellowish brown and reddish brown, firm clay loam, clay, and gravelly clay loam. The substratum to a depth of about 60 inches is yellowish brown, loose very gravelly loamy coarse sand. In a few areas the slope is 4 to 6 percent. In some areas on foot slopes, the surface layer is darker.

In a typical profile of the Miamian soil, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 16 inches thick. It is mostly dark yellowish brown, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In a few areas the slope is 4 to 6 percent.

Included with these soils in mapping are small areas of Ockley soils on the lower part of the slopes. These included soils have a subsoil that is thicker than that of the Eldean and Miamian soils. Small included areas of soils having a subsoil that is thinner than that of the Eldean and Miamian soils and severely eroded soils that have a clay loam surface layer are on the upper part of the slopes. These soils are droughtier and less productive than the Eldean and Miamian soils. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil. Included soils make up about 25 percent of the unit.

The root zone in the Eldean and Miamian soils generally is moderately deep. It is restricted by the sand and gravel in the Eldean soil and by the compact glacial till in the Miamian soil. Both soils have a medium nutrient-holding capacity. Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. It is moderately slow in the Miamian soil. Available water capacity is low in the Eldean soil and moderate in the Miamian soil. Because of erosion, the surface layer of both soils is lower in organic matter content than that of uneroded Eldean and Miamian soils. Surface runoff is medium or rapid. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part.

Most areas are used as cropland or pasture. If erosion is controlled, these soils are moderately well suited to corn, soybeans, and small grain. Erosion is a severe hazard. Also, the Eldean soil is droughty. A cropping sequence that includes close-growing crops and grasses and legumes helps to control erosion. Applying a system of conservation tillage that leaves crop residue on the surface, planting winter cover crops, and returning crop residue to the soil help to prevent excessive soil loss and conserve moisture. The soils are subject to rapid erosion if they are plowed in the fall. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

These soils are well suited to grasses and legumes for hay and pasture. No-till seeding methods help to control erosion and conserve moisture. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. These soils are well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing plants can be controlled by good site preparation, by prescribed spraying, and by cutting or girdling.

These soils are well suited to buildings. The slope and the shrink-swell potential are limitations. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations and basement walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling of the subsoil. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Local roads can be improved by additions of suitable base material, which helps to prevent the damage caused by low strength and frost action.

These soils are moderately well suited to septic tank absorption fields. The Eldean soil readily absorbs but does not adequately filter the effluent, and the Miamian soil does not absorb the effluent at a sufficiently rapid rate. The poor filtering capacity of the Eldean soil can result in the pollution of ground water. Installing the absorption field in suitable fill material improves the filtering capacity of the Eldean soil and increases the absorption rate in areas of the Miamian soil. Installing the distribution lines on the contour helps to prevent seepage of the effluent to the surface.

The land capability classification is IIIe; the woodland ordination symbol assigned to the Eldean soil is 2a, and that assigned to the Miamian soil is 1a.

ErD2—Eldean-Miamian complex, 12 to 18 percent slopes, eroded. These moderately steep, well drained soils are on long, narrow ridges and knolls on moraines and kames dissected by many small drainageways. Areas are 3 to 25 acres in size. Slopes are mainly convex and are 60 to 150 feet long. In most areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

This unit is about 40 percent Eldean loam, 35 percent Miamian silt loam, and 25 percent other soils. The Eldean soil is commonly on the tops and upper side slopes of knolls and ridges. The Miamian soil is on the middle and lower parts of the side slopes. The two soils occur as areas so intricately mixed that mapping them separately is not practical.

In a typical profile of the Eldean soil, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 17 inches thick. It is mostly dark yellowish brown and reddish brown, firm clay, clay loam, and gravelly clay loam. The substratum to a depth of about 60 inches is yellowish brown, loose very gravelly loamy coarse sand. In a few areas on foot slopes, the surface layer is darker.

In a typical profile of the Miamian soil, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 17 inches thick. It is mostly dark yellowish brown, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till.

Included with these soils in mapping are small areas of Ockley soils on the lower part of the slopes. These included soils have a subsoil that is thicker than that of the Eldean and Miamian soils. Small included areas of soils having a subsoil that is thinner than that of the Eldean and Miamian soils and severely eroded soils that have a clay loam surface layer are on the upper part of the slopes. These soils are droughtier and less productive than the Eldean and Miamian soils. Also included are a few areas where the slope is 6 to 10 percent and, in the boulder belt, areas where stones and boulders are on the surface and throughout the soil. Included soils make up about 25 percent of the unit.

The root zone in the Eldean and Miamian soils generally is moderately deep. It is restricted by the sand and gravel in the Eldean soil and by the compact glacial till in the Miamian soil. Both soils have a medium nutrient-holding capacity. Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. It is moderately slow in the Miamian soil. Available water capacity is low in the Eldean soil and moderate in the Miamian soil. Because of erosion, the surface layer of both soils is lower in organic matter content than that of uneroded Eldean and Miamian soils. Surface runoff is rapid. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part.

Most areas are used as cropland or pasture. These soils are poorly suited to corn and soybeans. They are better suited to small grain. The main management concern is a severe erosion hazard. Also, the Eldean soil is droughty. A cropping sequence that includes close-growing crops and grasses and legumes helps to control erosion. Applying a system of conservation tillage that leaves crop residue on the surface, planting winter cover crops, and returning crop residue to the soil help to prevent excessive soil loss and conserve moisture. The soils are subject to rapid erosion if they are plowed in the fall. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

These soils are moderately well suited to grasses and legumes for hay and pasture. Conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting, help to control erosion and conserve moisture. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. These soils are well suited to trees. Measures that control erosion and competing plants are needed. Removing vines and the less desirable trees and shrubs helps to control plant competition. Establishing logging roads and skid trails on the contour facilitates the use of equipment and reduces the erosion hazard. Water bars or other erosion-control measures are needed.

These soils are only moderately well suited to buildings because of the slope and the shrink-swell potential. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations and basement walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling of the subsoil. Local roads can be improved by additions of suitable base material, which helps to prevent the damage caused by low strength and frost action. The roads should be built across the slope. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

These soils are poorly suited to septic tank absorption fields. The Eldean soil readily absorbs but does not adequately filter the effluent, and the Miamian soil does not absorb the effluent at a sufficiently rapid rate. The poor filtering capacity of the Eldean soil can result in the pollution of ground water. Installing the absorption field in suitable fill material improves the filtering capacity of the Eldean soil and increases the absorption rate in areas of the Miamian soil. Installing the distribution lines on the contour helps to prevent seepage of the effluent to the surface.

The land capability classification is IVe; the woodland ordination symbol assigned to the Eldean soil is 2r, and that assigned to the Miamian soil is 1r.

GnB—Glynwood silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on knolls, ridges, and side slopes at the head of drainageways in the uplands. Most areas are irregular in shape and are 2 to 20 acres in size. Slopes are convex and are commonly 60 to 100 feet long. They are dissected by small drainageways.

In a typical profile, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 22 inches thick. It is mostly dark yellowish brown and brown, firm clay loam and clay. It is mottled below a depth of about 12 inches. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on foot slopes and areas where the slope is 8 to 12 percent. Also included are small areas of the very poorly drained Pewamo soils in narrow drainageways. Included soils make up about 15 percent of the unit.

The root zone of the Glynwood soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is medium. The subsoil is medium acid to neutral in the upper part and mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated or bare areas, it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. Erosion is a moderate hazard, and wetness is a slight limitation. Randomly spaced subsurface drains may be needed in the wetter included soils. Compaction is a problem if the soil is tilled when soft and wet. A cropping sequence that includes small grain or other close-growing crops and sod crops helps to maintain tilth and control erosion. Conservation tillage, winter cover crops, and grassed waterways also help to prevent excessive soil loss. Returning crop residue to the soil, adding other organic material, and planting cover crops improve tilth, increase the organic matter content, help to prevent excessive surface crusting, and increase the rate of water intake.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is soft and wet results in surface compaction, poor tilth, and excessive runoff and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is well suited to trees. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the slow permeability, a moderate shrink-swell potential, and the seasonal wetness. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. Strengthening foundations and basement walls and backfilling with coarser textured material help to prevent the structural damage caused by shrinking and swelling. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

In some areas perimeter drains around septic tank absorption fields are needed to lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Enlarging the absorption field helps to overcome the slow permeability. Local roads can be improved by additions of suitable base material and by a drainage system where outlets are available.

The land capability classification is IIe; the woodland ordination symbol is 2c.

GnB2—Glynwood silt loam, 2 to 6 percent slopes, eroded. This gently sloping, moderately well drained soil is on knolls, ridges, and side slopes at the head of drainageways in the uplands. Most areas are irregular in shape and are 4 to 40 acres in size. Slopes are convex and are commonly about 50 to 100 feet long. They are dissected by many small drainageways. In most areas the surface layer is a mixture of the original surface soil and the upper part of the subsoil.

In a typical profile, the surface layer is mixed brown and dark yellowish brown, firm silt loam about 8 inches thick. The subsoil is about 14 inches thick. It is mostly yellowish brown, mottled, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In some areas the soil is well drained and does not have mottles in the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on foot slopes and areas where the slope is 8 to 12 percent. Also included are small areas of the very poorly drained Pewamo soils in narrow drainageways and severely eroded areas where the surface layer is clay loam, tilth is poor, and the soil is less productive than the Glynwood soil. Included soils make up about 15 percent of the unit.

The root zone of the Glynwood soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is medium because of the gentle slope and the eroded surface layer. The subsoil is medium acid to neutral in the upper part and mildly alkaline in the lower part. The surface layer is moderately low in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall. Internal drainage is generally good, but some areas on the lower slopes are wet in spring.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. Erosion is a severe hazard. A significant amount of the original surface layer has already eroded away. Compaction is a problem if the soil is tilled when soft and wet. A cropping system that includes close-growing crops and grasses and legumes helps to control erosion. Conservation tillage, winter cover crops, and grassed waterways also help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth, help to prevent excessive surface crusting, and increase the rate of water intake. The soil is susceptible to severe erosion if it is plowed in the fall.

This soil is well suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is soft and wet results in surface compaction, poor tilth, and excessive runoff and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few scattered areas support hardwoods. This soil is well suited to trees. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the slow permeability, a moderate shrink-swell potential, and the seasonal wetness. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. Strengthening foundations and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

In some areas perimeter drains around septic tank absorption fields are needed to lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Enlarging the absorption field helps to overcome the slow permeability. Local roads can be improved by additions of suitable base material and by a drainage system where outlets are available.

The land capability classification is IIIe; the woodland ordination symbol is 2c.

GnC2—Glynwood silt loam, 6 to 12 percent slopes, eroded. This moderately sloping, moderately well drained soil is on knolls, ridges, and side slopes near drainageways in the uplands. Most areas are irregular in shape and are 3 to 70 acres in size. Slopes are 40 to 100 feet long and are commonly dissected by small, narrow drainageways. A few areas have short gullies 1 to 2 feet deep. In most areas the surface layer is a mixture of the original surface soil and the upper part of the subsoil.

In a typical profile, the surface layer is mixed brown and dark yellowish brown, firm silt loam about 8 inches thick. The subsoil is about 14 inches thick. It is mostly yellowish brown, mottled, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In some areas the surface layer is clay loam. In other areas the soil is well drained and does not have mottles in the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on foot slopes and areas where the slope is 15 to 18 percent. Also included are severely eroded areas where the surface layer is clay loam, tilth is poor, and the soil is less productive than this Glynwood soil. Included soils make up about 15 percent of the unit.

The root zone of the Glynwood soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Available water capacity is moderate. Permeability is slow. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is medium or rapid because of the slope and the eroded surface layer. The subsoil is medium acid to neutral in the upper part and mildly alkaline in the lower part. The surface layer is moderately low in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is poorly suited to corn, soybeans, and small grain. The hazard of erosion is severe in cultivated areas. Conservation tillage, cover crops, grassed waterways, and a cropping sequence that includes grasses and legumes help to control erosion and maintain tilth. Crop residue management and additions of manure improve tilth, help to prevent excessive surface crusting, and increase the rate of water intake. Tilling within the proper range of moisture content helps to prevent excessive compaction. The soil is highly susceptible to erosion if it is plowed in the fall.

This soil is well suited to grasses and legumes for hay or pasture. If the soil is plowed during seedbed preparation or if the pasture is overgrazed, erosion is a severe hazard. It can be controlled by no-till seeding methods and by cover crops or companion crops. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few scattered areas support hardwoods. This soil is well suited to trees. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is only moderately well suited to buildings and septic tank absorption fields because of the slow permeability, a moderate shrink-swell potential, the seasonal wetness, and the slope. Drains at the base of footings and exterior wall coatings help to keep basements dry. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover.

The effluent from septic tanks can seep to the surface because of the slope and the limited depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption fields helps to overcome the slow permeability. Interceptor drains are needed upslope from the absorption fields. Additions of suitable base material and a drainage system help to prevent the damage to local roads caused by frost action and low strength.

The land capability classification is IVe; the woodland ordination symbol is 2c.

GyC3—Glynwood clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, moderately well drained soil is on knolls, ridges, and side slopes at the head of drainageways in the uplands. Areas are about 5 to 20 acres in size. Some have short gullies 1 to 3 feet deep. Slopes are commonly 50 to 100 feet long. In most places erosion has removed most or all of the original surface soil. The present surface layer is mostly subsoil material.

In a typical profile, the surface layer is dark yellowish brown, firm clay loam about 6 inches thick. The subsoil is about 6 inches thick. It is mostly yellowish brown, mottled, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In some spots the substratum is exposed. In some areas the soil is well drained and does not have mottles in the subsoil.

Included with this soil in mapping are small areas of the uneroded Glynwood soils and areas where the slope is 15 to 18 percent. Also included are small areas of the somewhat poorly drained Blount soils. These soils are in the less sloping areas near and around the drainageways. Included soils make up about 15 percent of the unit.

The root zone of the Glynwood soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is low or medium. Permeability is slow. Available water capacity is low. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is rapid because of the slope and the severely eroded surface layer. This layer is low in organic matter content. Reaction is commonly mildly alkaline in the surface layer and moderately alkaline in the subsoil. Tilth is fair. The soil can be worked only within a narrow range of moisture content.

Most of the acreage has been cultivated. Some is used as pasture and some as cropland. This soil is poorly suited to corn and soybeans. It is better suited to small grain. Erosion is a severe hazard in cultivated areas. The cropping system should include grasses and legumes and only an occasionally grown cultivated crop. Conservation tillage, cover crops, crop residue management, and additions of other organic material help to control erosion and improve tilth. A good plant cover is the best means of controlling erosion. The soil is susceptible to rapid erosion if it is plowed in the fall.

This soil is moderately well suited to grasses and legumes for hay and pasture. If the soil is plowed during seedbed preparation or if the pasture is overgrazed, erosion is a severe hazard. It can be controlled by conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting. Cover crops or companion crops also help to control erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. The species selected for planting should be those that can withstand the high clay content in the surface layer and subsoil. Erosion control and proper site preparation are needed. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the slow permeability, a moderate shrink-swell potential, the seasonal wetness, and the slope, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Drains at the base of footings and exterior wall coatings help to keep basements dry. Strengthening foundations and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The hazard of erosion is severe during construction.

The effluent from septic tank absorption fields seeps to the surface in some areas because of the slope and the shallow depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption field helps to overcome the slow permeability. Interceptor drains are needed upslope from the absorption fields. Establishing lawns is difficult.

Blanketing the site with soil material containing less clay helps to establish the plant cover. Additions of suitable base material on sites for local roads helps to prevent the damage caused by low strength and frost action.

The land capability classification is IVe; the woodland ordination symbol is 2c.

GyD3—Glynwood clay loam, 12 to 18 percent slopes, severely eroded. This moderately steep, moderately well drained soil is on narrow side slopes and slope breaks at the head of drainageways in the uplands. Most areas are 2 to 14 acres in size. Some have short gullies 1 to 3 feet deep. Slopes are commonly 50 to 120 feet long. In most places erosion has removed most or all of the original surface soil. The present surface layer is mostly subsoil material.

In a typical profile, the surface layer is dark yellowish brown, firm clay loam about 6 inches thick. The subsoil is about 6 inches thick. It is mostly yellowish brown, mottled, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam glacial till. In some spots the substratum is exposed. In some areas the soil is well drained and does not have mottles in the subsoil.

Included with this soil in mapping are small areas of the uneroded Glynwood soil and areas where the slope is 20 to 25 percent. Included soils make up about 15 percent of the unit.

The root zone of the Glynwood soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is low or medium. Permeability is slow. Available water capacity is low. A seasonal high water table is at a depth of 24 to 42 inches. Surface runoff is very rapid because of the moderately steep slope and the severely eroded surface layer. This layer is low in organic matter content. Reaction commonly is mildly alkaline in the surface layer and moderately alkaline in the subsoil. Tilth is fair. The soil can be tilled only within a narrow range of moisture content.

Most of the acreage formerly was cultivated but is now pastured. Only a few areas are cropped. This soil is generally unsuited to cultivated crops and is poorly suited to grasses and legumes for hay and permanent pasture. Unless an adequate plant cover is maintained, erosion is a serious hazard. It can be controlled by conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods improve the pasture.

This soil is moderately well suited to trees. The species selected for planting should be those that can withstand the high clay content in the subsurface layer and subsoil. Competing vegetation should be controlled or removed. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Constructing logging 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.

This soil is poorly suited to buildings and septic tank absorption fields because of the slow permeability, the seasonal wetness, and the slope. Buildings should be designed so that they conform to the natural slope of the land. Drains at the base of footings and exterior wall coatings help to keep basements dry. The hazard of erosion is severe during construction.

The effluent from absorption fields seeps to the surface in some areas because of the slope and the shallow depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Interceptor drains are needed upslope from the absorption fields. Enlarging the absorption field helps to overcome the slow permeability. Establishing lawns is difficult. Blanketing the site with soil material containing less clay helps to establish the plant cover.

The land capability classification is VIe; the woodland ordination symbol is 2r.

LeB—Lewisburg silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on low knolls and ridges on uplands dissected by many drainageways. Most areas are 2 to 10 acres in size. Slopes are convex and are 60 to 80 feet long.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 7 inches thick. It is brown, mottled, firm clay and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm loam glacial till. In a few areas the depth to glacial till is more than 20 inches. Some areas are eroded. In these eroded areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby and Pyrmont soils on foot slopes, small areas of the very poorly drained Brookston soils in drainageways, and some areas where the depth to glacial till is less than 10 inches, tilth is poor, and the soil is less productive than the Lewisburg soil. These included soils make up about 15 percent of the unit. Also included are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Lewisburg soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is medium or low. Permeability is moderate or moderately slow in the subsoil and slow in the substratum. Available water capacity is low. Surface runoff is medium. A seasonal high water table is at a depth of 18 to 42 inches during extended wet periods. The subsoil is slightly acid or neutral in the upper part and mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. Erosion is a moderate hazard in cultivated areas. A system of conservation tillage that leaves crop residue on the surface, winter cover crops, and grassed waterways help to prevent excessive soil loss. Crop residue management and additions of other organic material improve tilth and fertility, help to prevent excessive surface crusting, and increase the rate of water intake. In some included areas, boulders and stones interfere with tillage and excavation.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when wet, the silt loam surface layer becomes compacted and tilth deteriorates. Under these conditions, the runoff rate and the erosion hazard increase. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is moderately well suited to buildings and septic tank absorption fields because of the slow permeability and the seasonal wetness. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Perimeter drains around septic tank absorption fields lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Enlarging the absorption field helps to overcome the slow permeability. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIe; the woodland ordination symbol is 2a.

Ln—Linwood muck. This level and nearly level, very poorly drained soil is in low bogs and swales on stream terraces and moraines in the uplands. It receives runoff from the higher adjacent soils and is subject to ponding. Areas are mainly long and narrow and are about 2 to 30 acres in size. Slope is 0 to 2 percent.

In a typical profile, the upper 21 inches is black and very dark gray, friable muck. Below this to a depth of about 60 inches is dark gray and gray, mottled, firm silt loam. In a few areas the muck is less than 16 inches thick.

Included with this soil in mapping are small areas of Edwards and Wallkill soils. These soils are near the edges of the mapped areas. They make up about 10 percent of the unit. Edwards soils are underlain by marl. Wallkill soils have mineral material in the upper part.

If drained, the Linwood soil has a deep root zone. It has a very high available water capacity and a high nutrient-holding capacity. Permeability is moderately slow to moderately rapid in the muck and moderate in the underlying mineral material. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water collects or ponds on the surface after periods of rainfall. The surface layer is very high in organic matter content. The muck is slightly acid to mildly alkaline, and the mineral material is neutral to moderately alkaline. The soil is highly compressible and unstable and is subject to subsidence or shrinkage if drained.

Most of the acreage is cropland or pasture. A few areas are used as habitat for wildlife. If drained, this soil is well suited to corn and soybeans. It is poorly suited to small grain, which lodges easily and is subject to frost heaving. Cultivated crops can be grown year after year if a high level of management is applied. Subsurface drains and open ditches are needed. Draining some areas is difficult because drainage outlets are inadequate. Ditchbanks are unstable. The effectiveness of subsurface drainage systems is reduced by the oxidation and uneven settlement of the organic material after the soil is drained. Unless the soil is protected by a plant cover, soil blowing is a hazard. It can be controlled by maintaining a plant cover and returning crop residue to the soil.

This soil is poorly suited to grasses for hay or pasture. Legumes, such as alfalfa, are subject to frost heaving in winter and spring. Water-tolerant grasses, especially reed canarygrass, grow well. Overgrazing or grazing when the soil is soft and wet damages the pasture.

Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. This soil is poorly suited to trees. The species selected for planting should be those that can withstand the wetness. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Removing vines and the less desirable trees and shrubs helps to control plant competition. The trees can be logged during periods when the ground is frozen.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of ponding, low strength, and the moderately slow permeability.

The land capability classification is IIw; the woodland ordination symbol is 4w.

Lp—Lippincott silty clay loam. This level and nearly level, very poorly drained soil is in slight depressions on glacial outwash terraces and low benches on stream terraces. It receives runoff from the higher adjacent soils and is subject to ponding. Areas are rather narrow and long. Most are 5 to 80 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark gray, friable and firm silty clay loam about 13 inches thick. The subsoil is about 25 inches thick. The upper part is gray and dark gray, mottled, firm silty clay loam, and the lower part is light brownish gray, mottled, firm very gravelly loam. The substratum to a depth of about 60 inches is light brownish gray, loose very gravelly coarse sandy loam and extremely gravelly loamy coarse sand.

Included with this soil in mapping are small areas of Montgomery, Patton, and Algiers soils. Montgomery and Patton soils have less gravel in the lower part than the Lippincott soil. Also, they are in lower areas. Algiers soils are somewhat poorly drained and are near the base of slopes. Included soils make up about 15 percent of the unit.

The root zone in the Lippincott soil is moderately deep. It is restricted by the sand and gravel. The nutrient-holding capacity is high. Permeability is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water often collects or ponds on the surface after periods of rainfall. The surface layer is high in organic matter content. The subsoil is slightly acid or neutral in the upper part and neutral to moderately alkaline in the lower part. The soil can be tilled only within a narrow range of moisture content.

Most of the acreage is cropland or pasture. If drained, this soil is well suited to corn, soybeans, and small grain. Most areas of cropland have been drained. Subsurface drains and open ditches improve drainage. The soil becomes compacted and cloddy if worked during periods when it is wet and sticky. Tilth can be maintained or improved by deferring tillage during these periods and by returning crop residue to the soil.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet and soft can easily result in compaction of the silty clay loam surface layer. Also, grazing when the soil is wet commonly results in poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The trees can be logged and planted during the drier parts of the year.

Because of the ponding and a poor filtering capacity, this soil is poorly suited to buildings and septic tank absorption fields. It is better suited to houses without basements than to houses with basements because of the ponding. Open ditches help to remove ponded water. In some areas the water table can be lowered by a subsurface drainage system. Onsite investigation is needed to determine whether or not drainage outlets are available. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. Installing the absorption field in suitable fill material improves the filtering capacity and raises the field above ponding levels. Local roads should be elevated above ponding levels. Also, a suitable base material is needed to prevent the damage caused by low strength.

The land capability classification is IIw; the woodland ordination symbol is 2w.

Md—Medway silt loam, occasionally flooded. This level and nearly level, moderately well drained soil is in long, narrow areas on flood plains, mainly along the major streams. Areas are 5 to 60 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 10 inches thick. The subsoil is brown, mottled, friable silt loam about 11 inches thick. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, friable clay loam and sandy loam. In some areas the surface layer is silty clay loam or loam. In other areas the soil is well drained and does not have mottles in the subsoil. In a few areas the surface layer is lighter colored.

This Medway soil has a deep root zone and a high nutrient-holding capacity. Permeability is moderate. A seasonal high water table is at a depth of 18 to 36 inches during extended wet periods. Surface runoff is slow. Available water capacity is high. The surface layer is high in organic matter content. The subsoil is mildly alkaline. Tilth is good.

Most areas are used for row crops, small grain, or meadow crops. This soil is well suited to corn and soybeans. If protected against flooding, row crops can be grown year after year. Flooding is most common in winter and spring and can damage winter grain crops in unprotected fields. Internal drainage is generally good, but a drainage system is needed in some wet spots. Subsurface drains are effective in removing excess water.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

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

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the flooding and the seasonal wetness. A few areas are protected by levees. The soil is a good source of topsoil.

The land capability classification is IIw; the woodland ordination symbol is 1a.

MmA—Miamian silt loam, 0 to 2 percent slopes. This level and nearly level, well drained soil is in scattered areas on low, smooth ridgetops. Most areas are 2 to 30 acres in size.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 23 inches of dark yellowish brown and yellowish brown, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In some areas the soil is moderately well drained. In other areas the substratum has strata of sandy loam, sand, silt, and some gravel at a depth of 40 to 80 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils on the flatter, slightly depressed parts of the ridgetops. Also included are small areas of soils that have a slope of 4 to 6 percent. Included soils make up about 10 percent of the unit.

The root zone of the Miamian soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. Surface runoff is slow. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated or bare areas, it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. Cultivated crops can be grown frequently if a high level of management is applied. The major management concern is maintaining good tilth and a high level of fertility. Compaction is a problem if the soil is tilled when wet and soft. Additions of large amounts of crop residue and other organic material help to maintain good tilth and prevent excessive surface crusting.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. It is compacted and is in poor tilth after the pasture is overgrazed or is grazed when wet. Under these conditions, establishing plants is difficult. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas support hardwoods. This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. The moderately slow permeability and a moderate shrink-swell potential are limitations. Properly shaping building sites helps to keep surface water away from foundations. Extending the foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Enlarging septic tank absorption fields helps to overcome the moderately slow permeability. Local roads can be improved by additions of suitable base material.

The land capability classification is I; the woodland ordination symbol is 1a.

MmB—Miamian silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on low knolls and ridges on uplands dissected by small drainageways. Most areas are about 5 to 100 acres in size. Slopes are convex and are commonly 60 to 100 feet long.

In a typical profile, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 23 inches of dark yellowish brown and yellowish brown, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In a few areas the soil is moderately well drained. In some areas it is eroded. In these eroded areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby and very poorly drained Brookston soils in and near drainageways and a few areas of soils that have a slope of about 8 to 10 percent. These included soils make up about 10 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. Surface runoff is medium. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland. This soil is suited to corn, soybeans, and small grain. The major management concerns are maintaining tilth and a high level of fertility and controlling erosion. Erosion is a moderate hazard if cultivated crops are grown. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Crop residue management and additions of other organic material improve tilth and fertility, help to prevent excessive surface crusting, and increase the rate of water intake. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few small areas support hardwoods. This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

Even though a moderate shrink-swell potential is a limitation, this soil is well suited to buildings. It is only moderately well suited to septic tank absorption fields because of the moderately slow permeability. Properly shaping building sites helps to keep surface water away from foundations. Extending the foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Enlarging septic tank absorption fields helps to overcome the moderately slow permeability. Local roads can be improved by additions of suitable base material.

The land capability classification is IIe; the woodland ordination symbol is 1a.

MmC2—Miamian silt loam, 6 to 12 percent slopes, eroded. This moderately sloping, well drained soil is on knolls, ridges, and side slopes at the head of drainageways in the uplands. It is dissected by small, narrow drainageways. Some areas have a few short gullies 1 to 2 feet deep. Most areas are 5 to 50 acres in size. Slopes are convex and are generally 40 to 100 feet long. In most areas the surface layer is a mixture of the original surface soil and the upper part of the subsoil.

In a typical profile, the surface layer is mixed brown and yellowish brown, firm silt loam about 7 inches thick. The subsoil is about 7 inches thick. It is mostly dark yellowish brown, firm clay loam and clay. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils near drainageways and on the lower parts of the slopes and some severely eroded areas where the surface layer is clay loam, tilth is poor, and the soil is less productive than this Miamian soil. These included soils make up about 15 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. Surface runoff is medium or rapid. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderately low in organic matter content. In cultivated or bare areas, it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is moderately well suited to corn and soybeans. It is well suited to small grain. If cultivated crops are grown, erosion is a hazard. Conservation tillage, cover crops, grassed waterways, and a cropping sequence that includes grasses and legumes help to prevent excessive soil loss. Crop residue management or regular additions of other organic material improve tilth, help to prevent excessive surface crusting, and increase the rate of water intake. Tilling only within the proper range of moisture content helps to prevent excessive compaction. The soil is subject to severe erosion if it is plowed in the fall. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

This soil is well suited to grasses and legumes for pasture or hay. Overgrazing or grazing when the soil is soft and wet causes surface compaction, excessive runoff, and poor tilth. Erosion can be controlled by no-till seeding methods and by cover crops or companion crops. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. The moderately slow permeability, a moderate shrink-swell potential, and the slope are limitations. Buildings should be designed so that they conform to the natural slope of the land. Extending foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. The effluent from septic tank absorption fields can seep to the surface because of the slope and the limited depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption field helps to overcome the moderately slow permeability. Local roads can be improved by additions of suitable base material.

The land capability classification is IIIe; the woodland ordination symbol is 1a.

MmD2—Miamian silt loam, 12 to 18 percent slopes, eroded. This moderately steep, well drained soil is generally on side slopes that parallel drainageways in the uplands. In a few areas it is on knolls. Some areas have scattered short gullies 1 to 2 feet deep. Most areas are 5 to 30 acres in size. Slopes are convex and are commonly 60 to 120 feet long. In most places erosion has removed part of the original surface soil. The present plow layer is a mixture of the original surface soil and the upper part of the subsoil.

In a typical profile, the surface layer is mixed brown and dark yellowish brown, firm silt loam about 7 inches thick. The subsoil is about 17 inches thick. It is mostly dark yellowish brown, firm clay loam and clay. The substratum at a depth of about 60 inches is yellowish brown, firm loam glacial till. In some areas the soil is slightly eroded.

Included with this soil in mapping are narrow strips of soils that have a slope of about 20 to 25 percent and some severely eroded areas where the surface layer is clay loam, tilth is poor, and the soil is less productive than this Miamian soil. These included soils make up about 15 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. Surface runoff is rapid. The subsoil is medium acid to neutral in the upper part and mildly alkaline in the lower part. The surface layer is moderately low in organic matter content. In cultivated areas it tends to crust or seal after periods of rainfall.

Most of the acreage is cropland or pasture. This soil is poorly suited to corn and soybeans and is moderately well suited to small grain. If cultivated crops are grown, erosion is a severe hazard. The cropping system should include grasses and legumes and only an occasionally grown cultivated crop. Conservation tillage, cover crops, grassed waterways, and a cropping sequence that includes grasses and legumes help to prevent excessive soil loss. Crop residue management or additions of other organic material improve tilth, help to prevent excessive surface crusting, and increase the rate of water intake. Tilling only within the proper range of moisture content helps to prevent excessive compaction. The soil is susceptible to erosion if it is plowed in the fall. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

This soil is moderately well suited to grasses and legumes for hay and pasture. If the soil is plowed during seedbed preparation or the pasture is overgrazed, erosion is a severe hazard. It can be controlled by conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting. Cover crops or companion crops also help to control erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is well suited to trees. Erosion control, good site preparation, prescribed spraying, and cutting or girdling are needed. Removing vines and the less desirable trees and shrubs helps to control plant competition. Establishing logging roads and skid trails on the contour facilitates the use of equipment and reduces the erosion hazard. Water bars, a protective plant cover, or other erosion-control measures are needed.

Because of the slope and the shrink-swell potential, this soil is only moderately well suited to buildings. It is poorly suited to septic tank absorption fields because of the slope and the moderately slow permeability. Buildings should be designed so that they conform to the natural slope of the land. Extending the foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. The hazard of erosion is severe if vegetation is removed. Stockpiling the surface layer and then spreading it hasten reestablishment of the plant cover. The effluent from septic tank absorption fields can seep to the surface because of the slope and the limited depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption field helps to overcome the moderately slow permeability.

The land capability classification is IVe; the woodland ordination symbol is 1r.

MmE—Miamian silt loam, 18 to 25 percent slopes. This well drained, steep soil is on side slopes along the major streams in the uplands. It is dissected by many small drainageways. Most areas are 3 to 20 acres in size. Slopes are 80 to 160 feet long and are mainly smooth and uniform. In some areas, the upper part of the slope is slightly convex and the toe slopes are slightly concave.

In a typical profile, the surface layer is very dark gray, friable silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 23 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In a few areas the surface layer is loam.

Included with the soil in mapping are small areas of soils that have a slope of about 30 to 40 percent and, on very steep escarpments, spots of severely eroded soils that have a lower available water capacity than this Miamian soil. These included soils make up about 15 percent of the unit. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is medium. Permeability is moderately slow. Available water capacity is moderate. Surface runoff is very rapid. The subsoil is medium acid or slightly acid in the upper part and mildly alkaline in the lower part.

A few areas are pastured. This soil is generally unsuited to cropland and is poorly suited to grasses and legumes for permanent pasture and meadow. Unless an adequate plant cover is maintained, erosion is a hazard. It can be controlled by conservation tillage methods of seedbed preparation that leave plant residue on the surface, including no-till planting. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition. In included areas in the boulder belt, boulders and stones interfere with pasture management and excavation.

Most areas are wooded. This soil is well suited to trees. Erosion control, good site preparation, prescribed spraying, and cutting or girdling are needed. Removing vines and the less desirable trees and shrubs helps to control plant competition. Establishing logging roads and skid trails on the contour facilitates the use of equipment and reduces the erosion hazard.

This soil is poorly suited to buildings and septic tank absorption fields because of the steep slope and the moderately slow permeability. Buildings should be designed so that they conform to the natural slope of the land. The effluent from septic tank absorption fields can seep to the surface. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption field helps to overcome the moderately slow permeability. If possible, the better suited soils nearby should be selected as sites for absorption fields. The erosion hazard is severe if the vegetative cover is removed.

The land capability classification is VIe; the woodland ordination symbol is 1r.

MnC3—Miamian clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, well drained soil is on knolls, ridges, and side slopes at the head of drainageways in the uplands. Short gullies 1 to 3 feet deep are common. Most areas are 2 to 30 acres in size. Slopes are convex and are commonly 50 to 100 feet long. In most places erosion has removed most or all of the original surface soil. The present surface layer is mostly subsoil material.

In a typical profile, the surface layer is yellowish brown, firm clay loam about 7 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 8 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In some spots the substratum is exposed.

Included with this soil in mapping are small areas of the less eroded Miamian soils and a few areas of soils that have a slope of 15 to 18 percent. These included soils make up about 10 percent of the unit. The root zone of the less eroded Miamian soils is thicker than that of this Miamian soil. Also, tilth is better. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is low or medium. Permeability is moderately slow. Available water capacity is low. Surface runoff is rapid because of the slope and the severely eroded surface layer. This layer is low in organic matter content. The subsoil is mildly alkaline or moderately alkaline and typically has free carbonates. Tilth is fair. The soil can be tilled only within a narrow range of moisture content.

Most of the acreage has been cultivated. Some areas are used as cropland. This soil is poorly suited to corn and soybeans. Erosion is a severe hazard if cultivated crops are grown. The cropping system should include grasses and legumes and only an occasionally grown cultivated crop. Conservation tillage, cover crops, grassed waterways, and crop residue management or additions of manure help to control erosion and improve tilth. A good plant cover is needed. The soil is susceptible to erosion if it is plowed in the fall. In included areas in the boulder belt, boulders and stones interfere with tillage and excavation.

Some areas are used for pasture and hay. This soil is moderately well suited to grasses and legumes for hay and pasture. The hazard of erosion is severe. If the soil is plowed during seedbed preparation or the pasture is overgrazed, erosion is a severe hazard. It can be controlled by conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting. Cover crops or companion crops also help to control erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

This soil is well suited to buildings but is poorly suited to septic tank absorption fields. The slow permeability, a moderate shrink-swell potential, and the slope are limitations. Buildings should be designed so that they conform to the natural slope of the land. Extending the foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. The effluent from septic tank absorption fields can seep to the surface because of the slope and the shallow depth to compact glacial till. Installing the distribution lines on the contour reduces this hazard. Establishing lawns is difficult. Blanketing the site with soil material containing less clay helps to establish the plant cover. Local roads can be improved by additions of suitable base material. The erosion hazard is severe during construction.

The land capability classification is IVe; the woodland ordination symbol is 1a.

MnD3—Miamian clay loam, 12 to 18 percent slopes, severely eroded. This moderately steep, well drained soil is on side slopes that parallel drainageways in the uplands. Short gullies 1 to 3 feet deep are common. Most areas are 2 to 22 acres in size. Slopes are convex and are commonly 50 to 100 feet long. In most places erosion has removed most or all of the original surface soil. The present surface layer is mostly subsoil material.

In a typical profile, the surface layer is yellowish brown, firm clay loam about 7 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 8 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. In some spots the substratum is exposed.

Included with this soil in mapping are small areas of the less eroded Miamian soils and a few areas of soils that have a slope of more than 20 percent. These included soils make up about 10 percent of the unit. The root zone of the less eroded Miamian soils is thicker than that of this Miamian soil. Also, tilth is better. Also included, in the boulder belt, are areas where stones and boulders are on the surface and throughout the soil.

The root zone of the Miamian soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is low or medium. Permeability is moderately slow. Available water capacity is low. Surface runoff is very rapid because of the slope and the severely eroded surface layer. This layer is low in organic matter content. The subsoil is mildly alkaline or moderately alkaline and commonly has free carbonates. Tilth is fair. The soil can be tilled only within a narrow range of moisture content.

Most of the acreage has been cultivated. Some areas are pastured, and some are used as cropland. This soil is generally unsuitable as cropland and is poorly suited to grasses and legumes for hay and pasture. Controlled grazing helps to maintain the plant cover and reduces the susceptibility to erosion and compaction. Conservation tillage methods of seedbed preparation that keep plant residue on the surface, including no-till planting, help to prevent excessive soil loss. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition. In included areas in the boulder belt, boulders and stones interfere with excavation and pasture management.

This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Establishing logging roads and skid trails on the contour facilitates the use of equipment and reduces the erosion hazard. Water bars, a protective plant cover, or other erosion-control measures are needed.

Because of the moderately slow permeability, a moderate shrink-swell potential, and the slope, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Extending the foundations into the substratum helps to prevent the structural damage caused by shrinking and swelling. Because of the shallow depth to compact glacial till and the slope, the effluent from septic tank absorption fields can seep to the surface. Installing the distribution lines on the contour reduces this hazard. Enlarging the absorption field helps to overcome the moderately slow permeability. Establishing lawns is difficult. Blanketing the site with soil material containing less clay helps to establish the plant cover. Local roads can be improved by additions of suitable base material. Bare areas are highly erodible.

The land capability classification is VIe; the woodland ordination symbol is 1r.

Mt—Montgomery silty clay. This level and nearly level, very poorly drained soil generally is in depressional areas on lakebeds that formerly were glacial lakes. In a few small areas, it is in depressional areas on uplands. It commonly is ponded during wet periods. Most areas are about 50 to 80 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark gray, firm silty clay about 13 inches thick. It is mottled below a depth of about 10 inches. The subsoil is dark gray and gray, mottled, firm silty clay about 28 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay. In some areas the surface layer is silty clay loam. In a few areas clay loam glacial till is at a depth of 5 to 6 feet.

Included with this soil in mapping are small areas of Algiers, Wallkill, and Pewamo soils. These soils are on the edges of the mapped areas. Algiers soils are somewhat poorly drained. Wallkill soils have organic material in the lower part. Pewamo soils formed in glacial till. Included soils make up about 15 percent of the unit.

If drained, the Montgomery soil has a deep root zone. It has a high nutrient-holding capacity. Permeability is slow or very slow. Available water capacity is high. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water often collects or ponds on the surface after periods of rainfall. The surface layer is high in organic matter content. The subsoil is slightly acid or neutral in the upper part and mildly alkaline in the lower part.

Most of the acreage is cropland or pasture. A few undrained areas are used as habitat for wildlife. If drained, this soil is well suited to corn, soybeans, and small grain. If the soil is well managed, row crops can be grown year after year. Most areas of cropland have been drained. Subsurface drains and open ditches are needed. Diversion terraces and open ditches are needed in some areas to intercept and divert excess runoff from the higher adjacent areas. The soil compacts readily and becomes cloddy if tilled when wet. Tilth can be improved by returning crop residue to the soil and by deferring tillage when the soil is wet and soft.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The wetness limits the use of planting and harvesting equipment in winter and spring. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seeding mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the ponding, the slow or very slow permeability, and a high shrink-swell potential, this soil is poorly suited to buildings and septic tank absorption fields. Surface and subsurface drains remove excess water. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Installing septic tank absorption fields in suitable fill material elevates the fields above high ponding levels and helps to overcome the restricted permeability. Local roads can be improved by a drainage system and by additions of suitable base material. These measures help to remove excess water and prevent the damage caused by low strength and by shrinking and swelling.

The land capability classification is IIIw; the woodland ordination symbol is 2w.

OcA—Ockley silt loam, 0 to 2 percent slopes. This level and nearly level, well drained soil is on outwash terraces bordering the major streams. Most areas are 5 to 30 acres in size and are irregularly shaped.

In a typical profile, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil is about 34 inches thick. It is friable and firm and is dark yellowish brown and dark brown. It is silt loam and silty clay loam in the upper part and gravelly clay loam in the lower part. The substratum to a depth of about 70 inches is brown, loose extremely gravelly loamy coarse sand. In some areas the soil is moderately well drained and has mottles in the upper part of the subsoil.

Included with this soil in mapping are narrow areas where the slope is 4 to 8 percent. These areas are on short breaks at the head of drainageways. Also included are small areas of the moderately well drained Medway soils on flood plains and small areas of Wea soils on slope breaks to the uplands. Wea soils have a dark surface layer. Included soils make up about 10 percent of the unit.

The Ockley soil has a deep root zone and a high nutrient-holding capacity. Permeability is moderate in the subsoil and very rapid in the substratum. Available water capacity is moderate. Surface runoff is slow. The surface layer is moderate in organic matter content. The subsoil is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. Tilth is good.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, small grain, and nursery and truck crops. If well managed, it can be used for cultivated crops year after year. In areas that are farmed intensively, the major management concern is maintaining good tilth and a high level of fertility. Returning crop residue to the soil helps to maintain the organic matter content and good tilth. The soil is well suited to irrigation. A good supply of underground water generally is available.

This soil is well suited to pasture, but it rarely is used for permanent pasture because it is so well suited to row crops. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

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

This soil is well suited to buildings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for buildings. Strengthening foundations and basement walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling of the subsoil. Because of a poor filtering capacity in the substratum, installing septic tank absorption fields too deep in the soil can result in pollution of ground water. Low strength and frost action are limitations on sites for local roads. Strengthening or replacing the base material helps to overcome these limitations. A few areas have been excavated for sand and gravel. The soil is a good source of sand and gravel.

The land capability classification is I; the woodland ordination symbol is 1a.

OcB—Ockley silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on low slope breaks, knolls, and ridges on outwash terraces and on kames in the uplands. Slopes generally are convex and are 80 to 140 feet long. Most areas are 5 to 40 acres in size.

In a typical profile, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil is about 34 inches thick. It is mostly dark yellowish brown and dark brown, firm silty clay loam, clay loam, and gravelly clay loam. The substratum to a depth of about 70 inches is yellowish brown, loose very gravelly loamy coarse sand. In some areas the soil is a poor source of sand and gravel because the substratum is sandy loam or loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Savona soils near the base of the sloping uplands. Also included are scattered small areas of Eldean soils, which have sand and gravel at a depth of 20 to 40 inches. Included soils make up about 10 percent of the unit.

The Ockley soil has a deep root zone and a high nutrient-holding capacity. Permeability is moderate in the subsoil and very rapid in the substratum. Available water capacity is moderate. Surface runoff is medium. The surface layer is moderate in organic matter content. The subsoil is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. Tilth is good.

Nearly all of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. If well managed, it can be used for cultivated crops year after year. In areas that are farmed intensively, the major management concerns are maintaining good tilth and a high level of fertility and controlling erosion. Conservation tillage, winter cover crops, and crop residue management help to maintain the organic matter content and good tilth and prevent excessive soil loss.

This soil is well suited to pasture, but it rarely is used for permanent pasture because it is so well suited to row crops. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

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

This soil is well suited to buildings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for buildings. Strengthening foundations and basement walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling of the subsoil. Because of a poor filtering capacity in the substratum, installing septic tank absorption fields too deep in the soil can result in the pollution of ground water. Low strength and frost action are limitations on sites for local roads. Strengthening or replacing the base material helps to overcome these limitations. A few areas have been excavated for sand and gravel. The soil is a good source of sand and gravel.

The land capability classification is IIe; the woodland ordination symbol is 1a.

OdA—Odell silt loam, 0 to 3 percent slopes. This level and nearly level, somewhat poorly drained soil is in scattered areas on uplands. Areas are irregularly shaped and are about 2 to 10 acres in size.

In a typical profile, the surface layer is very dark grayish brown, friable silt loam about 12 inches thick. The subsoil is dark brown, light olive brown, and yellowish brown, mottled, firm clay loam about 23 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable loam glacial till.

Included with this soil in mapping are small areas of the very poorly drained Brookston and Patton soils in depressions and small areas of Crosby soils in the slightly higher landscape positions. Crosby soils have a surface layer that is lighter colored than that of the Odell soil. Also included are small areas of the moderately well drained Celina soils on the higher knolls. Included soils make up about 15 percent of the unit.

The root zone of the Odell soil is moderately deep. It is restricted by compact glacial till. The nutrient-holding capacity is high. Permeability is moderately slow. Available water capacity is high. Surface runoff is slow. A seasonal high water table is at a depth of 12 to 36 inches during extended wet periods. The surface layer is high in organic matter content. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Tilth generally is good.

Most of the acreage is used for row crops or small grain. If drained, this soil is well suited to corn, soybeans, and small grain. Subsurface drains are effective in removing excess water.

This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when wet, the silt loam surface layer becomes compacted and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to buildings and septic tank absorption fields because of the seasonal wetness and the moderately slow permeability. The water table can be lowered by subsurface drains in some areas. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Drains at the base of footings and exterior wall coatings help to keep basements dry. Installing septic tank absorption fields in suitable fill material elevates the fields above the seasonal high water table and helps to overcome the moderately slow permeability. On sites for local roads, a drainage system and suitable base material are needed to prevent the damage caused by frost action and seasonal wetness.

The land capability classification is IIw; no woodland ordination symbol is assigned.

Pa—Patton silty clay loam. This level and nearly level, very poorly drained soil is in depressional areas that formerly were small glacial lakes. It receives runoff from the higher adjacent soils and is subject to ponding. Most areas are 5 to 55 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark grayish brown, friable silty clay loam about 11 inches thick. The subsurface layer is very dark gray, mottled, friable silty clay loam about 6 inches thick. The subsoil is gray and dark gray, mottled, firm silty clay loam about 19 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay loam. In some areas the soil is 4 to 5 feet deep over loam till. In a few areas free carbonates are at the surface and throughout the soil.

Included with this soil in mapping are small areas of the somewhat poorly drained Algiers soils. These soils are along the edges of the mapped areas. Also included, in the deeper depressions, are small areas of Montgomery soils, which have more clay in the subsoil and substratum than the Patton soil. Included soils make up about 10 percent of the unit.

In drained areas, the Patton soil has a deep root zone. It has a high nutrient-holding capacity. Permeability is moderately slow. Available water capacity is high. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water often collects or ponds on the surface after periods of rainfall. The subsoil is neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is high in organic matter content. It can be tilled only within a narrow range of moisture content.

Most of the acreage is cultivated (fig. 6). If drained, this soil is well suited to corn, soybeans, and small grain. If well managed, it can be cultivated year after year. Most areas of cropland have been drained. Subsurface drains and open ditches are needed. Careful management is needed to maintain good tilth because the soil becomes compacted and cloddy if tilled when wet and soft.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs help to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The use of planting and harvesting equipment is limited during wet periods. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is poorly suited to buildings and septic tank absorption fields because of the ponding and the moderately slow permeability. Surface drains remove ponded water. In some areas the water table can be lowered by subsurface drains. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Installing septic tank absorption fields in suitable fill material elevates the fields above high ponding levels and helps to overcome the moderately slow permeability. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 2w.

Pe—Pewamo silty clay loam. This level and nearly level, very poorly drained soil generally is in broad depressions on till plains. In some areas, mainly on moraines, it is along narrow drainageways. It receives runoff from the higher adjacent soils and is subject to ponding (fig. 7). Most areas are irregularly shaped and are 3 to 100 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark grayish brown, firm silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, mottled, firm silty clay loam about 4 inches thick. The subsoil is about 54 inches thick. It is dark gray and gray, mottled, firm clay and clay loam. The substratum to a depth of about 72 inches is brown, mottled, firm clay loam glacial till. In some areas the dark surface soil is only about 6 to 8 inches thick. In a few areas the surface layer is silt loam. In places the subsoil has less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils at the head of drainageways and small areas of the very poorly drained Montgomery soils in extremely low depressions. Included soils make up about 5 percent of the unit.

In drained areas, the Pewamo soil has a deep root zone. It has a high nutrient-holding capacity. Permeability is moderately slow. Available water capacity is high. A seasonal high water table is near or above the surface for long periods. Surface runoff is very slow, and water often ponds or collects on the surface after periods of rainfall. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is high in organic matter content. It can be tilled only within a narrow range of moisture content.

Most of the acreage is used for row crops and small grain. A few areas are wooded or pastured. If drained, this soil is well suited to corn, soybeans, and small grain. If the soil is well managed, row crops can be grown year after year. Most areas of cropland have been drained. Subsurface drains and open ditches are needed. Diversion terraces may be needed to intercept and divert

Figure 6.—An area of Patton silty clay loam used as cropland. A severely eroded Miamian soil is in the lighter colored areas in the background.

excess runoff from the higher adjacent areas. Maintaining tilth is important because the soil becomes compacted and cloddy if tilled during periods when it is wet and soft. Tilth can be maintained or improved by deferring tillage during these periods and by returning crop residue to the soil.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few scattered areas support hardwoods. This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The wetness limits the use of planting and harvesting equipment in winter and spring. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the

Figure 7.—Ponding in an area of Pewamo silty clay loam.

remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is poorly suited to buildings and septic tank absorption fields because of the ponding and the moderately slow permeability. In some areas the water table can be lowered by a subsurface drainage system. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Installing septic tank absorption fields in suitable fill material raise the fields above normal ponding levels and helps to overcome the moderately slow permeability. On sites for local roads, a drainage system and suitable base material are needed to prevent the damage caused by ponding, low strength, and frost action.

The land capability classification is IIw; the woodland ordination symbol is 2w.

PyA—Pyrmont silt loam, 0 to 3 percent slopes. This level and nearly level, somewhat poorly drained soil is in irregularly shaped areas on uplands. Most areas are 5 to 40 acres in size. Slopes are mainly convex, but a few are concave.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is yellowish brown and brown, mottled, firm clay loam about 11 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm and very firm loam glacial till. Some areas are eroded.

Included with this soil in mapping are small narrow areas of the very poorly drained Brookston soils in depressions and drainageways and small areas of the moderately well drained Lewisburg and Celina soils in the higher positions at the head of drainageways. Also included are spots where the depth to glacial till is less than 10 inches and the soil is less productive than this Pyrmont soil. Included soils make up about 10 percent of the unit.

The root zone of the Pyrmont soil is shallow. It is restricted by compact glacial till. The nutrient-holding capacity is medium or low. Permeability is moderate or moderately slow in the subsoil and slow in the substratum. Available water capacity is moderate. Surface runoff is slow. A seasonal high water table is at a depth of 6 to 18 inches during extended wet periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The surface layer is moderate in organic matter content. In cultivated or bare areas, it tends to crust after periods of rainfall.

Most of the acreage is cropland. This soil is well suited to corn, soybeans, and small grain. The seasonal wetness is the principal limitation. A subsurface drainage system commonly is supplemented by a surface drainage system. Compaction is a problem if the soil is tilled when soft and wet. Crop residue management or additions of other organic material help to maintain good tilth and prevent excessive surface crusting.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

Some scattered areas support hardwoods. Because of the seasonal wetness and the shallow root zone, this soil is only moderately well suited to trees.

Because of the seasonal wetness and the slowly permeable substratum, this soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior coatings on basement walls help to keep basements dry. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Perimeter drains around septic tank absorption fields lower the seasonal high water table. Onsite investigation is needed to determine whether or not drainage outlets are available. Increasing the size of the absorption field helps to overcome the restricted permeability. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 3a.

Sa—Saranac silty clay, frequently flooded. This level and nearly level, very poorly drained soil is on low flood plains. It occurs as one long and narrow area about 70 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark grayish brown, firm silty clay about 10 inches thick. The subsoil is about 30 inches thick. It is dark gray and very dark gray, mottled, firm silty clay and silty clay loam. The upper part of the substratum is grayish brown, mottled, friable, stratified clay loam and silt loam. The lower part to a depth of about 66 inches is dark grayish brown, mottled, firm clay loam glacial till. In a few areas the surface layer is lighter colored silty clay loam.

Included with this soil in mapping are small areas of Montgomery soils in slight depressions and Pewamo soils in the slightly higher landscape positions. Montgomery soils formed in lakebed sediments. Pewamo soils formed in glacial till. Included soils make up about 10 percent of the unit.

The Saranac soil has a deep root zone when the water table is low. It has a high nutrient-holding capacity. Permeability is moderately slow. Available water capacity is high. Surface runoff is very slow. A seasonal high water table is near the surface during extended wet periods. The subsoil is neutral or mildly alkaline. The surface layer is high in organic matter content. It is readily compacted and becomes cloddy if tilled when wet. It can be tilled only within a narrow range of moisture content.

Nearly all of the acreage is cropland. The flooding and the seasonal wetness are the main management concerns. The flooding usually occurs during winter and spring. If drained, this soil is well suited to corn and soybeans, which can be planted after the period of most spring floods. The soil is less well suited to winter crops, specialty crops, and other crops that can be severely damaged by floodwater. Subsurface drains help to lower the water table. Timely tillage is important because the soil puddles and clods if worked when wet and soft. Cover crops help to maintain tilth and fertility.

If drained, this soil is well suited to grasses and legumes for hay and pasture. Overgrazing and grazing when the soil is soft and wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. The trees can be planted and harvested during the drier parts of the year.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the flooding, the seasonal wetness, and the moderately slow permeability.

The land capability classification is IIIw; the woodland ordination symbol is 2w.

SeA—Savona silt loam, 0 to 2 percent slopes. This level and nearly level, somewhat poorly drained soil is on low benches on outwash terraces bordering the major streams. It generally is above the normal level of flooding. Most areas are 5 to 30 acres in size.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 2 inches thick. The subsoil is about 38 inches thick. The upper part is grayish brown, mottled, firm clay, and the lower part is yellowish brown and brown, mottled, firm gravelly loam and friable very gravelly coarse sandy loam. The substratum to a depth of about 72 inches is brown, mottled, loose extremely gravelly coarse sand. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of the very poorly drained Lippincott and Westland soils in depressions. Also included are a few spots where the soil is less than 30 inches deep over sand and gravel, has a lower available water capacity than the Savona soil, and is less productive. Included soils make up about 15 percent of the unit.

The Savona soil has a deep root zone. It has a medium nutrient-holding capacity. Available water capacity is high. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Surface runoff is slow. A seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The surface layer is moderate in organic matter content. The subsoil is neutral or slightly acid in the upper part and neutral or mildly alkaline in the lower part.

Most of the acreage is cropland or pasture. This soil is well suited to corn, soybeans, and small grain. If a high level of management is applied, cultivated crops can be frequently grown. The seasonal wetness is the main limitation. Unless drained, the soil warms up slowly and dries out late in spring. Most areas of cropland have been drained. Subsurface drains are commonly supplemented by open ditches. Cover crops, crop residue management, or additions of other organic material help to maintain good tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet results in poor tilth because the silt loam surface layer compacts easily. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

Because of the seasonal wetness, this soil is only moderately well suited to buildings. In some areas the water table can be lowered by a drainage system. Onsite investigation is needed to determine whether or not drainage outlets are available. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations.

This soil is poorly suited to septic tank absorption fields because of the seasonal wetness and the restricted permeability in the subsoil. Installing the absorption fields in suitable fill material elevates the fields above the seasonal high water table and helps to overcome the restricted permeability. Because of a poor filtering capacity in the substratum, installing the fields too deep in the soil can result in the pollution of ground water. On sites for local roads, suitable base material and a drainage system are needed to prevent the damage caused by low strength and frost action.

The land capability classification is IIw; the woodland ordination symbol is 3a.

Sh—Shoals silt loam, occasionally flooded. This level and nearly level, somewhat poorly drained soil is on flood plains. It makes up the entire flood plain along many of the smaller streams. Some areas are dissected by braided flood channels. Some receive seepage from the adjacent uplands. Areas are long and narrow and are 2 to 15 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is dark grayish brown, friable silt loam about 5 inches thick. The upper part of the substratum is multicolored, mottled, friable silt loam. The lower part to a depth of about 60 inches is grayish brown, mottled, stratified, friable sandy loam and loam. In some areas the surface layer is loam. In a few areas glacial till is at a depth of 36 to 48 inches.

Included with this soil in mapping are small areas of the moderately well drained Eel and Medway soils. Eel soils are next to the stream channels. Medway soils are at the base of the sloping uplands. Included soils make up about 15 percent of the unit.

The Shoals soil has a deep root zone when the water table is low. It has a medium nutrient-holding capacity. Permeability is moderate. Available water capacity is high. Surface runoff is slow. A seasonal high water table is at a depth of 6 to 18 inches during extended wet periods. The surface layer is moderate in organic matter content. Reaction is neutral or mildly alkaline in the upper 20 inches and mildly alkaline or moderately alkaline below that depth.

This soil is well suited to corn and soybeans. Seasonal wetness and flooding are the main management concerns. Flooding is common in winter and spring but is less frequent during the growing season. It often damages winter grain crops in unprotected fields. The seasonal high water table can be lowered by a subsurface drainage system, which is commonly supplemented by a surface drainage system. Draining some areas is difficult because drainage outlets are inadequate.

A few areas are pastured. This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when wet, the silt loam surface layer is easily compacted and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

Most areas are undrained and are used as woodland. This soil is well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields because of the flooding and the seasonal wetness.

The land capability classification is IIw; the woodland ordination symbol is 2a.

Tr—Treaty silty clay loam. This level and nearly level, very poorly drained soil generally is in irregularly shaped upland depressions 10 to 40 acres in size. In a few areas it occurs as narrow bands along drainageways. The bands are commonly less than 5 acres in size. The soil receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is about 34 inches thick. The upper part is gray and dark gray, mottled, firm silty clay loam, and the lower part is light olive brown, mottled, firm clay loam. The substratum to a depth of about 68 inches is olive brown, mottled, friable loam glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby and moderately well drained Celina soils in the slightly higher landscape positions. These soils make up about 15 percent of the unit.

If drained, the Treaty soil has a deep root zone. It has a high nutrient-holding capacity. Permeability is moderately slow. Available water capacity is high. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow and often collects or ponds on the surface. The subsoil is neutral or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The surface layer is high in organic matter content. It becomes hard and cloddy if tilled when wet.

Most of the acreage is used for intertilled crops and small grain. If drained, this soil is well suited to corn, soybeans, and small grain. If the soil is well managed, row crops can be grown year after year. Most areas of cropland have been drained. A subsurface drainage system is effective in removing excess water. Diversion terraces may be needed to intercept and divert excess runoff from the higher adjacent areas. Tilth can be maintained or improved by returning crop residue to the soil and by deferring tillage when the soil is wet and soft.

A few areas are pastured. This soil is well suited to grasses and legumes for hay or pasture. If the pasture is overgrazed or is grazed when the soil is soft and wet, the silty clay loam surface layer is easily compacted and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few undrained areas support hardwoods. This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The wetness limits the use of planting and harvesting equipment in winter and spring. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

This soil is poorly suited to buildings and septic tank absorption fields because of the ponding and the restricted permeability. In some areas the water table can be lowered by a subsurface drainage system. Onsite investigation is needed to determine whether or not drainage outlets are available. Properly shaping building sites helps to keep surface water away from foundations. Drains at the base of footings and exterior wall coatings help to keep basements dry. Stockpiling the surface layer and then spreading it during the final grading can hasten reestablishment of the plant cover. Installing septic tank absorption fields in suitable fill material raises the fields above normal ponding levels and helps to overcome the restricted permeability. Local roads can be improved by a drainage system and by additions of suitable base material.

The land capability classification is IIw; the woodland ordination symbol is 2w.

Ud—Udorthents, loamy. These level to moderately sloping, well drained soils are in areas where the landscape has been greatly altered by construction activities. The underlying sand and gravel generally have been removed. Most areas are on knolls and ridges along drainageways and near the edges of bodies of water in the uplands. The areas are mainly 5 to 45 acres in size. Slope ranges from 0 to 12 percent.

Typically, the upper 60 inches is a mixture of silt loam and clay loam surface soil and subsoil material and calcareous, firm loam glacial till. In most places much of the surface layer, subsoil, and substratum has been removed. In other places soil material has been added.

Included with these soils in mapping are soils that have a slope of about 15 to 25 percent. These included soils are on short breaks near the edges of the bodies of water. Also included are small areas of very poorly drained or somewhat poorly drained, sandy soils near drainageways on the lower parts of the landscape; a few small landfills and borrow pits; and small areas of undisturbed soils. Included areas make up about 15 percent of the unit.

The soils are generally low or very low in organic matter content. Their physical condition is poor. Permeability generally is moderately slow to rapid. Available water capacity is dominantly low, but it varies. Reaction in the upper 2 feet is dominantly neutral to moderately alkaline. In many graded or eroded areas, free carbonates are throughout the profile. The soils are easily eroded unless the surface is protected by a suitable plant cover.

Most areas are used as sources of gravel or as sites for buildings, limestone quarries, or recreational uses. A few areas are used as landfills or borrow pits. Most of the excavated sites contain water, and some are used for recreational activities, such as boating and fishing.

Grasses and legumes can be established if the site is mulched and seeded and fertilizer is applied. Most areas are suitable for trees, especially the trees that can withstand alkaline conditions. The suitability for building site development and septic tank absorption fields varies because the soil properties and characteristics vary. Onsite investigation is needed to determine the suitability for specific uses and the hazards and limitations affecting those uses.

No land capability classification or woodland ordination symbol is assigned.

Wb—Wallkill silt loam. This level and nearly level, very poorly drained soil occurs as depressional areas on outwash terraces and uplands. It receives runoff from the higher adjacent soils and is subject to ponding. Most areas are about 3 to 15 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is dark gray, friable silt loam about 8 inches thick. The next layer is dark gray, mottled, firm silt loam about 12 inches thick. Below this to a depth of about 72 inches is black, dark brown, and reddish brown, nonsticky muck. In a few areas the surface layer is silty clay loam. In a few places the mineral layer is less than 16 inches thick.

Included with this soil in mapping are small areas of Montgomery, Pewamo, and Brookston soils. These soils are on slight rises near the edges of the mapped areas. They do not have muck in the lower part of the profile. They make up about 10 percent of the unit.

The Wallkill soil has a deep root zone when the water table is low. It has a high nutrient-holding capacity. Permeability is moderate in the mineral part of the soil and moderately rapid or rapid in the underlying muck. Available water capacity is very high. Surface runoff is very slow, and water often collects or ponds on the surface after periods of rainfall. A seasonal high water table is near or above the surface for long periods. The surface layer is high in organic matter content. The soil is neutral or mildly alkaline throughout.

Drained areas are used mainly for cultivated crops, but undrained areas are too wet for crops. If drained, this soil is well suited to corn and soybeans. It is moderately well suited to small grain. Subsurface drains and open ditches are needed to lower the water table. Diversion terraces commonly are needed to intercept runoff from the higher, sloping areas. Draining some areas is difficult because of inadequate drainage outlets. Subsidence of the organic material can reduce effectiveness of the subsurface drains. Ditchbanks are unstable in areas where the organic layer is thick.

This soil is moderately well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is soft and wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The use of planting or harvesting equipment is limited during wet periods. This equipment can be used more easily during the drier parts of the year. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of low strength, the ponding, and a poor filtering capacity, this soil is generally unsuitable as a site for buildings and septic tank absorption fields.

The land capability classification is IIIw; the woodland ordination symbol is 4w.

WeA—Wea silt loam, 0 to 2 percent slopes. This level and nearly level, well drained soil is on outwash terraces bordering the major streams. Most areas are irregularly shaped and are 5 to 40 acres in size.

In a typical profile, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 10 inches thick. The subsoil is about 40 inches thick. It is dark yellowish brown, firm silty clay loam and clay loam and friable gravelly clay loam. The substratum to a depth of about 70 inches is yellowish brown, loose very gravelly coarse sand. In some areas the soil is moderately well drained and has mottles in the upper part of the subsoil.

Included with this soil in mapping are narrow strips of soils that have a slope of 4 to 6 percent. These soils are on short slope breaks at the head of drainageways. Also included are some areas of occasionally flooded soils on low terraces and small areas of the moderately well drained Medway soils on flood plains. Included soils make up about 10 percent of the unit.

The Wea soil has a deep root zone and a high nutrient-holding capacity. Permeability is moderate in the subsoil and very rapid in the substratum. Available water capacity is high. Surface runoff is slow. The surface layer is high in organic matter content. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Tilth is good.

This soil is used as cropland or pasture. It is well suited to corn, soybeans, small grain, and nursery and truck crops. If well managed, it can be used for row crops year after year. In areas that are farmed intensively, the major management concern is maintaining tilth and a high level of fertility. Returning crop residue to the soil and adding other organic material help to maintain good tilth. The soil is well suited to irrigation. A good supply of underground water generally is available.

This soil is well suited to pasture, but it is rarely used for permanent pasture because it is so well suited to row crops. Overgrazing or grazing when the soil is soft and wet causes compaction and poor tilth. Proper stocking rates, pasture rotation, and deferred grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to buildings and septic tank absorption fields. The shrink-swell potential is a limitation on sites for buildings. Strengthening foundations and basement walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling of the subsoil. Because of a poor filtering capacity in the substratum, installing septic tank absorption fields too deep in the soil can result in the pollution of ground water. On sites for local roads, strengthening or replacing the base material helps to prevent the damage caused by low strength. A few areas have been excavated for sand and gravel. The soil is a good source of sand and gravel.

The land capability classification is I; no woodland ordination symbol is assigned.

Ws—Westland silty clay loam. This level and nearly level, very poorly drained soil is in slight depressions on glacial outwash terraces and stream terraces. It receives runoff from the higher adjacent soils and is subject to ponding. Areas are rather broad and irregularly shaped and are 5 to 100 acres in size. Slope is 0 to 2 percent.

In a typical profile, the surface layer is very dark gray, firm silty clay loam about 10 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay loam about 5 inches thick. The subsoil is grayish brown, mottled, firm gravelly loam about 30 inches thick. The substratum to a depth of about 68 inches is light brownish gray, mottled, loose very gravelly sand. In a few areas the depth to loose sand and gravel is less than 40 inches.

Included with this soil in mapping are narrow strips of Montgomery and Patton soils. These soils are near the edges of the mapped areas. They have less gravel in the lower part than the Westland soil. Also included are small areas of the somewhat poorly drained Algiers soils near the base of the slopes. Included soils make up about 15 percent of most areas.

The Westland soil has a deep root zone and a high nutrient-holding capacity. Permeability is moderate in the subsoil and very rapid in the substratum. Available water capacity is high. A seasonal high water table is near or above the surface during extended wet periods. Surface runoff is very slow, and water often collects or ponds on the surface after periods of rainfall. The surface layer is high in organic matter content. The subsoil is neutral in the upper part and neutral or mildly alkaline in the lower part. The soil can be tilled only within a narrow range of moisture content.

Most of the acreage is cropland or pasture. If drained, this soil is well suited to corn, soybeans, and small grain. Row crops can be grown year after year if a high level of management is applied. Most areas of cropland have been drained. Subsurface drains and open ditches are needed. Tilth can be maintained or improved by returning crop residue to the soil and by deferring tillage when the soil is wet and soft.

This soil is well suited to grasses and legumes for hay and pasture. If the pasture is overgrazed or is grazed when the soil is wet, the silty clay loam surface layer is easily compacted and tilth deteriorates. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

A few areas are wooded. This soil is moderately well suited to trees. Removing vines and the less desirable trees and shrubs helps to control plant competition. Competing vegetation can be removed by good site preparation, by prescribed spraying, and by cutting or girdling. The wetness limits the use of planting and harvesting equipment in winter and spring. The trees can be planted and harvested during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of the ponding, this soil is poorly suited to buildings and septic tank absorption fields. It is better suited to houses without basements than to houses with basements. In some areas surface and subsurface drains remove excess water. Onsite investigation is needed to determine whether or not drainage outlets are available. Drains at the base of footings and exterior wall coatings help to keep basements dry. Properly shaping building sites helps to keep surface water away from foundations. Installing septic tank absorption fields in suitable fill material raises the fields above high ponding levels. Local roads can be improved by additions of suitable base material, which helps to prevent the damage caused by low strength and frost action. The roads should be elevated above high ponding levels.

The land capability classification is IIw; the woodland ordination symbol is 2w.

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 360,000 acres in the survey area, or nearly 93 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in associations 1, 4, 6, and 10, which are described under the heading "General Soil Map Units." About 280,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for about half of the county's total agricultural income each year.

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

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

Soils that have limitations, such as a seasonal high water table, frequent flooding during the growing season, or inadequate rainfall, qualify for prime farmland only in areas where these limitations have been overcome by such measures as drainage, flood control, or irrigation. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

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

Crops and Pasture

Lloyd K. Young, district conservationist, Soil Conservation Service, helped prepare this section.

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

More than 307,800 acres in the county was used for crops and pasture in 1978 (*17*). Of this total, about 240,000 acres was used for row crops, mainly soybeans and corn; 31,475 acres for close-grown crops, mainly wheat and oats; 20,528 acres in rotation hay and pasture; and 17,490 for permanent pasture. The rest was idle land or was used for specialty crops, mainly vegetables, tobacco, and orchards.

The acreage used for crops and pasture is gradually decreasing as more and more land is used for urban development. In 1982, an estimated 12,700 acres in the county was urban and built-up land. This soil survey can be helpful to those making land use decisions that will influence the future role of farming in the county.

The paragraphs that follow describe the major concerns in managing the cropland and pasture in the county. The management concerns are water erosion, drainage, fertility, and tilth.

Water erosion is a major problem on about half of the cropland and pasture in Darke County. It is a hazard on soils that have a slope of more than 2 percent. Examples are the Blount and Crosby soils that have a slope of 2 to 6 percent.

Loss of part of the surface soil through erosion reduces the productivity and available water capacity of the soil. If the finer textured subsoil material is mixed with the remaining surface soil by plowing, tilth in the resulting surface layer generally is poorer than that in the original surface layer. Many of the soils in Darke County have a surface layer that is fairly high in content of silt and low to moderate in organic matter content and have a clayey subsoil. Such soils are highly susceptible to erosion. In many of the more sloping areas, preparing a good seedbed and tilling are more difficult because part or nearly all of the original friable surface soil has been eroded away. This erosion is common on Glynwood and Miamian soils.

Erosion also results in sedimentation of streams. Control of erosion minimizes this pollution and improves the quality of the water for municipal and recreation uses and for fish and wildlife.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soil. Including forage crops of grasses and legumes in the cropping sequence helps to control erosion on livestock farms. The legumes also provide nitrogen and the grasses and legumes improve tilth for the following crop.

Slopes are so short and irregular in most areas of Celina, Glynwood, and Miamian soils that contour tillage and terracing are not practical. On these soils a cropping sequence that includes grasses and legumes is needed unless erosion is controlled by a conservation tillage system that leaves crop residue on the surface. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazard of erosion. No-till planting of corn and soybeans, which is common on an increasing acreage in the county, is effective in controlling erosion on gently sloping and moderately sloping soils. It is suitable on many of the soils in the county, especially well drained soils, such as Miamian, Eldean, and Ockley. A good drainage system is needed if no-till crops are planted on very poorly drained soils, such as Brookston, Treaty, and Westland.

Terraces and diversions reduce the length of slopes and thus the risk of erosion. Many of the soils in Darke County, however, are not well suited to terraces and diversions because slopes are irregular, the terrace channels are excessively wet, and the clayey subsoil is exposed in the channels.

Grassed waterways are natural or constructed drainage outlets that are protected by a grass cover. Natural drainageways are the best sites for grassed waterways, partly because a good channel commonly can be established with a minimum of shaping. The waterway should be wide and flat, so that it can be easily crossed by farm machinery. Water- and sediment-control basins can be used as an alternative to grassed waterways. They collect water, reduce the peak flow, and trap sediment. The water is released through a subsurface drain. The amount of land normally taken out of production is less in areas where these basins are used than in areas where grassed waterways are used.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

Soil drainage is a major management concern on nearly three-fourths of the acreage used for crops and pasture in the county. Crops grow well on very poorly drained soils only if excess water is removed. The wetness results from a seasonal high water table and periodic flooding. All of the very poorly drained soils in the county are subject to ponding and flooding. Unless drained, very poorly drained to somewhat poorly drained soils are so wet that crops are often damaged. Soils that are not adequately drained dry out and warm up slowly in the spring. As a result, tillage and planting are delayed. A drainage system generally is not needed in moderately well drained and well drained soils. Random subsurface drains may be needed, however, in some seepy spots in areas of moderately well drained soils.

The efficiency of drainage systems varies with the different kinds of soil. Most of the seasonally wet soils on uplands are moderately permeable to slowly permeable. Examples are Blount, Brookston, Crosby, Pewamo, Pyrmont, and Treaty soils. Soils that formed in lacustrine sediment, such as Montgomery and Del Rey soils, are slowly permeable or very slowly permeable. All of these seasonally wet soils are drained mainly by subsurface drains, open ditches, land smoothing, or a combination of these. Subsurface drains should be more closely spaced in the more slowly permeable soils than in the more rapidly permeable soils. Locating adequate drainage outlets for subsurface drainage systems is difficult in some areas of Montgomery and Patton soils and in many areas of organic soils.

Information about the design of the drainage system for each kind of soil is contained in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Soil fertility is affected by reaction and the supply of plant nutrients. The soils in about one-third of the soil series in the county have a dark surface layer, are nearly neutral in reaction, and contain moderate amounts of phosphorus and large amounts of potassium. Many of the light colored upland soils are naturally acid and generally have a supply of plant nutrients that is below the optimum. The soils on flood plains commonly have a neutral or mildly alkaline surface layer and are naturally higher in content of plant nutrients than most upland soils. Organic soils have a slightly acid to mildly alkaline surface layer and generally are deficient in boron and other trace elements.

Additions of lime and fertilizer to all soils should be based on the results of soils tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils in good tilth are friable and porous.

Most of the soils used for crops and pasture in the county have a surface layer of light colored silt loam that is only moderate in organic matter content. Tilth in such soils generally is good, but a crust forms on the surface during periods of intensive rainfall. The crust is hard and impervious to water when dry. As a result, it reduces the infiltration rate and increases the runoff rate. Regular additions of crop residue or other organic material can maintain or improve tilth and help to prevent excessive crusting.

Fall plowing is generally not suitable on the light colored soils that have a silt loam surface layer because of the crust that forms in winter and spring. Many of the soils that are plowed in the fall are nearly as dense and hard at planting time as they were before they were plowed. Also, much of the cropland in the county consists of the more sloping soils, which are subject to erosion if they are plowed in the fall.

The dark surface layer of Brookston, Montgomery, Patton, and Pewamo soils contains more clay than the surface layer of most light colored soils. Poor tilth can be a problem because these dark soils often stay wet until late in spring. If they are plowed when wet and soft, the soils tend to be very cloddy when dry. As a result of the cloddiness, preparing a good seedbed is difficult. Fall plowing generally results in good tilth in the spring.

Many *field crops* suited to the soils and climate of the county are not now commonly grown. Corn and soybeans are the main row crops. Wheat and oats are the most common close-growing crops. Grain sorghum, sunflowers, and similar crops can be grown if economic conditions are favorable. Also, many kinds of grass and legume seed can be produced.

Specialty crops grown commercially in Darke County include tobacco, tomatoes, strawberries, potatoes, apples, peaches, and nursery plants. The acreage used for these crops and for other vegetables and small fruits can be increased if economic conditions are favorable. The investment in labor and machinery and other costs are generally higher than those for general farm crops. Because of the high value of the specialty crops, good soil management and cultural practices are needed.

The soils in the county that have good natural drainage and warm up early in the spring are especially suitable for many vegetables, orchard crops (fig. 8), nursery plants, and small fruits. These are the Eldean, Miamian, Ockley, and Wea soils that have a slope of less than 6 percent. These soils make up about 47,580 acres in the county. Most of the tobacco is grown on the very poorly drained, dark Brookston soils and the somewhat poorly drained, light colored Crosby soils. Both of these soils are drained before tobacco is grown.

If drained, the organic soils are suitable for a wide range of vegetable crops. These are the Carlisle, Edwards, and Linwood soils, which make up 1,271 acres in the county.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Permanent pasture makes up more than 5 percent of the farmland in the county. Much of the permanent pasture occurs as areas of the more sloping, eroded or severely eroded soils and as narrow strips and irregularly shaped areas of occasionally flooded soils. Open woodlots also are pastured, but they generally provide poor-quality grazing because the cover of forage plants is sparse. Permanent pastures near farmsteads are commonly used as feedlots or access lanes. The chief forage species in the county are tall fescue, Kentucky bluegrass, orchardgrass, and ladino clover.

Most of the soils in the county can be used for high-quality permanent pasture. The moderately sloping to steep soils, such as Eldean, Miamian, and Glynwood soils, are commonly eroded or severely eroded and are low in fertility. Also, less water is available to plants because runoff is rapid or very rapid. The cover of forage species in areas of these soils can be greatly improved. It responds well to good pasture and soil management practices. Forage growth is generally good on the level to gently sloping Crosby, Celina, Blount, Glynwood, and Miamian soils. The Medway, Eel, and Shoals soils on flood plains are well suited to permanent pasture. Flooding during the growing season can damage row crops and small grain but is much less of a hazard in areas of permanent pasture.

Permanent pasture and cropland require similar management. Lime and fertilizer should be applied at rates indicated by soil tests. Control of weeds by periodic clipping and applications of recommended herbicide, proper stocking rates, and controlled grazing help to keep the pasture in good condition. The latest information about seeding mixtures, herbicide treatment, and other management factors for specific soils can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 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.

Figure 8.—An orchard in an area of Crosby and Miamian soils.

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 rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*15*). Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

When the first settlers arrived, most of Darke County was covered by mixed hardwoods. Most of the forest has been cleared. In 1978, only 20,680 acres, or about 5 percent of the total acreage in the county, was woodland (*17*). The wooded areas are small, widely scattered woodlots, mainly on naturally wet soils that are undrained and on steep soils in the uplands. A few woodlots are on level or nearly level, well drained soils.

Some good-quality logs of red oak, white oak, and black walnut are harvested from the better managed woodland. The woodlots also are a source of firewood, lumber for rough construction, and edible nuts. The demand for firewood and for high-quality logs has increased.

Woodland not only adds to the farm income but also provides esthetic benefits that cannot be measured in monetary terms. Trees add natural beauty to the landscape. The recreational value of woodland is becoming increasingly important. As the population increases, the need for areas of woodland for camping, hiking, and hunting also increases.

Thinning out mature trees and undesirable species can improve much of the woodland in the county. Protection from grazing and fire and control of disease and insects also can improve the stands. The Soil Conservation Service, the Cooperative Extension Service, and the Ohio Department of Natural Resources, Division of Forestry, can help in determining specific woodland management needs.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each suitable soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. It is based on the site index of the species listed first in the *common trees* column. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *r* indicates steep slopes; *x*, stoniness or rockiness; *w*, excessive 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*, high content of coarse fragments in the soil profile. 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.

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

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

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

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index 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.

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

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 9). 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

Figure 9.—A young windbreak in an area of Blount soils.

of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from the Ohio Department of Natural Resources, Division of Forestry.

Recreation

The potential for developing the natural resources in Darke County for recreation is good. The natural attractions, along with some recent manmade developments, are increasingly drawing people to the county. The rolling topography and wooded areas along the larger streams are suitable for camping and other recreational uses. Ohio has developed 300 acres of wildlife preserve. The county has four commercial campgrounds. Greenville has a system of parks.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils 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

Wildlife is an important natural resource in Darke County. The most common species are pheasants, rabbits, quail, deer, waterfowl, and squirrels. Raccoons, opossums, skunks, muskrats, woodchucks, foxes, and many species of birds also are numerous.

Most of the soils in the county are suitable for use as habitat for some kinds of wildlife. The local game protector, the Cooperative Extension Service, and the Soil Conservation Service can provide specific information about managing wildlife habitat.

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

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor (*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, barley, and soybeans.

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, 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 switchgrass, goldenrod, foxtail, ragweed, beggarweed, milkweed, thistles, daisies, nightshade, and dandelion.

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, maple, cherry, sweetgum, apple, hawthorn, black walnut, dogwood, hickory, blackhaw, viburnum, grape, and briers. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are 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 Scotch pine, Virginia pine, Norway spruce, and eastern redcedar.

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

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

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

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

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

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

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

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

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

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

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

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

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

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

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 10). "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.

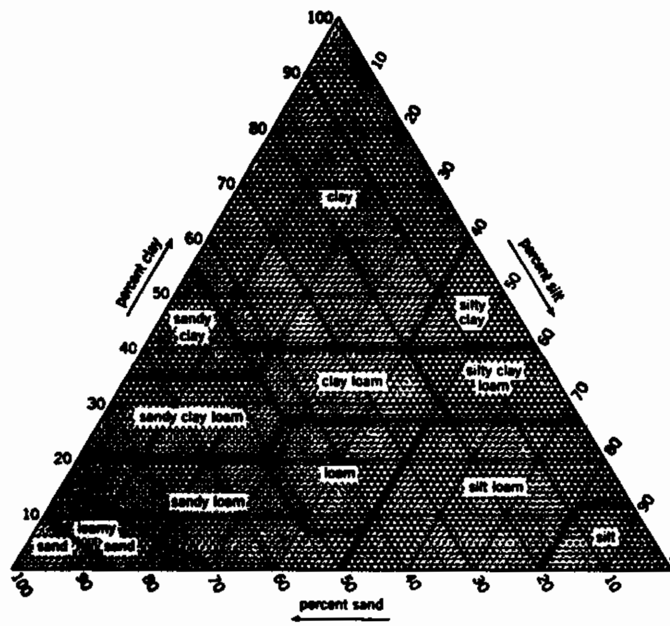


Figure 10.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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

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

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

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

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, 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 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

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.

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

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

Several soils in Darke County were sampled by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained on most samples include particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

These data were used in classifying and correlating the soils and in evaluating their behavior characteristics. Five pedons were selected as representative of their respective series and are described under the heading "Soil Series and Their Morphology." These series and their laboratory identification numbers are Brookston (DK-28), Lippincott (DK-27), Miamian (DK-29), Montgomery (DK-25), and Savona (DK-26).

In addition to the Darke County data, laboratory data are also available from nearby counties that have many of the same kinds of soil. These data and the Darke County data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio. Some of these data have been published in special studies of the soils in Darke County and in nearby counties (*12, 18*).

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*16*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. 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 Mollisol.

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 Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

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 Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*16*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Algiers Series

The Algiers series consists of somewhat poorly drained, moderately permeable soils on flood plains and stream terraces. These soils formed in recent alluvium over an older buried soil. Slopes are 0 to 2 percent.

Algiers soils are commonly adjacent to Carlisle, Montgomery, Patton, and Westland soils and are similar to Eel and Medway soils. Carlisle soils formed in organic material in the lower landscape positions. Montgomery, Patton, and Westland soils have a mollic epipedon. They are in the slightly lower landscape positions. Eel and Medway soils are moderately well drained.

Typical pedon of Algiers silt loam, occasionally flooded, in an area in Harrison Township about 3 miles east of Hollansburg; about 350 feet west and 250 feet south of the center of sec. 2, T. 10 N., R. 1 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure parting to moderate fine and medium granular; friable; common fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

C—9 to 21 inches; brown (10YR 4/3) silt loam; weak coarse subangular blocky structure; friable; few fine roots; few faint dark yellowish brown (10YR 4/4) coatings on faces of peds; about 2 percent coarse fragments; neutral; clear smooth boundary.

2Ab1—21 to 28 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; neutral; clear wavy boundary.

2Ab2—28 to 34 inches; very dark gray (10YR 3/1) silty clay loam; common fine distinct grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) mottles; moderate fine and medium subangular blocky structure; firm; about 1 percent coarse fragments; neutral; clear wavy boundary.

2Bgb—34 to 50 inches; dark gray (10YR 4/1) silty clay loam; common fine faint grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) mottles; weak coarse subangular blocky structure; firm; about 2 percent coarse fragments; neutral; clear wavy boundary.

2Cg—50 to 60 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The recent alluvium is 20 to 36 inches thick. Reaction is slightly acid or neutral in the recent alluvium and neutral or mildly alkaline in the buried A and B horizons.

The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). Some pedons have an A horizon, which is 1 to 3 inches thick. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or silty clay loam.

The 2Ab horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is 10 to 15 inches thick. It is clay loam or silty clay loam. The content of coarse fragments in this horizon ranges from 0 to 5 percent.

The 2B horizon has hue of 10YR or is neutral in hue. It has value of 4 or 5 and chroma of 2 or less. It is silty clay loam, clay loam, or loam. The content of coarse fragments in this horizon ranges from 1 to 10 percent.

The 2C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 3. It is clay loam or silty clay loam. The content of coarse fragments in this horizon ranges from 1 to 15 percent.

Blount Series

The Blount series consists of somewhat poorly drained soils formed in calcareous, moderately fine textured glacial till on uplands. Permeability is slow. Slopes range from 0 to 6 percent.

Blount soils are commonly adjacent to Glynwood and Pewamo soils and are similar to Crosby and Del Rey soils. Glynwood soils are moderately well drained and are in the higher landscape positions. Pewamo soils are very poorly drained and are in depressions and drainageways. Crosby soils have less clay in the substratum than the Blount soils. Del Rey soils formed in lacustrine sediments. They have a lower content of coarse fragments throughout than the Blount soils and are stratified in the substratum.

Typical pedon of Blount silt loam, 2 to 6 percent slopes, in an area in York Township about 2 miles east-southeast of Rossburg; about 330 feet north and 350 feet east of the southwest corner of sec. 31, T. 12 N., R. 3 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; common fine roots; about 2 percent coarse fragments; medium acid; abrupt smooth boundary.

BE—9 to 12 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate fine and medium angular blocky structure; firm; few fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few distinct light brownish gray (10YR 6/2) silt coatings; about 2 percent coarse fragments; medium acid; clear smooth boundary.

Bt1—12 to 16 inches; yellowish brown (10YR 5/4) clay; common medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; slightly acid; gradual wavy boundary.

Bt2—16 to 20 inches; yellowish brown (10YR 5/4) clay; many medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; neutral; clear wavy boundary.

BC—20 to 26 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—26 to 40 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; few fine roots; common light gray (10YR 7/2) calcium carbonate coatings on structural faces; about 5 percent coarse fragments; strong effervescence; moderately alkaline; diffuse wavy boundary.

C2—40 to 60 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct grayish brown (10YR 5/2) mottles; massive but with widely spaced vertical fractures; firm; few light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 40 inches. The content of coarse fragments in the solum ranges from 2 to 10 percent. The depth to free carbonates ranges from 19 to 36 inches.

The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). Pedons in wooded areas have an A horizon, which is 3 to 4 inches thick, and an E horizon, which is 2 to 3 inches thick. The Bt horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 to 4. It is silty clay, clay, or clay loam. Reaction is medium acid or slightly acid in the upper part of the Bt horizon and neutral or mildly alkaline in the lower part of the Bt horizon and in the BC horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam or clay loam. The content of coarse fragments in this horizon ranges from 5 to 15 percent.

Brookston Series

The Brookston series consists of very poorly drained, moderately permeable soils in depressions and along narrow drainageways in the uplands. These soils formed in calcareous, medium textured glacial till. Slopes are 0 to 2 percent.

These soils are taxadjuncts because the increase in content of clay from the surface layer to the subsoil is less than is definitive for the Brookston series. This difference, however, does not alter the usefulness or behavior of the soils.

Brookston soils are commonly adjacent to Celina, Crosby, and Pyrmont soils and are similar to Patton, Pewamo, and Treaty soils. Celina, Crosby, and Pyrmont soils are better drained than the Brookston soils and are in the higher landscape positions. Patton and Treaty soils have more silt, less sand, and fewer coarse fragments in the upper part of the subsoil than the Brookston soils. Pewamo soils have more clay in the subsoil and substratum than the Brookston soils.

Typical pedon of Brookston silty clay loam, in an area in Van Buren Township about 2.5 miles north of Arcanum; about 740 feet west and 2,060 feet south of the northeast corner of sec. 28, T. 9 N., R. 3 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; friable; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

BAg—11 to 18 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; firm; few fine roots; few faint gray (10YR 5/1) coatings on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

Btg1—18 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; firm; few fine roots; few faint gray (10YR 5/1) clay films on faces of peds; few dark grayish brown (10YR 4/2) fillings 1 to 2 inches wide in old krotovinas; few concretions (iron and manganese oxides); about 2 percent coarse fragments; neutral; gradual wavy boundary.

Btg2—26 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam; many coarse distinct light olive brown (2.5Y 5/4) mottles; moderate medium angular and subangular blocky structure; firm; few fine roots; few faint gray (10YR 5/1) clay films on faces of peds; few dark grayish brown (10YR 4/2) fillings 1 to 2 inches wide in old krotovinas; few concretions (iron and manganese oxides); about 5 percent coarse fragments; neutral; clear wavy boundary.

BCg—37 to 47 inches; grayish brown (10YR 5/2) clay loam; many medium distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; firm; few yellowish brown (10YR 5/6) concretions (iron oxide); few light gray (10YR 7/2) calcium carbonate coatings on faces of peds; about 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—47 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct grayish brown (10YR 5/2) mottles; massive but with widely spaced vertical fractures; friable; few very dark gray (10YR 3/1) clay loam fillings 0.5 to 1.0 inch wide in old krotovinas; common light gray (10YR 7/2) calcium carbonate coatings on fractures; about 10 percent coarse fragments; few yellowish brown (10YR 5/6) concretions (iron oxide); discontinuous sand lenses 0.5 inch to 2.0 inches thick and at intervals of 6 to

12 inches; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Most pedons have free carbonates in the BC horizon.

The A horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or black (10YR 2/1). The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is commonly silty clay loam, but in some pedons it has subhorizons of silty clay or clay loam 4 to 6 inches thick. The content of coarse fragments in this horizon is less than 10 percent. The BC horizon has colors similar to those of the Bt horizon. It is silty clay loam or clay loam. The content of coarse fragments in the BC and C horizons is 5 to 15 percent. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. It is loam or silt loam.

Carlisle Series

The Carlisle series consists of very poorly drained, organic soils in bogs on stream terraces and moraines. These soils formed in organic deposits derived from woody material, grasses, sedges, and reeds. Permeability is moderately slow to moderately rapid. Slopes are 0 to 2 percent.

Carlisle soils are commonly adjacent to Algiers, Edwards, Linwood, and Wallkill soils. Algiers and Wallkill soils are in the slightly higher areas near foot slopes. Algiers soils are mineral throughout, and Wallkill soils are mineral in the upper part. Edwards and Linwood soils are in landscape positions similar to those of the Carlisle soils. Edwards soils are underlain by marl. Linwood soils are underlain by mineral material.

Typical pedon of Carlisle muck, in an area in Washington Township about 1.5 miles northwest of Sharpeye; about 1,800 feet east and 20 feet south of the northwest corner of sec. 28, T. 12 N., R. 1 E.

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face and rubbed, dark gray (10YR 4/1) dry; about 5 percent fiber, none rubbed; moderate medium granular structure; friable; few fine woody fragments; neutral; clear smooth boundary.

Oa1—10 to 15 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 5 percent fiber, none rubbed; weak medium and coarse subangular blocky structure parting to moderate fine granular; friable; few fine woody fragments; neutral; clear smooth boundary.

Oa2—15 to 34 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 20 percent fiber, none rubbed; weak coarse subangular blocky structure; friable; few woody fragments; mildly alkaline; clear wavy boundary.

Oa3—34 to 48 inches; sapric material, dark reddish brown (5YR 2/2) broken face, dark reddish brown (5YR 3/2) rubbed; about 30 percent fiber, 5 percent rubbed; massive; nonsticky; common woody fragments 1/8 to 1/4 inch in diameter; few shell fragments; mildly alkaline; clear wavy boundary.

Oa4—48 to 66 inches; sapric material, dark brown (7.5YR 3/2) broken face and rubbed; about 5 percent fiber, none rubbed; massive; nonsticky; few woody fragments 1/8 to 1/4 inch in diameter; few shell fragments; mildly alkaline.

The organic deposit is more than 51 inches thick. It is neutral or mildly alkaline throughout. It is mostly sapric material, but some pedons have 6 to 10 inches of hemic material in the bottom tier.

The surface tier is black (10YR 2/1 or N 2/0) or very dark brown (10YR 2/2). The subsurface tier has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 4.

Celina Series

The Celina series consists of moderately well drained soils formed in calcareous, medium textured glacial till on uplands. Permeability is moderately slow. Slopes range from 0 to 6 percent.

Celina soils are commonly adjacent to Brookston, Crosby, and Miamian soils and are similar to Glynwood, Lewisburg, and Miamian soils. Brookston soils have a mollic epipedon. They are in depressions and along drainageways. Crosby soils are somewhat poorly drained and are in the slightly lower landscape positions. Miamian soils are well drained and are in the higher landscape positions. Glynwood soils have more clay in the substratum than the Celina soils. Lewisburg soils have a solum that is thinner than that of the Celina soils.

Typical pedon of Celina silt loam, 2 to 6 percent slopes, in an area in Adams Township about 1.5 miles north of Bradford; about 265 feet south and 1,650 feet east of the center of sec. 9, T. 9 N., R. 4 E.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—10 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; few faint brown (10YR 4/3) clay films and silt coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 1 percent coarse fragments; neutral; clear wavy boundary.

Bt2—15 to 22 inches; dark yellowish brown (10YR 4/4) clay; few medium distinct grayish brown (10YR 5/2) and brown (10YR 5/3) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots;

common faint dark brown (10YR 3/3) and brown (10YR 4/3) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; neutral; clear wavy boundary.

BC—22 to 27 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—27 to 38 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); common light gray (10YR 7/2) calcium carbonate coatings on faces of peds; about 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—38 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) mottles; massive but with widely spaced vertical fractures; firm; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); common light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. It is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 18 to 36 inches. Some pedons have a loess mantle as much as 12 inches thick.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). Some pedons have A and E horizons. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, silty clay loam, or clay. The content of coarse fragments ranges from 1 to 10 percent in the Bt and BC horizons and from 5 to 15 percent in the C horizon. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is loam or silt loam.

Crosby Series

The Crosby series consists of somewhat poorly drained soils formed in calcareous, medium textured glacial till on uplands. Permeability is slow. Slopes range from 0 to 6 percent.

Crosby soils are commonly adjacent to Brookston, Celina, and Treaty soils and are similar to Blount, Del Rey, and Pyrmont soils. Brookston and Treaty soils have a mollic epipedon. They are in the lower landscape positions. Celina soils are moderately well drained and are in the higher landscape positions. Blount soils have more clay in the substratum than the Crosby soils. Del Rey soils formed in lacustrine sediments and have fewer coarse fragments in the subsoil and substratum than the Crosby soils. Pyrmont soils have a solum that is thinner than that of the Crosby soils.

Typical pedon of Crosby silt loam, 0 to 2 percent slopes, in an area in Twin Township about 1.5 miles southwest of Arcanum; about 160 feet west and 65 feet south of the northeast corner of sec. 17, T. 8 N., R. 3 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

E—9 to 12 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak fine and medium subangular blocky structure; friable; few fine roots; few faint light brownish gray (10YR 6/2) silt coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); slightly acid; clear wavy boundary.

Btg—12 to 21 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; neutral; clear wavy boundary.

Bt—21 to 30 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; neutral; clear wavy boundary.

BC—30 to 38 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; very few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—38 to 52 inches; yellowish brown (10YR 5/4) loam; few fine distinct light brownish gray (10YR 6/2) mottles; massive; firm; few yellowish brown (10YR 5/8) concretions (iron oxide); about 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse wavy boundary.

C2—52 to 60 inches; yellowish brown (10YR 5/4) loam; few fine distinct gray (10YR 6/1) mottles; massive;

firm; few yellowish brown (10YR 5/8) concretions (iron oxide); about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to free carbonates ranges from 18 to 36 inches. Some pedons have a loess mantle as much as 12 inches thick.

The Ap horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2). Some pedons have an A horizon, which is 2 to 3 inches thick. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is medium acid to neutral. It is silty clay loam, clay loam, or clay. The content of coarse fragments ranges from 2 to 10 percent in the Bt and BC horizons and from 5 to 15 percent in the C horizon. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or silt loam.

Del Rey Series

The Del Rey series consists of somewhat poorly drained, slowly permeable soils formed in moderately fine textured and medium textured lacustrine sediments. These soils are on broad flats at the edge of former glacial lakes. Slopes range from 0 to 3 percent.

Del Rey soils are commonly adjacent to Montgomery soils and are similar to Blount and Crosby soils. Montgomery soils are very poorly drained and are in depressions. Blount and Crosby soils formed in glacial till and have a higher content of coarse fragments in the lower part than the Del Rey soils.

Typical pedon of Del Rey silt loam, 0 to 3 percent slopes, in an area in Wabash Township about 1.5 miles east of Burkettsville; about 975 feet east and 96 feet south of the northwest corner of sec. 1, T. 14 N., R. 2 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—10 to 13 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; firm; common fine roots; few faint pale brown (10YR 6/3) silt coatings on faces of peds; few faint grayish brown (10YR 5/2) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—13 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; common fine roots; common distinct dark gray (10YR 4/1) clay films on faces of peds; slightly acid; clear wavy boundary.

Bt3—21 to 26 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium angular and subangular blocky; firm; few fine roots; common faint dark gray (10YR 4/1) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

BC—26 to 30 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; very few faint grayish brown (10YR 5/2) clay films on faces of peds; neutral; clear wavy boundary.

C—30 to 60 inches; light olive brown (2.5Y 5/4) stratified silty clay loam and silt loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; massive but with very weak bedding planes; friable; thin laminations of light yellowish brown (10YR 6/4) fine sand; few light gray (10YR 7/1) calcium carbonate coatings on bedding planes; strong effervescence; moderately alkaline.

The solum ranges from 26 to 42 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. In some pedons the BC horizon has free carbonates.

The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1). The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silty clay or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Edwards Series

The Edwards series consists of very poorly drained, organic soils in bogs and swales on stream terraces and moraines. These soils formed in organic material over marl, which is at a depth of 16 to 48 inches. The organic material was derived mainly from grasses, sedges, and reeds. Permeability is moderately slow to moderately rapid in the organic material and varies in the marl. Slopes are 0 to 2 percent.

Edwards soils are commonly adjacent to Carlisle, Linwood, and Wallkill soils. The adjacent soils do not have marl in the lower part. Carlisle and Linwood soils are in landscape positions similar to those of the Edwards soils. Wallkill soils are in the slightly higher areas near foot slopes.

Typical pedon of Edwards muck, in an area in Harrison Township about 2 miles west of Braffetsville; about 350 feet south and 25 feet west of the northeast corner of sec. 31, T. 10 N., R. 1 E.

Op—0 to 12 inches; sapric material, black (10YR 2/1) broken face and rubbed, black (10YR 2/1) dry;

about 2 percent fiber, none rubbed; moderate fine and medium granular structure; friable; few fine roots; neutral; clear smooth boundary.

Oa1—12 to 23 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 15 percent fiber, none rubbed; moderate medium and coarse subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.

Oa2—23 to 27 inches; sapric material, black (10YR 2/1), broken face and rubbed; about 15 percent fiber, none rubbed; friable; weak coarse subangular blocky structure; mildly alkaline; abrupt wavy boundary.

C1—27 to 48 inches; light gray (10YR 7/1) marl; few fine faint light olive gray (5Y 6/2) mottles; massive; friable; about 15 percent shell fragments; violent effervescence; moderately alkaline; clear wavy boundary.

C2—48 to 60 inches; gray (10YR 6/1) marl; few medium faint light olive gray (5Y 6/2) mottles; massive; friable; about 5 percent shell fragments; violent effervescence; moderately alkaline.

The organic material ranges from 16 to 48 inches in thickness. It is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). It is neutral or mildly alkaline. Some pedons contain free carbonates throughout.

The C horizon has hue of 10YR, value of 5 to 8, and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. In some pedons it has sandy or loamy layers, which are 2 to 4 inches thick.

Eel Series

The Eel series consists of moderately well drained, moderately permeable soils formed in alluvium on flood plains along the major streams. These are the dominant soils on many of the narrow flood plains. Slopes are 0 to 2 percent.

Eel soils are commonly adjacent to Medway and Shoals soils and are similar to Algiers and Medway soils. Medway soils are in landscape positions similar to those of the Eel soils. They have a mollic epipedon. Algiers and Shoals soils are somewhat poorly drained. Algiers soils have a buried surface layer at a depth of 20 to 36 inches. Shoals soils are in the slightly lower landscape positions.

Typical pedon of Eel silt loam, occasionally flooded, in an area in Washington Township about 5 miles northwest of Sharpeye; about 105 feet south and 660 feet west of the center of sec. 19, T. 12 N., R. 1 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine roots; about 1 percent coarse fragments; neutral; clear smooth boundary.

C1—8 to 18 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint brown (10YR 4/3) mottles; weak medium and coarse subangular blocky structure; friable; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); few fine black (10YR 2/1) charcoal fragments; about 1 percent coarse fragments; mildly alkaline; clear smooth boundary.

C2—18 to 29 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; friable; few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; mildly alkaline; clear wavy boundary.

C3—29 to 43 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; massive; friable; thin lenses of light brownish gray (10YR 6/2) gravelly loam less than 1 inch thick; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C4—43 to 60 inches; yellowish brown (10YR 5/4) stratified very gravelly loam and gravelly sandy loam; massive; very friable; few bedding planes 1 to 2 inches thick; few fine black (10YR 2/1) charcoal fragments; about 40 percent coarse fragments, 10 percent more than 3 inches in diameter; strong effervescence; moderately alkaline.

Reaction is neutral or mildly alkaline in the upper 20 inches and is mildly alkaline or moderately alkaline below a depth of 20 inches. Most pedons have free carbonates below a depth of 30 inches. The content of coarse fragments increases with increasing depth. It ranges from 2 to 10 percent in the upper 40 inches. The depth to mottles ranges from 10 to 18 inches.

The Ap horizon is brown (10YR 4/3 or 5/3) or dark grayish brown (10YR 4/2). Some pedons have an A horizon. This horizon is very dark gray (10YR 3/1). It is 2 to 3 inches thick. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4. It is silt loam, loam, or clay loam to a depth of 40 inches and gravelly loam, gravelly clay loam, gravelly sandy loam, very gravelly loam, or very gravelly sandy loam below a depth of 40 inches.

Eldean Series

The Eldean series consists of well drained soils formed in glacial outwash (fig. 11). These soils are mainly on outwash terraces along the larger streams. A few areas are on kames and moraines in the uplands. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Slopes range from 0 to 18 percent.

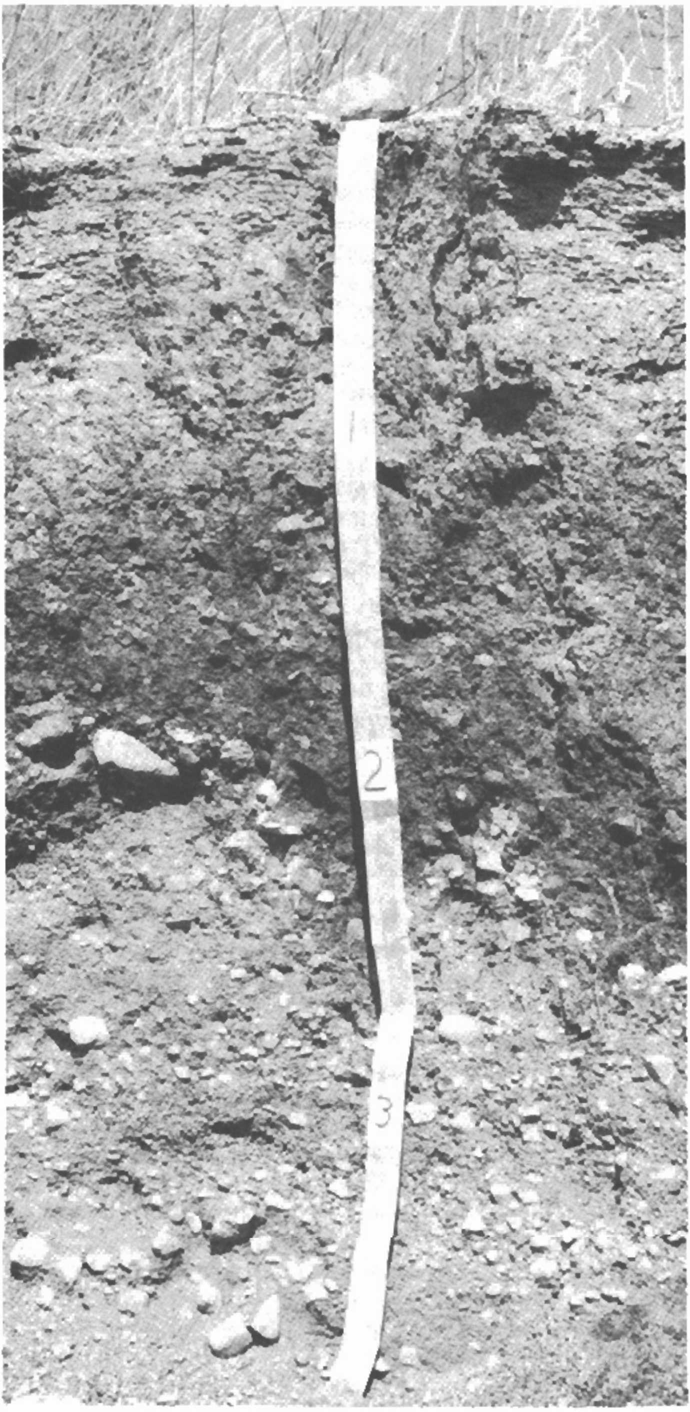


Figure 11.—Profile of Eldean soils, which formed in loamy glacial outwash over gravelly and sandy outwash. Depth is marked in feet.

Eldean soils are commonly adjacent to Lippincott, Miamian, Ockley, Savona, and Westland soils. Lippincott, Savona, and Westland soils are wetter than the Eldean soils and are in the lower landscape positions. Miamian soils formed in glacial till on moraines and kames. They do not have sand and gravel in the substratum. Ockley soils are in the slightly lower landscape positions. Their solum is more than 40 inches thick.

Typical pedon of Eldean loam, 0 to 2 percent slopes, in an area in Harrison Township about 0.5 mile northwest of Braffetsville; about 990 feet north and 975 feet west of the southeast corner of sec. 28, T. 10 N., R. 1 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; friable; few fine roots; about 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—8 to 11 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 5 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—11 to 22 inches; dark brown (7.5YR 4/4) clay; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct brown (7.5YR 4/2) clay films on faces of peds; about 10 percent coarse fragments; slightly acid; gradual wavy boundary.

Bt3—22 to 28 inches; dark brown (7.5YR 4/4) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark brown (7.5YR 3/2) clay films on faces of peds; about 10 percent coarse fragments; neutral; clear irregular boundary.

BC—28 to 36 inches; brown (7.5YR 4/2) gravelly clay loam; weak coarse subangular blocky structure; firm; few fine roots; few faint dark brown (7.5YR 3/2) clay films on faces of peds and pebbles; common pale brown (10YR 6/3) calcium carbonate coatings on pebbles and faces of peds; about 20 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

C—36 to 60 inches; yellowish brown (10YR 5/4) very gravelly loamy sand; single grained; loose; about 50 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. It is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 18 to 36 inches. The content of coarse fragments increases with increasing depth. It is 2 to 10 percent in Ap horizon and 5 to 35 percent in the BC horizon.

The Ap horizon is brown (10YR 4/3), dark grayish brown (10YR 4/2), or dark brown (7.5YR 4/2). Pedons in wooded areas have an A horizon, which is 3 to 4 inches thick, and an E horizon, which is 4 to 6 inches thick. The

Bt horizon has hue of 10YR to 5YR and value and chroma of 3 to 5. It is clay loam or clay. The BC horizon is 5 to 12 inches thick. It is gravelly loam, gravelly sandy loam, or gravelly clay loam. It has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. In some pedons tongues of the BC horizon extend for 2 or 3 feet into the C horizon. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is very gravelly sand or very gravelly loamy sand.

Glynwood Series

The Glynwood series consists of moderately well drained soils on uplands. These soils formed in calcareous, moderately fine textured glacial till. Permeability is slow. Slopes range from 2 to 18 percent.

Glynwood soils are commonly adjacent to Blount and Pewamo soils and are similar to Celina and Miamian soils. Blount soils are somewhat poorly drained and are in the lower landscape positions. Pewamo soils are very poorly drained and are in depressions and drainageways. Celina and Miamian soils have less clay in the substratum than the Glynwood soils.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, in an area in Allen Township about 0.5 mile east of Rossburg; about 2,000 feet east and 125 feet north of the southwest corner of sec. 26, T. 14 N., R. 2 E.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; common fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

BE—10 to 12 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; neutral; clear wavy boundary.

Bt1—12 to 19 inches; dark yellowish brown (10YR 4/4) clay; few fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; common faint brown (10YR 4/3) clay films on faces of peds; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; neutral; gradual wavy boundary.

Bt2—19 to 26 inches; dark yellowish brown (10YR 4/4) clay; few fine distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint brown (10YR 4/3) clay films on faces of peds; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 10 percent coarse fragments; neutral; clear wavy boundary.

BC—26 to 32 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; very few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few light gray (10YR 7/2) calcium carbonate coatings on pebbles and vertical faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—32 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint pale brown (10YR 6/3) and yellowish brown (10YR 5/6) mottles; massive but with widely spaced vertical fractures; firm; few light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 12 percent coarse fragments; strong effervescence; moderately alkaline.

The solum typically ranges from 20 to 36 inches in thickness, but in severely eroded areas it ranges from 10 to 20 inches. It commonly is medium acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. In severely eroded areas, however, the upper part of the subsoil is moderately alkaline. The depth to free carbonates typically ranges from 16 to 32 inches, but in severely eroded areas it is less than 10 inches. The content of coarse fragments is 2 to 10 percent in the solum and 5 to 15 percent in the C horizon.

The Ap horizon is dark grayish brown (10YR 4/2), dark yellowish brown (10YR 4/4), or brown (10YR 4/3). It is typically silt loam but is clay loam in severely eroded areas. Pedons in wooded areas have A and E horizons. The A horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). It is 3 to 5 inches thick. The E horizon is light brownish gray (10YR 6/2). It is 4 to 6 inches thick. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam, clay loam, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam.

Lewisburg Series

The Lewisburg series consists of moderately well drained soils on uplands. These soils formed in calcareous, medium textured glacial till. Permeability is moderate or moderately slow in the solum and slow in the substratum. Slopes range from 2 to 6 percent.

Lewisburg soils are commonly adjacent to Brookston and Pyrmont soils and are similar to Celina soils.

Brookston soils are very poorly drained and are in depressions and along narrow drainageways. Pyrmont soils are somewhat poorly drained and are in the lower landscape positions. Celina soils have a solum that is more than 20 inches thick.

Typical pedon of Lewisburg silt loam, 2 to 6 percent slopes, in an area in Butler Township about 3.5 miles south of New Madison; about 60 feet north and 2,640 feet west of the southeast corner of sec. 31, T. 10 N., R. 2 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; weak fine and medium subangular blocky structure parting to moderate medium granular; friable; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bt—9 to 14 inches; brown (10YR 4/3) clay; few fine distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) mottles; moderate medium subangular and angular blocky structure; firm; few fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent coarse fragments; neutral; clear wavy boundary.

BC—14 to 16 inches; brown (10YR 4/3) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few faint dark grayish brown (10YR 4/2) clay films on vertical faces of peds; few strong brown (7.5YR 5/6) concretions (iron and manganese oxides); about 8 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—16 to 30 inches; yellowish brown (10YR 5/4) loam; few medium distinct brownish yellow (10YR 6/6) and grayish brown (10YR 5/2) mottles; weak fine and medium angular blocky structure; firm; common light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 12 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—30 to 60 inches; yellowish brown (10YR 5/4) loam; few medium distinct brownish yellow (10YR 6/6) and grayish brown (10YR 5/2) mottles; massive but with widely spaced vertical fractures; firm; few light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; about 12 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 14 to 20 inches in thickness. It is slightly acid or neutral in the upper part and mildly alkaline in the lower part. The depth to free carbonates ranges from 12 to 20 inches. In most pedons the BC horizon has free carbonates. The content of coarse fragments in the solum ranges from 2 to 10 percent.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or clay. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4.

Linwood Series

The Linwood series consists of very poorly drained, organic soils in bogs and swales on terraces and moraines. These soils formed in organic material over loamy mineral material. The organic deposits were derived from woody material, grasses, sedges, and reeds. Permeability is moderately slow to moderately rapid in the organic material and moderate in the loamy material. Slopes are 0 to 2 percent.

Linwood soils are commonly adjacent to Carlisle, Edwards, and Wallkill soils. Carlisle and Edwards soils are in landscape positions similar to those of the Linwood soils. Carlisle soils are organic to a depth of more than 51 inches. Edwards soils are underlain by marl. Wallkill soils have mineral material in the upper part. They are in the slightly higher landscape positions.

Typical pedon of Linwood muck, in an area in Neave Township about 1 1/3 miles north of Weavers; about 1,300 feet north and 200 feet west of the center of sec. 20, T. 11 N., R. 2 E.

Oa1—0 to 7 inches; sapric material, black (10YR 2/1) moist and dry, broken face and rubbed; about 2 percent fiber, none rubbed; moderate fine and medium granular structure; friable; many fine roots; neutral; clear smooth boundary.

Oa2—7 to 14 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, none rubbed; moderate fine and medium subangular blocky structure; friable; common fine roots; about 2 percent woody fragments; neutral; clear wavy boundary.

Oa3—14 to 21 inches; sapric material, very dark gray (10YR 3/1) broken face and rubbed; about 30 percent dark reddish brown (5YR 3/2) fiber, 2 percent rubbed; weak coarse subangular blocky structure; friable; common fine roots; about 5 percent woody fragments; neutral; clear wavy boundary.

Cg1—21 to 44 inches; dark gray (5Y 4/1) silt loam; common medium faint olive gray (5Y 5/2) and common medium distinct olive (5Y 5/4) mottles; massive; firm; neutral; clear wavy boundary.

Cg2—44 to 60 inches; gray (5Y 5/1) silt loam; few medium faint olive gray (5Y 5/2) and few medium distinct olive (5Y 5/4) mottles; massive; firm; slight effervescence; mildly alkaline.

The organic material ranges from 16 to 30 inches in thickness. It is slightly acid to mildly alkaline. The surface tier is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). The subsurface tier has hue of 10YR or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 2.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is neutral to moderately alkaline. It is dominantly silt loam, fine sandy loam, loam, or silty clay loam. In some pedons, however, it has subhorizons of silty clay or fine sand 2 to 4 inches thick.

Lippincott Series

The Lippincott series consists of very poorly drained soils formed in glacial outwash in slight depressions on glacial outwash terraces and low benches on stream terraces. Permeability is moderate in the solum and rapid in the substratum. Slopes are 0 to 2 percent.

Lippincott soils are commonly adjacent to Eldean, Ockley, Patton, Savona, and Westland soils and are similar to Westland soils. Eldean, Ockley, and Savona soils are better drained than the Lippincott soils and are in the higher landscape positions. Patton soils are in the slightly lower landscape positions. They have fewer coarse fragments in the lower part than the Lippincott soils. Westland soils have a solum that is more than 40 inches thick. They are in landscape positions similar to those of the Lippincott soils.

Typical pedon of Lippincott silty clay loam, in an area in Harrison Township about 1.5 miles southwest of New Madison; about 825 feet west and 900 feet north of the center of sec. 23, T. 10 N., R. 1 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; few fine roots; about 1 percent coarse fragments; neutral; clear smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium angular blocky structure; firm; few fine roots; about 1 percent coarse fragments; neutral; clear smooth boundary.

Btg1—13 to 20 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; few faint gray (10YR 5/1) clay films on faces of peds; few strong brown (7.5YR 5/6) streaks (iron oxide); about 2 percent coarse fragments; neutral; clear wavy boundary.

Btg2—20 to 28 inches; gray (10YR 5/1) silty clay loam; common fine faint grayish brown (2.5Y 5/2) and common fine prominent light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; few faint dark gray (10YR 4/1) clay films on faces of peds; about 5 percent coarse fragments; neutral; abrupt irregular boundary.

BCg—28 to 38 inches; light brownish gray (10YR 6/2) very gravelly loam; many medium distinct dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) mottles; weak coarse subangular blocky structure; firm; few faint dark gray (10YR 4/1) clay films on faces of peds; common light gray (10YR 7/2) calcium carbonate coatings and few soft partly weathered dolomitic pebbles; about 35 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

Cg1—38 to 50 inches; light brownish gray (10YR 6/2) very gravelly coarse sandy loam; single grained; loose; about 55 percent coarse fragments; strong effervescence; moderately alkaline; gradual irregular boundary.

Cg2—50 to 60 inches; light brownish gray (10YR 6/2) extremely gravelly loamy coarse sand; single grained; loose; about 65 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. It is slightly acid or neutral in the upper part and neutral to moderately alkaline in the lower part. The depth to free carbonates ranges from 20 to 30 inches. The content of coarse fragments ranges from 1 to 10 percent in the A and Bt horizons and from 15 to 40 percent in the BC horizon. The thickness of the mollic epipedon ranges from 10 to 18 inches.

The A horizon is very dark brown (10YR 2/2), black (10YR 2/1), or very dark gray (10YR 3/1). The Btg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 2 or less. It is silty clay loam, clay loam, silty clay, or clay. The BC horizon is 6 to 16 inches thick. It is gravelly loam or very gravelly loam. The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is the very gravelly or extremely gravelly analogs of sand or loamy coarse sand below a depth of 50 inches.

Medway Series

The Medway series consists of moderately well drained, moderately permeable soils formed in alluvium on flood plains. Slopes are 0 to 2 percent.

These soils are taxadjuncts to the Medway series because they contain free carbonates throughout the solum. Also, they are deeper to gray mottles than is definitive for the series. These differences, however, do not alter the usefulness or behavior of the soils.

Medway soils are commonly adjacent to Eel and Shoals soils and are similar to Algiers and Eel soils. Algiers, Eel, and Shoals soils do not have a mollic epipedon. Eel soils are in landscape positions similar to those of the Medway soils. Shoals and Algiers soils are in the slightly lower landscape positions.

Typical pedon of Medway silt loam, occasionally flooded, in an area in Adams Township about 0.5 mile southwest of Gettysburg; about 660 feet south and 330 feet west of the northeast corner of sec. 35, T. 10 N., R. 3 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and medium granular structure; friable; few fine roots; about 2 percent coarse fragments; about 5 percent shell fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—9 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; few fine roots; about 2 percent coarse fragments; about 5 percent shell fragments; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—19 to 30 inches; brown (10YR 4/3) silt loam; common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; few faint dark grayish brown (10YR 4/2) coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; about 2 percent shell fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—30 to 52 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; massive; friable; about 5 percent coarse fragments; about 2 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cg—52 to 60 inches; grayish brown (10YR 5/2) sandy loam; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; about 10 percent coarse fragments; about 2 percent shell fragments; strong effervescence; moderately alkaline.

The solum ranges from 28 to 36 inches in thickness. It is mildly alkaline or moderately alkaline. The thickness of the mollic epipedon ranges from 16 to 24 inches. The content of coarse fragments ranges from 2 to 10 percent in the solum and from 5 to 40 percent in the C horizon.

The A horizon is very dark gray (10YR 3/1) to dark brown (10YR 3/3). The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is dominantly silt loam or loam, but some pedons have thin subhorizons of clay loam or sandy clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is loam, silt loam, sandy loam, silty clay loam, or clay loam. Many pedons have stratified sand and gravel below a depth of 40 inches.

Miamian Series

The Miamian series consists of well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous, medium textured glacial till. Slopes range from 0 to 25 percent.

Miamian soils are commonly adjacent to Brookston, Celina, Crosby, and Eldean soils and are similar to Celina and Glynwood soils. Brookston, Celina, and Crosby soils are wetter than the Miamian soils and are in the lower landscape positions. Eldean soils formed in glacial outwash and have sand and gravel in the substratum. They are on outwash terraces. Glynwood soils have more clay in the substratum than the Miamian soils.

Typical pedon of Miamian silt loam, 2 to 6 percent slopes, in an area in Harrison Township about 3.5 miles northwest of Braffetsville; about 1,320 feet south and 820 feet east of the northwest corner of sec. 19, T. 10 N., R. 1 E.

Ap—0 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; about 1 percent pebbles; neutral; abrupt smooth boundary.

Bt1—10 to 17 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; few faint brown (7.5YR 4/4) clay films on faces of peds; few very dark grayish brown (10YR 3/2) organic coatings in root channels; about 2 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—17 to 24 inches; dark yellowish brown (10YR 4/4) clay; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common faint brown (7.5YR 4/4) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

BC—24 to 33 inches; yellowish brown (10YR 5/4) clay loam; weak coarse subangular blocky structure; firm; few faint dark brown (10YR 3/3) clay films on faces of peds; common light gray (10YR 7/2) calcium carbonate coatings on pebbles and faces of peds; about 10 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1—33 to 42 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; firm; about 12 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; about 12 percent coarse fragments; strong effervescence; moderately alkaline.

The solum typically ranges from 20 to 40 inches in thickness, but in severely eroded areas it is as little as 10 inches thick. It commonly is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. In severely eroded areas, however, the subsoil is mildly alkaline or moderately alkaline. The depth to free carbonates typically ranges from 18 to 38 inches, but in severely eroded areas it is less than 10 inches. In many pedons the BC horizon has free carbonates. Some pedons have a loess mantle as much as 12 inches thick. The content of coarse fragments ranges from 2 to 10 percent in the part of the solum below the loess mantle and from 5 to 15 percent in the C horizon.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3 or 5/3), yellowish brown (10YR 5/6), or dark yellowish brown (10YR 4/4). It is typically silt loam but is clay loam in severely eroded areas. Pedons in wooded areas have A and E horizons. The A horizon is very dark gray (10YR 3/1) or black (10YR 2/1). It is 3 to 4 inches thick. The E horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4). It is 4 to 8 inches thick. The Bt horizon has hue of 10YR or 7.5YR and value and chroma of 4 or 5. It is silty clay loam, clay loam, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is loam or silt loam.

Montgomery Series

The Montgomery series consists of very poorly drained soils formed in fine textured lacustrine sediments. These soils generally are in depressions in lakebeds. A few areas are in depressions in the uplands. Permeability is slow or very slow. Slopes are 0 to 2 percent.

Montgomery soils are commonly adjacent to Algiers, Del Rey, Lippincott, Patton and Saranac soils. Algiers and Del Rey soils are somewhat poorly drained and are in the slightly higher landscape positions. Lippincott soils also are in the slightly higher landscape positions. They have outwash sand and gravel in the substratum. Patton soils have less clay in subsoil and substratum than the Montgomery soils. They are in landscape positions similar to those of the Montgomery soils. Saranac soils formed in alluvium on flood plains.

Typical pedon of Montgomery silty clay, in an area in Wabash Township about 2 miles northwest of North Star; about 395 feet south and 500 feet east of the northwest corner of sec. 6, T. 12 N., R. 3 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; firm; few fine roots; slightly acid; clear smooth boundary.

A—10 to 13 inches; very dark gray (10YR 3/1) silty clay; grayish brown (10YR 5/2) dry; few medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; few fine roots; patchy dark gray (10YR 4/1) pressure faces on peds; few very dark grayish brown (10YR 3/2) concretions (iron and manganese oxides); neutral; clear wavy boundary.

Bg1—13 to 24 inches; dark gray (10YR 4/1) silty clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to strong fine and medium angular blocky; firm; few fine roots; few faint dark gray (5Y 4/1) and light olive brown (2.5Y 5/4) pressure faces on peds; few very dark grayish brown (10YR 3/2) concretions (iron and manganese oxides); few yellowish red (5YR 5/6) concretions (iron oxide); neutral; diffuse wavy boundary.

Bg2—24 to 31 inches; gray (10YR 5/1) silty clay; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium prismatic structure parting to strong medium angular blocky; firm; few fine roots; few faint dark gray (10YR 4/1) pressure faces on peds; few brown (7.5YR 5/4) concretions (iron oxide); neutral; clear wavy boundary.

BCg—31 to 41 inches; gray (10YR 5/1) silty clay; many medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; firm; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); slight effervescence; mildly alkaline; gradual wavy boundary.

Cg—41 to 60 inches; gray (10YR 6/1) silty clay; many medium distinct yellowish brown (10YR 5/4) and light olive brown (2.5Y 5/4) mottles; weak coarse angular blocky structure; firm; slight effervescence; moderately alkaline.

The solum ranges from 28 to 48 inches in thickness. It is slightly acid to mildly alkaline. The mollic epipedon is 12 to 16 inches thick.

The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The Bg and BCg horizons have hue of 10YR to 5Y or are neutral in hue. They have value of 3 to 6 and chroma of 2 or less. The Bg horizon is dominantly silty clay or silty clay loam. In some pedons, however, it has subhorizons of loam or clay loam 2 to 4 inches thick. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is typically silty clay, but in some pedons it is stratified silty clay loam and silty clay and has thin subhorizons of silt loam.

Ockley Series

The Ockley series consists of well drained soils formed in glacial outwash on outwash terraces along the major streams. A few areas are on kames. Permeability is moderate in the solum and very rapid in the substratum. Slopes range from 0 to 6 percent.

Ockley soils are commonly adjacent to Eldean, Lippincott, Savona, Wea, and Westland soils and are similar to Wea soils. Eldean soils are in the slightly higher landscape positions. They have a solum that is thinner than that of the Ockley soils. Lippincott and Westland soils are very poorly drained and are in depressions. Savona soils are somewhat poorly drained and are in the slightly lower landscape positions. Wea soils have a mollic epipedon. They are in positions on outwash terraces similar to those of the Ockley soils.

Typical pedon of Ockley silt loam, 0 to 2 percent slopes, in an area in Adams Township about 1 mile southeast of Gettysburg; about 1,650 feet west and 185 feet south of the northeast corner of sec. 31, T. 9 N., R. 4 E.

Ap—0 to 11 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; few fine roots; slightly acid; clear smooth boundary.

BE—11 to 15 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse subangular blocky structure; friable; few fine roots; common faint brown (10YR 5/3) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—15 to 22 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few faint reddish brown (5YR 4/3) clay films on faces of peds; medium acid; clear wavy boundary.

Bt2—22 to 34 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm, sticky; many faint reddish brown (5YR 4/4) clay films on faces of peds; about 2 percent very dark gray (10YR 3/1) shale fragments; about 10 percent coarse fragments; medium acid; clear irregular boundary.

Bt3—34 to 45 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; weak coarse subangular blocky structure; friable; few faint dark brown (7.5YR 3/2) and dark reddish brown (5YR 3/2) clay films on faces of peds; subhorizon of dark reddish brown (5YR 3/2) clay between depths of 42 and 45 inches; about 30 percent coarse fragments; few weathered limestone fragments; neutral; abrupt irregular boundary.

C—45 to 70 inches; brown (10YR 4/3) extremely gravelly loamy coarse sand; single grained; loose; about 65 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. It is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 38 to 58 inches.

The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The Bt horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam in the upper part and gravelly clay loam, gravelly loam, or gravelly sandy clay loam in lower part. The content of coarse fragments is 0 to 10 percent in upper part of this horizon and 15 to 45 percent in the lower part. In some pedons tongues of the Bt3 horizon extend 8 to 12 inches into the C horizon. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is gravelly, very gravelly, or extremely gravelly loamy coarse sand or sand.

Odell Series

The Odell series consists of somewhat poorly drained soils formed in calcareous, medium textured glacial till on uplands. Permeability is moderately slow. Slopes range from 0 to 3 percent.

Odell soils are commonly adjacent to Brookston and Crosby soils. Brookston soils are very poorly drained and are in depressions and along narrow drainageways. Crosby soils are commonly in the slightly higher landscape positions. They do not have a mollic epipedon.

Typical pedon of Odell silt loam, 0 to 3 percent slopes, in an area in Liberty Township about 1.5 miles north of Glen Karn; about 1,300 feet east and 500 feet south of the northwest corner of sec. 29, T. 11 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; few fine roots; about 2 percent coarse fragments; few black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear smooth boundary.

A—9 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bt1—12 to 18 inches; dark brown (10YR 3/3) clay loam, grayish brown (10YR 5/2) dry; many medium distinct olive brown (2.5Y 4/4) and few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; few faint dark gray (10YR 4/1) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

Bt2—18 to 26 inches; light olive brown (2.5Y 5/4) clay loam; few medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent coarse fragments; neutral; clear wavy boundary.

BC—26 to 35 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—35 to 60 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; massive but with widely spaced vertical fractures; friable; few light gray (10YR 7/1) calcium carbonate coatings on vertical fractures; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 20 to 40 inches. The content of coarse fragments ranges from 2 to 5 percent in the upper part of the solum and from 5 to 15 percent in the lower part and in the C horizon. The thickness of the mollic epipedon ranges from 12 to 22 inches.

The A horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 3 or 4. It is loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or 4. It is loam or silt loam.

Patton Series

The Patton series consists of very poorly drained soils formed in medium textured and moderately fine textured lacustrine sediments. These soils are in depressional areas on uplands and slack-water terraces. Permeability is moderately slow. Slopes are 0 to 2 percent.

Patton soils are commonly adjacent to Algiers, Brookston, Montgomery, and Westland soils and are similar to Brookston, Pewamo, and Treaty soils. Algiers soils are somewhat poorly drained and are in the slightly higher landscape positions. Brookston, Pewamo, and Treaty soils have a higher content of coarse fragments in the lower part than the Patton soils. Brookston soils are in the slightly higher depressions on uplands. Montgomery soils are in landscape positions similar to those of the Patton soils. They have more clay in the subsoil and substratum than the Patton soils. Westland soils are on glacial outwash terraces and stream terraces. They have outwash sand and gravel in the substratum.

Typical pedon of Patton silty clay loam, in an area in Greenville Township about 3 miles north of Greenville; about 660 feet west and 660 feet south of the northeast corner of sec. 14, T. 12 N., R. 2 E.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—11 to 17 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

Bg1—17 to 22 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common faint very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; clear wavy boundary.

Bg2—22 to 31 inches; gray (10YR 5/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) and olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots; few faint dark gray (10YR 4/1) silt coatings on faces of peds; about 1 percent coarse fragments; neutral; clear wavy boundary.

BCg—31 to 36 inches; gray (10YR 5/1) silty clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few dark gray (10YR 4/1) fillings (1 to 2 inches in diameter) in krotovinas; about 1 percent coarse fragments; mildly alkaline; gradual wavy boundary.

Cg—36 to 60 inches; gray (10YR 5/1) silty clay loam; many coarse distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 26 to 40 inches in thickness. It is neutral in the upper part and neutral or mildly alkaline in the lower part. Some pedons have free carbonates in the BC horizon.

The Ap horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The Bg horizon has hue of 5Y to 10YR or is neutral in hue. It has value of 4 or 5 and chroma of 2 or less. It is typically silty clay loam, but some pedons have thin subhorizons of silty clay or silt loam. The C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. In some pedons it is stratified silty clay loam and silt loam, and in a few pedons it has subhorizons of fine sand less than 2 inches thick.

Pewamo Series

The Pewamo series consists of very poorly drained, moderately slowly permeable soils in depressions and along narrow drainageways in the uplands. These soils formed in calcareous, moderately fine textured glacial till. Slopes are 0 to 2 percent.

These soils are taxadjuncts because the increase in content of clay from the surface soil to the subsoil is less than is definitive for the Pewamo series. This difference, however, does not alter the usefulness or behavior of the soils.

Pewamo soils are commonly adjacent to Blount, Glynwood, and Saranac soils and are similar to Brookston, Patton, and Treaty soils. Blount and Glynwood soils are better drained than the Pewamo soils. They are in the higher landscape positions. They do not have a mollic epipedon. Saranac soils formed in alluvium on flood plains. Brookston, Patton, and Treaty soils have less clay in the B and C horizons than the Pewamo soils.

Typical pedon of Pewamo silty clay loam, in an area in Patterson Township about 1.5 miles southwest of Yorkshire; about 2,100 feet north and 25 feet east of the center of sec. 24, T. 12 N., R. 3 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium angular and subangular blocky structure; firm; common fine roots; neutral; clear smooth boundary.

A—8 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, gray (10YR 5/1) dry; few fine faint brown (10YR 5/3) mottles; moderate medium angular blocky structure; firm; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Btg1—12 to 19 inches; dark gray (10YR 4/1) clay; common fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; few faint gray (5Y 5/1) clay films on faces of peds and in voids; about 2 percent coarse fragments; neutral; clear smooth boundary.

Btg2—19 to 26 inches; dark gray (10YR 4/1) clay; common medium prominent olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; few faint gray (5Y 5/1) clay films on faces of peds and in voids; common very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; mildly alkaline; clear wavy boundary.

Btg3—26 to 37 inches; dark gray (5Y 4/1) clay; many medium prominent olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few brown (7.5YR 4/4) iron streaks; common very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 2 percent coarse fragments; mildly alkaline; clear wavy boundary.

BCg—37 to 66 inches; gray (5Y 5/1) clay loam; many coarse prominent olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; few fine roots; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; mildly alkaline; clear wavy boundary.

C—66 to 72 inches; brown (10YR 4/3) clay loam; common medium faint dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure in the upper part, massive in the lower part; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 28 to 70 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Some pedons have free carbonates in the BC horizon. The content of coarse fragments ranges from 0 to 15 percent in the solum and from 5 to 15 percent in the C horizon.

The A horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). The Btg horizon has hue of 5Y, 2.5Y, or 10YR, value of 4 to 6, and chroma of 1 to 4. It is clay loam or clay. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It is silty clay loam or clay loam.

Pyrmont Series

The Pyrmont series consists of somewhat poorly drained soils formed in calcareous, medium textured glacial till on uplands. Permeability is moderate or moderately slow in the solum and slow in the substratum. Slopes range from 0 to 3 percent.

Pyrmont soils are commonly adjacent to Brookston and Lewisburg soils and are similar to Crosby soils. Brookston soils are very poorly drained and are in depressions and along narrow drainageways. Lewisburg soils are moderately well drained and in the higher landscape positions. Crosby soils have a solum that is more than 20 inches thick.

Typical pedon of Pyrmont silt loam, 0 to 3 percent slopes, in an area in Harrison Township about 2.5 miles south of New Madison; about 1,100 feet south and 990 feet east of the center of sec. 36, T. 10 N., R. 1 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure parting to moderate medium granular; friable; common fine roots; about 5 percent coarse fragments; few shale fragments; neutral; abrupt smooth boundary.

BE—8 to 11 inches; yellowish brown (10YR 5/4) clay loam; many medium faint dark yellowish brown (10YR 4/4) and many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; about 5 percent coarse fragments; neutral; clear wavy boundary.

Bt—11 to 16 inches; brown (10YR 5/3) clay loam; common medium faint dark grayish brown (10YR 4/2) and few medium faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular and angular blocky structure; firm; many distinct grayish brown (10YR 5/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; neutral; clear wavy boundary.

BC—16 to 19 inches; brown (10YR 5/3) clay loam; few medium distinct dark grayish brown (10YR 4/2) mottles; weak medium and coarse subangular blocky structure; firm; few faint grayish brown (10YR

5/2) clay films on vertical faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—19 to 32 inches; yellowish brown (10YR 5/4) loam; few medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few light brownish gray (10YR 6/2) and light gray (10YR 7/2) calcium carbonate coatings on faces of peds; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual irregular boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) loam; few medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; massive but with widely spaced vertical fractures; very firm; few light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 14 to 20 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 12 to 18 inches. The content of coarse fragments ranges from 2 to 10 percent in the solum and from 8 to 12 percent in the C horizon.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay loam or clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4.

Saranac Series

The Saranac series consists of very poorly drained, moderately slowly permeable soils formed in alluvium over glacial till. These soils are on flood plains. Slopes are 0 to 2 percent.

Saranac soils are commonly adjacent to Montgomery and Pewamo soils. The adjacent soils regularly decrease in content of organic matter with increasing depth. Montgomery soils are in lakebeds, and Pewamo soils are on uplands.

Typical pedon of Saranac silty clay, frequently flooded, in an area in Mississinawa Township about 7 miles north of Union City; about 300 feet east and 870 feet south of the northwest corner of sec. 30, T. 14 N., R. 1 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; firm; common fine roots; about 1 percent coarse fragments less than 5 millimeters in diameter; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); mildly alkaline; abrupt smooth boundary.

Bg1—10 to 18 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; few fine roots; few faint dark gray (10YR 4/1) coatings on faces of peds; about 2 percent coarse fragments less than 5 millimeters in diameter; few reddish brown (5YR 5/4) concretions (iron oxide); mildly alkaline; gradual wavy boundary.

Bg2—18 to 28 inches; dark gray (10YR 4/1) silty clay; many fine and medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; about 2 percent coarse fragments less than 5 millimeters in diameter; few reddish brown (5YR 5/4) concretions (iron oxide); mildly alkaline; clear wavy boundary.

Bg3—28 to 40 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium and coarse subangular blocky structure; firm; about 4 percent coarse fragments less than 5 millimeters in diameter; few reddish brown (5YR 5/4) concretions (iron oxide); mildly alkaline; clear wavy boundary.

Cg1—40 to 54 inches; grayish brown (10YR 5/2) stratified clay loam and silt loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; friable; about 10 percent coarse fragments 5 to 15 millimeters in diameter; strong effervescence; moderately alkaline; clear irregular boundary.

2Cg2—54 to 66 inches; dark grayish brown (10YR 4/2) clay loam; few medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; about 10 percent coarse fragments 5 to 15 millimeters in diameter; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); strong effervescence; moderately alkaline.

The solum ranges from 36 to 56 inches in thickness. It is typically neutral or mildly alkaline throughout. In some pedons, however, it is moderately alkaline in the lower part. The content of coarse fragments increases with increasing depth. It ranges from 1 to 8 percent in the solum and from 10 to 25 percent in the C horizon. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The Ap horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). The B horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2.

Savona Series

The Savona series consists of somewhat poorly drained soils formed in glacial outwash on outwash terraces along the major streams. Permeability is moderate or moderately slow in the solum and rapid or very rapid in the substratum. Slopes are 0 to 2 percent.

Savona soils are commonly adjacent to Eldean, Lippincott, Ockley, Wea, and Westland soils. Eldean, Ockley, and Wea soils are well drained and are in the higher landscape positions. Lippincott and Westland soils are very poorly drained and are in depressions.

Typical pedon of Savona silt loam, 0 to 2 percent slopes, in an area in Harrison Township on the west edge of New Madison; about 320 feet west and 740 feet north of the center of sec. 13, T. 10 N., R. 1 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; few fine roots; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

Eg—10 to 12 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; many faint light brownish gray (10YR 6/2) silt coatings on faces of peds; about 2 percent coarse fragments; few dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

Btg1—12 to 19 inches; grayish brown (10YR 5/2) clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; many faint gray (10YR 5/1) clay films on faces of peds; few dark concretions (iron and manganese oxides); about 5 percent coarse fragments; neutral; gradual wavy boundary.

Btg2—19 to 27 inches; grayish brown (10YR 5/2) clay; common medium distinct brown (10YR 5/3) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; many faint gray (10YR 5/1) clay films on faces of peds; few dark concentrations (iron and manganese oxides); about 10 percent coarse fragments; neutral; clear wavy boundary.

Bt—27 to 38 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) gravelly loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few distinct gray (10YR 5/1) clay films on faces of peds; few dark concretions (iron and manganese oxides); about 20 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

BC—38 to 50 inches; brown (10YR 4/3) very gravelly coarse sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; few distinct gray (10YR 5/1) clay films on faces of peds and on coarse fragments; few dark concretions (iron and manganese oxides); about 45 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—50 to 72 inches; brown (10YR 5/3) extremely gravelly coarse sand; few fine faint grayish brown (10YR 5/2) mottles; single grained; loose; about 68 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 40 to 55 inches in thickness. It is neutral or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 24 to 40 inches. Most pedons have free carbonates in the BC horizon. The content of coarse fragments ranges from 0 to 15 percent in the upper part of the solum and from 15 to 45 percent in the lower part.

The Ap horizon is dark grayish brown (10YR 4/2), dark gray (10YR 4/1), or grayish brown (10YR 5/2). The Bt horizon has hue of 10YR or 2.5Y, value or 4 or 5, and chroma of 2 to 4. It is clay loam or clay in the upper part and gravelly clay loam or gravelly loam in the lower part. The BC horizon ranges from 10 to 24 inches in thickness. It is very gravelly clay loam, very gravelly coarse sandy loam, or very gravelly loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very gravelly sand to extremely gravelly loamy coarse sand and is stratified in many pedons.

Shoals Series

The Shoals series consists of somewhat poorly drained, moderately permeable soils formed in alluvium on flood plains. These soils make up the entire flood plain along many of the smaller streams. Slopes are 0 to 2 percent.

Shoals soils are commonly adjacent to Eel and Medway soils. The adjacent soils are moderately well drained and are in the higher landscape positions.

Typical pedon of Shoals silt loam, occasionally flooded, in an area in Adams Township about 0.75 mile south of Gettysburg; about 1,650 feet south and 330 feet east of the northwest corner of sec. 31, T. 9 N., R. 4 E.

A—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; many fine roots; mildly alkaline; clear smooth boundary.

C—5 to 8 inches; brown (10YR 5/3) silt loam; many coarse faint grayish brown (10YR 5/2) mottles; weak medium and coarse granular structure; friable; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Cg—8 to 17 inches; dark gray (10YR 4/1) silt loam; common medium distinct dark yellowish brown (10YR 4/4) and dark brown (7.5YR 4/4) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

C'—17 to 22 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; friable; few fine roots; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C'g1—22 to 34 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) and dark brown (7.5YR 4/4) mottles; massive; friable; few roots; few very dark gray (10YR 3/1) concretions (iron and manganese oxides); about 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C'g2—34 to 60 inches; grayish brown (10YR 5/2) stratified sandy loam and loam; common medium distinct dark yellowish brown (10YR 4/4) and few fine faint dark grayish brown (10YR 4/2) mottles; massive; friable; about 10 percent coarse fragments; slight effervescence; mildly alkaline.

Reaction is neutral or mildly alkaline in the upper 20 inches and mildly alkaline or moderately alkaline below a depth of 20 inches. The content of coarse fragments increases with increasing depth. It ranges from 0 to 12 percent in the upper 40 inches.

The A horizon is dark brown (10YR 3/3) or dark grayish brown (10YR 4/2). The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. The part of this horizon within a depth of 34 inches is silt loam, loam, or clay loam. Some pedons have stratified sand and gravel below a depth of 50 inches.

Treaty Series

The Treaty series consists of very poorly drained, moderately slowly permeable soils in depressions and along narrow drainageways in the uplands. These soils formed in loess and in the underlying calcareous, medium textured glacial till. Slopes are 0 to 2 percent.

These soils are taxadjuncts because the increase in content of clay from the surface layer to the subsoil is less than is definitive for the Treaty series. This difference, however, does not alter the usefulness or behavior of the soils.

Treaty soils are commonly adjacent to Crosby soils and are similar to Brookston, Patton and Pewamo soils. Crosby soils are somewhat poorly drained and are in the higher landscape positions. Brookston soils have more sand, a higher content of coarse fragments, and less silt in the upper part of the subsoil than the Treaty soils. Patton soils have fewer coarse fragments in the lower part than the Treaty soils. Pewamo soils have more clay in the subsoil and substratum than the Treaty soils.

Typical pedon of Treaty silty clay loam, in an area in Liberty Township about 3.5 miles west of Palestine; about 350 feet east and 75 feet south of the northwest corner of sec. 18, T. 11 N., R. 1 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, gray (10YR 5/1) dry; weak fine and medium subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

Btg1—10 to 16 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; few faint dark gray (10YR 4/1) clay films on faces of peds; few concretions (iron and manganese oxides); neutral; clear smooth boundary.

Btg2—16 to 24 inches; gray (10YR 5/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) and few medium faint dark gray (10YR 4/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many faint dark gray (10YR 4/1) clay films on faces of peds; few concretions (iron and manganese oxides); neutral; clear wavy boundary.

2Btg3—24 to 32 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many faint dark gray (10YR 4/1) clay films on faces of peds; about 5 percent coarse fragments; mildly alkaline; clear wavy boundary.

2BC—32 to 44 inches; light olive brown (2.5Y 5/4) clay loam; many medium prominent gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

2C—44 to 68 inches; olive brown (2.5Y 4/4) loam; common medium prominent gray (10YR 5/1) mottles; massive but with widely spaced vertical fractures; friable; few light gray (10YR 7/2) calcium carbonate coatings on vertical fractures; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 38 to 56 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1. The 2BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. The content of coarse fragments ranges from 2 to 10 percent in the 2Bt and 2BC horizons and from 5 to 15 percent in the 2C horizon. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam or silt loam.

Wallkill Series

The Wallkill series consists of very poorly drained soils formed in alluvium and in organic material. These soils are in depressions on outwash terraces and moraines. Permeability is moderate in the alluvium and moderately rapid or rapid in the organic material. Slopes are 0 to 2 percent.

Wallkill soils are commonly adjacent to Carlisle, Edwards, Linwood, and Patton soils. Carlisle, Edwards, and Linwood soils are in the lower positions in the deeper depressions. They do not have mineral material in the upper part. Patton soils are in the slightly higher landscape positions. They have a mollic epipedon.

Typical pedon of Wallkill silt loam, in an area in Harrison Township about 2.5 miles west of New Madison; about 1,045 feet south and 185 feet east of the northwest corner of sec. 15, T. 10 N., R. 1 E.

Ap—0 to 8 inches; dark gray (10YR 4/1) silt loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; friable; many fine roots; mildly alkaline; clear smooth boundary.

Cg—8 to 20 inches; dark gray (10YR 4/1) silt loam; common medium distinct dark grayish brown (2.5Y 4/2) mottles; weak coarse subangular blocky structure; firm; common fine roots; neutral; clear wavy boundary.

2Oa1—20 to 24 inches; sapric material, black (10YR 2/1), broken face and rubbed; about 30 percent fiber, less than 1 percent rubbed; many distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) silt coatings on faces of peds; weak coarse subangular blocky structure; nonsticky; few fine roots; neutral; clear wavy boundary.

2Oa2—24 to 48 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 30 percent fiber, less than 1 percent rubbed, massive; nonsticky; neutral; clear wavy boundary.

2Oa3—48 to 56 inches; sapric material, dark brown (7.5YR 3/2), broken face and rubbed; about 50 percent fiber, less than 1 percent rubbed; massive; nonsticky; common reddish brown (5YR 4/4) woody fragments 1/8 to 1/2 inch in diameter; neutral; clear wavy boundary.

2Oa4—56 to 72 inches; sapric material, reddish brown (5YR 4/4) broken face and rubbed, very dark gray (5YR 3/1) when exposed to air; about 70 percent fiber, 5 percent rubbed; massive; nonsticky; common reddish brown (5YR 4/4) woody fragments 1/8 to 1/2 inch in diameter; neutral.

The mineral material ranges from 16 to 30 inches in thickness. Reaction is neutral or mildly alkaline throughout the profile.

The Ap horizon is dark gray (10YR 4/1), dark brown (10YR 3/3), or dark grayish brown (10YR 4/2). The Cg horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. It is commonly silt loam but is silty clay loam in some pedons. The organic material is typically sapric. In a few pedons, however, it is hemic below a depth of 30 inches, and in some pedons it has subhorizons of sedimentary peat 4 to 6 inches thick. The 2Oa horizon has hue of 10YR to 5YR, value of 2 to 4, and chroma of 1 to 4.

Wea Series

The Wea series consists of well drained soils formed in glacial outwash on outwash terraces along the major streams. Permeability is moderate in the solum and very rapid in the substratum. Slopes are 0 to 2 percent.

Wea soils are commonly adjacent to Eldean, Ockley, and Savona soils and are similar to Ockley soils. Eldean and Ockley soils do not have a mollic epipedon. Eldean soils are in the slightly higher landscape positions. Ockley soils are in landscape positions similar to those of the Wea soils. Savona soils are somewhat poorly drained and are in the slightly lower landscape positions.

Typical pedon of Wea silt loam, 0 to 2 percent slopes, in an area in Harrison Township about 1 mile northwest of Braffetsville; about 990 feet east and 400 feet south of the center of sec. 28, T. 10 N., R. 1 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate medium and coarse granular; friable; common fine roots; neutral; clear smooth boundary.

A—8 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.

Bt1—18 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; many distinct very dark grayish brown (10YR 3/2) organic coatings and clay films on faces of peds; neutral; clear smooth boundary.

Bt2—27 to 44 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common distinct dark brown (7.5YR 3/2) clay films on faces of peds; few distinct dark brown (10YR 3/3) organic coatings on faces of peds; about 12 percent coarse fragments less than 0.25 inch in diameter; neutral; clear irregular boundary.

BC—44 to 58 inches; dark yellowish brown (10YR 3/4) gravelly clay loam; weak coarse subangular blocky structure; friable; few faint very dark grayish brown

(10YR 3/2) clay films on faces of peds; common pale brown (10YR 6/3) calcium carbonate coatings on pebbles; about 25 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

C—58 to 70 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; single grained; loose; about 50 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 48 to 68 inches in thickness. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 40 to 62 inches. The thickness of the mollic epipedon ranges from 14 to 22 inches.

The Ap horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam or clay loam. The content of coarse fragments in this horizon ranges from 0 to 15 percent. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is very gravelly coarse sand or very gravelly loamy coarse sand.

Westland Series

The Westland series consists of very poorly drained soils formed in glacial outwash in slight depressions on glacial outwash terraces and stream terraces. Permeability is moderate in the solum and very rapid in the substratum. Slopes are 0 to 2 percent.

Westland soils are commonly adjacent to Eldean, Lippincott, Ockley, Patton, and Savona soils and are similar to Lippincott soils. The well drained Eldean and Ockley and somewhat poorly drained Savona soils are in the higher landscape positions. Lippincott soils are in landscape positions similar to those of the Westland soils. They have a solum that is less than 40 inches thick. Patton soils are in depressions on uplands and slack-water terraces. They have fewer coarse fragments in the lower part than the Westland soils.

Typical pedon of Westland silty clay loam, in an area in Liberty Township on the east edge of Palestine; about 1,070 feet east and 960 feet north of the southwest corner of sec. 14, T. 11 N., R. 1 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; firm; common fine roots; about 2 percent coarse fragments; neutral; clear wavy boundary.

A—10 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) mottles; moderate fine and medium angular blocky structure; firm; few fine roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Btg1—15 to 20 inches; grayish brown (2.5Y 5/2) clay loam; common medium distinct light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; firm; few fine roots; many faint dark gray (10YR 4/1) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

Btg2—20 to 28 inches; grayish brown (2.5Y 5/2) clay loam; many medium distinct light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; few fine roots; common faint dark gray (10YR 4/1) clay films on faces of peds; about 5 percent coarse fragments; neutral; gradual wavy boundary.

Btg3—28 to 34 inches; grayish brown (2.5Y 5/2) clay loam; many coarse distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; firm; few faint dark gray (10YR 4/1) clay films on faces of peds; about 5 percent coarse fragments; mildly alkaline; clear wavy boundary.

BCg—34 to 45 inches; grayish brown (2.5Y 5/2) gravelly loam; common medium distinct yellowish brown (10YR 5/4) mottles; friable; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; few light gray (10YR 7/2) remnants of limestone fragments; about 25 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

Cg—45 to 68 inches; light brownish gray (2.5Y 6/2) very gravelly sand; few fine distinct light olive brown (2.5Y 5/4) mottles; single grained; loose; about 50 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 40 to 56 inches in thickness. It is neutral in the upper part and neutral or mildly alkaline in the lower part. The depth to free carbonates ranges from 32 to 50 inches. In most pedons the BC horizon has free carbonates. The thickness of the mollic epipedon ranges from 12 to 18 inches.

The A horizon is very dark brown (10YR 2/2), black (10YR 2/1), or very dark gray (10YR 3/1). The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or less. It is clay loam or silty clay loam. The content of coarse fragments ranges from 2 to 10 percent in the Btg horizon and from 15 to 35 percent in the BC horizon. The BC horizon ranges from 5 to 16 inches in thickness. It is gravelly loam or gravelly clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is very gravelly sand or very gravelly loamy sand.

Formation of the Soils

This section relates the factors of soil formation to the soils in Darke County. It also describes the processes of soil formation.

Factors of Soil Formation

Soils form through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the interrelationships among five factors—the physical and mineralogical composition of the parent material, the climate under which the parent material accumulated and has existed since accumulation, the living organisms in and on the soil, the topography, and the length of time that the processes of soil formation have been active (*7*). Because different factors dominate in different areas throughout the county, many kinds of soil have formed.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. Most of the soils in Darke County formed in Wisconsin glacial till. This till was deposited directly by glacial ice. It consists mostly of clay, silt, sand, gravel, and few boulders. The content of calcium carbonate ranges from 25 to 45 percent. In most places the till is deep over bedrock. Miamian, Celina, Crosby, Blount, Brookston, Glynwood, and Pewamo are examples of soils that formed in thick deposits of till.

Some of the soils in the county formed in glacial outwash. This material was laid down by glacial meltwater. It is mostly loamy material and sand and gravel. Eldean and Savona are examples of soils that formed in outwash. In most places these soils are good sources of sand and gravel.

Some soils formed in recent alluvium along streams. Alluvium is soil material that was eroded from soils upstream and was deposited on flood plains downstream during periods of flooding. The soils that formed in alluvium are buried under fresh alluvium when they are flooded. They show very little evidence of genetic development. They are the youngest soils in the county. Eel and Shoals soils are examples. Some of the alluvium in the county has a high organic matter content. Medway soils formed in this alluvium.

Carlisle, Edwards, and Linwood soils formed in organic material. This material is derived from plants and other organisms that have died. It has accumulated in depressions that are very wet. A few of the depressions are ponded all year.

Del Rey, Montgomery, and Patton soils formed in lacustrine sediments. These sediments are in areas where glacial meltwater moved very slowly because relief was low or the path of the water was blocked by glacial ice. The slowly moving water carried the finer particles, which settled to the bottom and formed deposits of clay and silt.

Climate

The climate of Darke County is humid, temperate, and continental. During the period of soil formation, it favored physical and chemical weathering and biologic activity. Rainfall supplied sufficient percolating water to leach carbonates to a moderate depth in Miamian, Celina, Crosby, and other soils. Wet and dry cycles favored the translocation of clay minerals and the formation of soil structure in Miamian, Eldean, and other soils.

Temperature variations favored physical and chemical weathering of the soil material. Freezing and thawing helped to develop soil structure. Warm summer temperatures favored the chemical weathering of primary minerals.

Both rainfall and temperature favored plant growth and the subsequent accumulation of organic matter in all of the soils. Additional information about the climate is given under the heading "General Nature of the County."

Living Organisms

At the time of settlement, the vegetation in Darke County was mostly hardwoods. Beech, maple, oak, hickory, and ash were the most common trees. There were some grassy clearings on the better drained sites and marshy openings in poorly drained swales. Generally, soils that formed under hardwoods are lighter in color and contain less organic matter than soils that formed under grasses.

Soils that formed in the forested areas are acid and moderately fertile. Examples are Miamian, Crosby, and Blount soils. The better drained soils in the grassy clearings are dark, are less acid than the soils that formed in forested areas, and are more fertile. Examples are Medway, Odell, and Wea soils. The soils in the marshy swales are very poorly drained, dark, and fertile.

Examples are Brookston, Pewamo, and Montgomery soils. In a few areas the swales were saturated for long periods. Carlisle, Edwards, and Linwood soils formed in these areas.

Small animals, insects, worms, and roots form channels, which result in a more permeable soil. Animals mix the soil material and contribute organic matter. Worm channels or worm casts are plentiful in the highly organic surface layer of Medway and Odell soils. Crawfish channels are common in the very poorly drained Brookston, Pewamo, and Montgomery soils.

Human activities also affect soil formation. Plowing and planting introduce changes in the plant cover. Some areas are drained, and others are irrigated. In places the soil is removed for construction purposes. Also, applications of lime and fertilizer change the chemistry of the soils.

Topography

Many of the differences among soils in Darke County are caused by differences in topography. For example, Miamian, Celina, and Crosby soils formed under similar conditions, except for natural drainage, which is determined mainly by topography. The well drained Miamian soils are in areas where surface and internal drainage is good. The moderately well drained Celina soils are in areas of more gentle topography where the water table is seasonally high for brief but significant periods. The somewhat poorly drained Crosby soils are in areas where the water table is seasonally high for significant periods.

The very poorly drained soils in the county are level or nearly level and are mainly in depressions. In these areas runoff is very slow or ponded. Because organic matter decomposes slowly in wet soils, most very poorly drained soils have a thick, dark surface layer. Examples are Pewamo, Brookston, Montgomery, and Patton soils. The organic Carlisle, Linwood, and Edwards soils are in swampy depressions where the soil material is saturated most of the time.

The solum of the steeper soils generally is thinner than that of the less sloping soils in the same series. This difference is the result of a more rapid runoff rate and a greater degree of erosion on the steeper soils.

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. In many places, however, the factors other than time have been responsible for most of the differences in the kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile develops slowly. In steep areas, where soil is removed almost as rapidly as it forms, distinct horizons do not develop.

Most of the soils in the county have well developed profiles. Examples are Miamian, Eldean, Celina, and Crosby soils. Frequent deposition of fresh sediments periodically interrupts the formation of soils on flood plains. Eel and Shoals are examples. The horizons below their surface layer are not well developed.

Processes of Soil Formation

The factors of soil formation affect four soil-forming processes. These processes are additions, losses, transfers, and alterations (*11*). Some of the processes promote differences among the soils, whereas others retard or preclude differentiation.

The most important addition to the soils in Darke County is that of organic matter. Soils that formed under deep-rooted grasses or where a high water table has restricted decomposition of organic matter have a thick, dark surface layer. Examples are Brookston and Montgomery soils. Some organic matter accumulates as a thin mat on the surface of most soils. This dark layer is generally obliterated by cultivation. Severe erosion also can remove all evidence of this addition to the profile.

Montgomery, Brookston, Patton, Pewamo, and Treaty soils are seasonally waterlogged. They continually accumulate bases through additions brought in by the ground water. The additions of bases are generally greater than the losses. Medway, Shoals, and Eel soils periodically receive additions of soil material during periods of flooding. Additions of lime and fertilizer in cultivated areas counteract, or may even exceed, the normal losses of plant nutrients.

Leaching of carbonates from calcareous parent material is one of the most significant losses that preceded many other chemical changes in the solum. Most of the glacial till in Darke County has a carbonate content ranging from 25 to 45 percent. In most of the soils, leaching has removed the carbonates to a depth of 2 feet or more. Thus, the upper 2 feet of most soils is acid. Other minerals in the soil are subject to the same chemical weathering, but their resistance is higher and removal is slower.

The alteration of minerals, such as biotite and feldspar, follows the removal of carbonates. This alteration results in changes in color within the profile. Free iron oxides are segregated by a fluctuating high water table. The gray colors and mottles in Brookston, Pewamo, and other soils result from this process. Soils that do not have a seasonal high water table have brownish colors with stronger chroma or redder hue. Examples are Miamian and Eldean soils.

Seasonal wet and dry cycles are largely responsible for the transfer of clay from the A horizon to the faces of peds in the B horizon. The fine clay becomes suspended in percolating water in the A horizon and is carried by the water to the B horizon. The transfer of fine clay accounts for the clay films on faces of peds in the B horizon of Eldean, Celina, Glynwood, and Miamian soils.

Transformations of mineral compounds occur in most soils. The results of these transformations are most apparent if horizon development is not affected by rapid erosion or by the accumulation of material at the surface. The primary silicate minerals are weathered chemically into secondary minerals, mainly those of the layer-lattice silicate clays. Most of the layer-lattice clays remain in the profile but are transferred from the upper horizons to the lower ones.

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Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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.

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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

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-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. 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.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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.

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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The depth of the soil over bedrock. Deep soils are more than 40 inches deep over bedrock; moderately deep soils, 20 to 40 inches; and shallow soils, 10 to 20 inches.

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.

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.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

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.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the 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.

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

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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.

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.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

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

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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 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.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

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

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).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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

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

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.

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

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Perimeter drain. A drain installed around the perimeter of a septic tank absorption field to lower the water table. Also called a curtain drain.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

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

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

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.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

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 degree of acidity or alkalinity is expressed as—

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

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled 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 of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

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.

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.

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.

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

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 glacial lake or other body of still water in front of a glacier.

Water bar. A shallow trench and a mound of earth constructed at an angle across a road or trail to intercept and divert surface runoff and control erosion.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.