SOIL SURVEY OF

Armstrong County, Pennsylvania

United States Department of Agriculture
Soil Conservation Service
in cooperation with
The Pennsylvania State University
College of Agriculture and the Pennsylvania
Department of Environmental Resources
State Conservation Commission

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1965–70. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the Pennsylvania State University, College of Agriculture, and the Pennsylvania Department of Environmental Resources, State Conservation Commission. It is part of the technical assistance furnished to the Armstrong County Conservation District. The Armstrong County Board of Commissioners helped to finance the survey.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, woodlands, and wildlife areas; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Armstrong County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Foresters and others can refer to the section "Use of the Soils as Woodland" where the soils of the county are grouped according to their suitability for trees.

Wildlife managers and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for buildings and for recreation areas in the section "Use of the Soils for Community Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about the soils in the section "Formation and Classification of the Soils."

Newcomers in the area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: A typical rural scene in Armstrong County. Stripcropping in the foreground is on Wharton soils, Ernest soils are in the low swale, and Rayne and Gilpin soils are on the hill in the background.

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Issued February 1977

SOIL SURVEY OF ARMSTRONG COUNTY, PENNSYLVANIA

BY GEORGE D. MARTIN, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY GEORGE D. MARTIN AND JOHN T. HAAGEN, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE IN COOPERATION WITH THE PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE, AND THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES, STATE CONSERVATION COMMISSION

ARMSTRONG COUNTY lies in west central Pennsylvania, approximately 50 miles north of Pittsburgh (fig. 1). The Allegheny River, Redbank Creek, and the Kiskiminetas River form the northern and southwestern boundaries. The county borders Indiana and Jefferson Counties on the east, Butler County on the west, Clarion County on the north, and Westmoreland on the south.

Armstrong County covers approximately 656 square miles, or 419,840 acres. About 39 percent of the land area is farmed. Slightly more than half the county is in woodland, mostly pole-sized second or third growth timber. Because Armstrong County is near Pittsburgh, urban areas are increasing in the county.

The population of Armstrong County was 75,590 in 1970. Many farmers receive the larger part of their income off the farm in industry. Many county residents work in industries along the Allegheny Valley to the south of Armstrong County.

The larger communities in Armstrong County are Kittanning, the county seat, Ford City, Leechburg, Freeport, Vandergrift, Apollo, Elderton, Dayton,

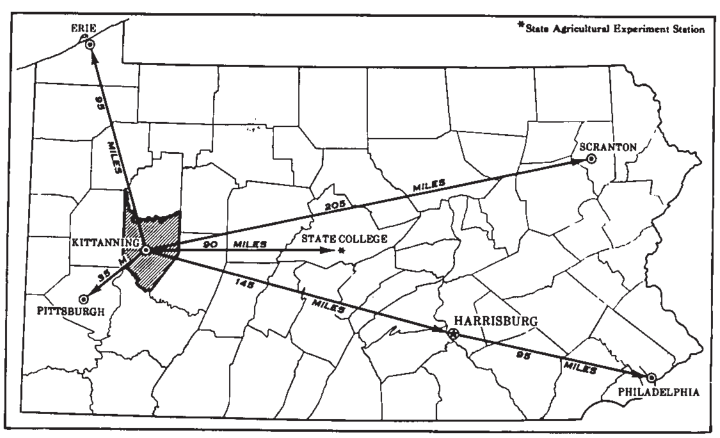

Figure 1.—**Location of Armstrong County in Pennsylvania.**

Parker, and Worthington. Indiana University of Pennsylvania has a center in Kittanning.

Armstrong County has excellent transportation facilities. Major highways in the county are U.S. Highway 422, State Highways 68, 268, 85, 66, 28, and 56, and the Allegheny Expressway. Railroads include the Penn Central, Pittsburgh and Shawmut, and the Baltimore and Ohio. The navigable river, freight truck lines, and bus lines also provide transportation.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Armstrong County, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ernest and

Rayne, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hazleton very stony loam, 8 to 25 percent slopes, is one of several phases within the Hazleton series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Armstrong County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Gilpin-Weikert complex, 3 to 8 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Weikert and Gilpin soils, 25 to 70 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Urban land is a land type in Armstrong County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial interpretations of soils. They test these interpretations by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the interpretations according to the results of their studies and consultation. Thus, the interpretations that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Armstrong County. A soil association is a landscape that has a distinct proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the county, who want to compare different parts of the county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreation facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Most of the soil names and some of the boundaries of the general soil map for Armstrong County do not agree with those in the soil surveys of Jefferson County and Indiana County. This is because of changes in the concept of some series and different soil patterns. Also, some soils were combined with other associations in correlation.

The soil associations in Armstrong County are described in the following pages.

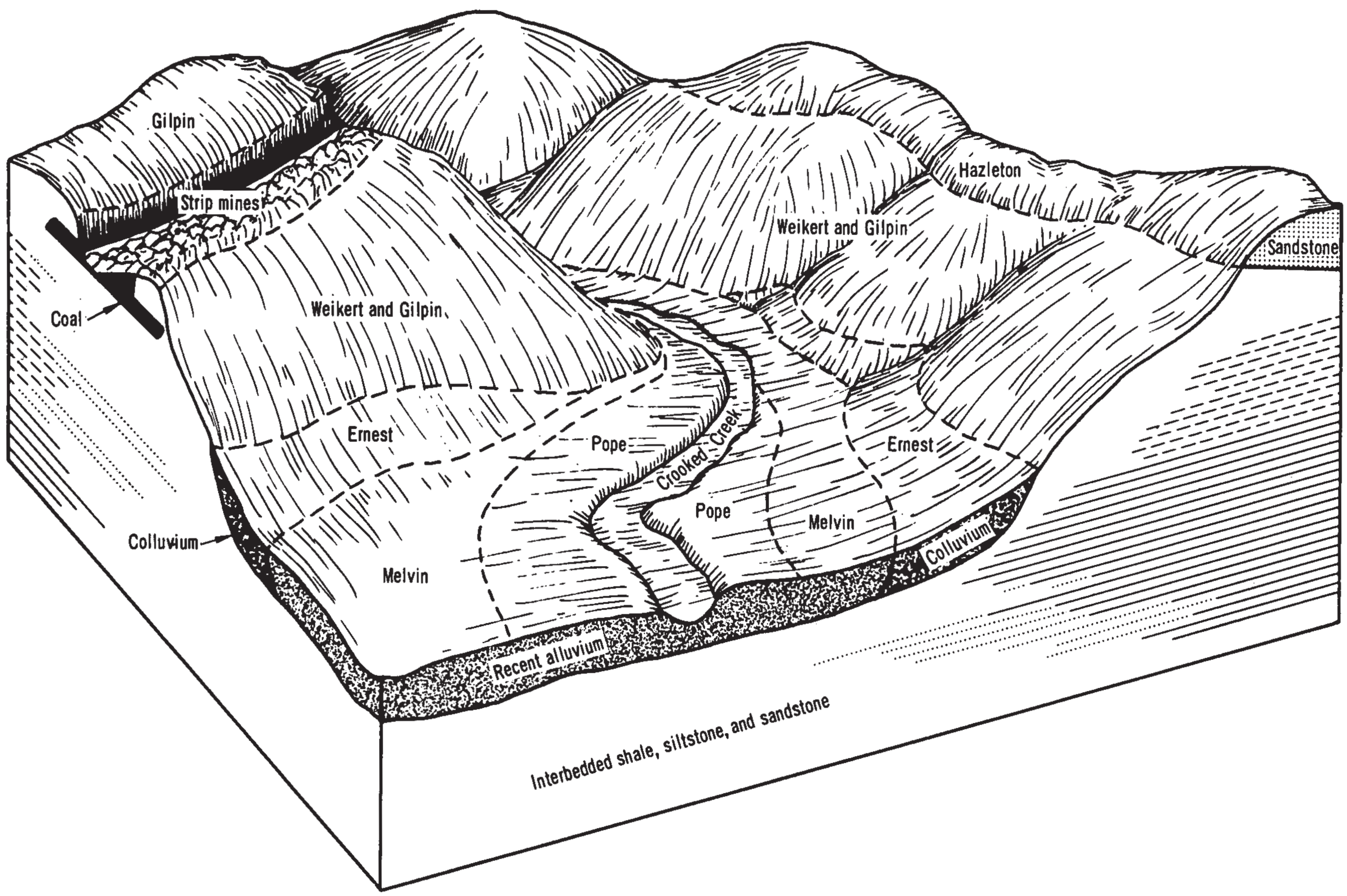

Figure 2.—**Soils and underlying material in the Weikert-Gilpin association.**

1. *Weikert-Gilpin association*

Well-drained, shallow and moderately deep, steep and very steep soils on uplands

This association consists of long, narrow, steep, dissected areas adjacent to rivers, creeks, and streams. The soils formed in material weathered from interbedded shale, siltstone, and sandstone (fig. 2).

This association makes up about 27 percent of the county. About 50 percent of the association is Weikert soils, 25 percent is Gilpin soils, and 25 percent is minor soils.

The Weikert soils are shallow, well drained, and shaly. They have a restricted root zone and are droughty.

The Gilpin soils are moderately deep and well drained. They have a higher available moisture capacity than the Weikert soils.

Among the minor soils are Hazleton and Ernest soils on uplands and Pope and Melvin soils on flood plains.

Steep slopes severely limit the use of the soils in this association. Much of the association is wooded, and areas that were cleared are now reverting to natural vegetation. Some of the most scenic areas of the county, as well as many areas that have been strip mined, are in this association.

2. *Gilpin-Weikert-Ernest association*

Well drained and moderately well drained, shallow to deep, gently sloping to moderately steep soils on benches, ridges, and hillsides

This association consists of small, gently sloping and sloping ridgetops and benches and moderately steep hillsides. There are many narrow valleys cut by streams. The soils formed in material weathered from shale, siltstone, and sandstone (fig. 3).

This association makes up about 24 percent of the county. About 40 percent of the association is Gilpin soils, 25 percent is Weikert soils, and 10 percent is Ernest soils. Minor soils make up about 25 percent.

The Gilpin soils are moderately deep, well drained, and medium textured. They are on uplands.

The Weikert soils are shallow, well drained, shaly, and droughty.

The Ernest soils are deep and moderately well drained. They have a fragipan in the subsoil and a seasonal high water table.

Among the minor soils are Wharton, Cavode, Rayne, and Hazleton soils.

The dissected landscape and complex slopes of the soils of this association make farming with modern machinery difficult. Much of the association was farmed

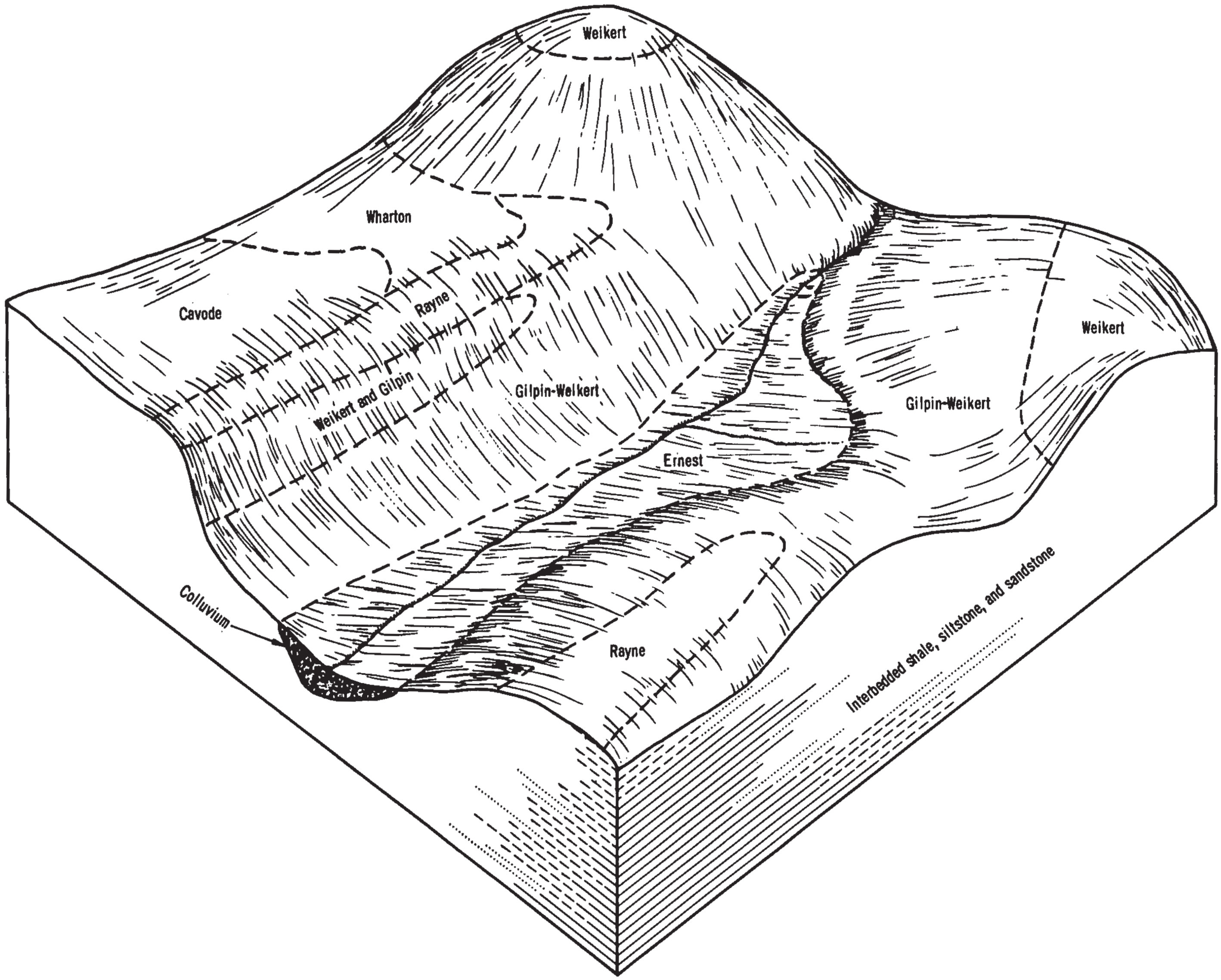

***Figure 3.*—Soils and underlying material in the Gilpin-Weikert-Ernest association.**

in the past but is now idle and returning to natural vegetation. Many of the steeper areas have been planted to Christmas trees. Some areas are suited to limited urban development.

3. Rainsboro-Melvin-Steff association

Moderately well drained to poorly drained, deep, nearly level to gently sloping soils on terraces and flood plains

This association consists of broad acres adjacent to large creeks and rivers. The soils are underlain by stream sediment (fig. 4).

This association makes up about 9 percent of the county. About 28 percent of the association is Rainsboro soils, 23 percent is Melvin soils, and 14 percent is Steff soils. Minor soils make up 35 percent.

The Rainsboro soils are moderately well drained. These soils have a fragipan and a seasonal high water table. They are normally well above the present level of flooding and, in some places, are 200 to 300 feet above the Allegheny River.

The Melvin soils are poorly drained and are on flood plains. In many places the water table is near the surface most of the year.

The Steff soils are moderately well drained and are on flood plains. They have a seasonal high water table.

Among the minor soils are Gilpin and Weikert soils on uplands, Allegheny soils on terraces, and Pope soils on flood plains.

Most of the early towns and boroughs of Armstrong County were in this association, and much of the recent urban development has been on the terraces adjacent to these towns. Railroads and early highways were built on this association because construction was easy on the gently sloping soils.

Further development on the flood plains is limited by the hazard of flooding. Sites for development on the

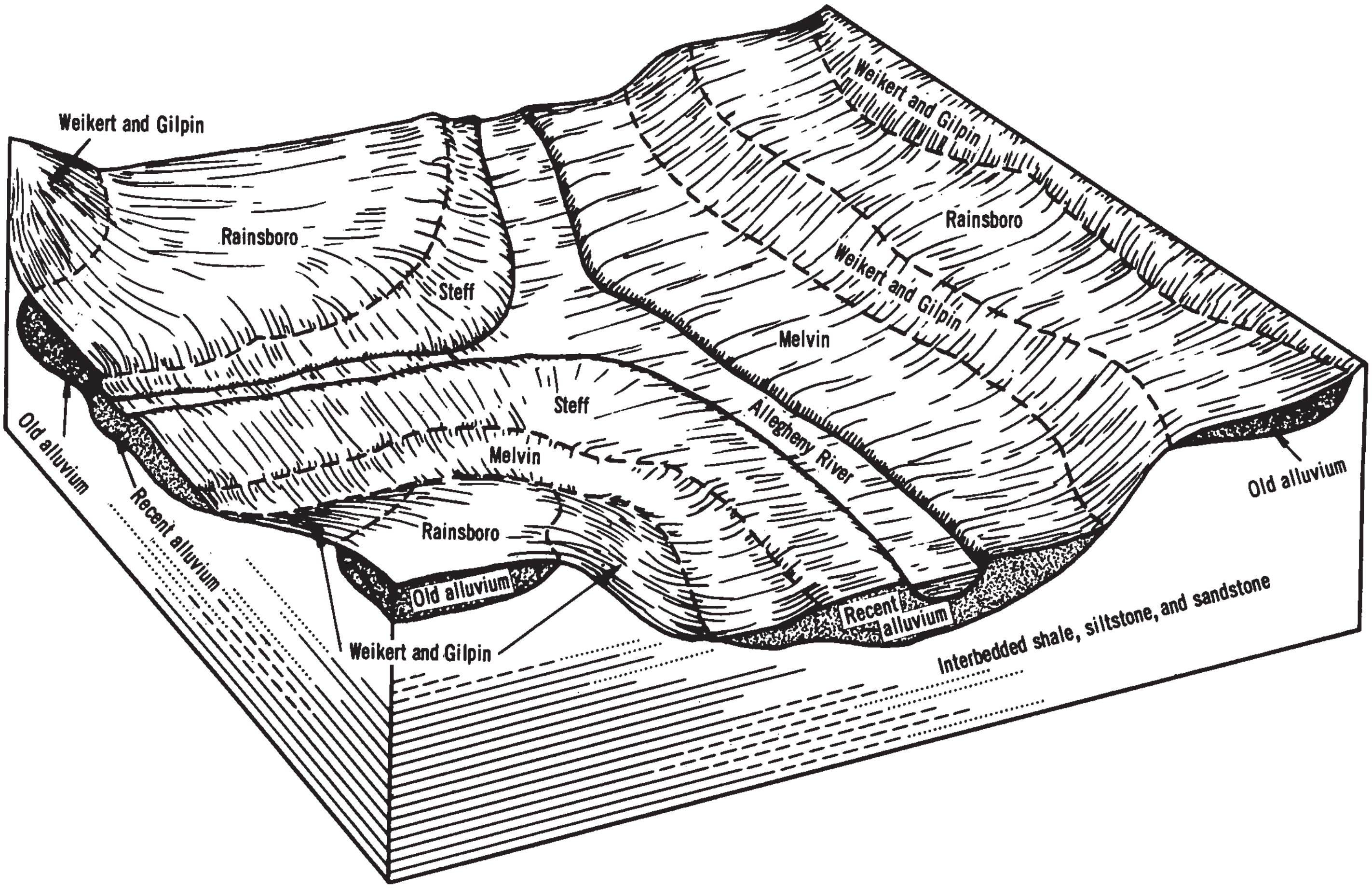

Figure 4.—Soils and underlying material in the Rainsboro-Melvin-Steff association.

terraces should be investigated carefully because many areas have a high water table. Many of the terraces have been quarried for sand and gravel.

4. *Rayne-Ernest-Hazleton association*

Well drained and moderately well drained, deep, gently sloping to moderately steep soils in low-lying areas on ridgetops, and on hillsides

This association consists of narrow ridgetops and knolls and some low-lying depressions and toe slopes. Most of the soils formed in material weathered from shale, but some formed in colluvium at the base of slopes, and some soils on ridges formed in material weathered from sandstone (fig. 5). Many streams and drainageways dissect the association.

This association makes up about 19 percent of the county. About 30 percent of the association is Rayne soils, 25 percent is Ernest soils, and 15 percent is Hazleton soils. Minor soils make up 30 percent.

The Rayne soils are deep and well drained. They formed in material weathered from shale and siltstone. Slope is the main limitation to use.

The Ernest soils are deep and moderately well drained. Because they contain a fragipan in the subsoil, these soils have a seasonal high water table.

The Hazleton soils are deep, well drained, and stony or channery. They formed in material weathered from sandstone.

Minor soils are Cavode, Gilpin, Melvin, Weikert, and Wharton soils.

Some productive farms are on this association, and many of the soils have only moderate limitations for urban development.

5. *Wharton-Rayne-Cavode association*

Well drained to somewhat poorly drained, deep, nearly level to moderately steep soils on ridges, benches, and hillsides

This association consists of uplands that are dissected by small streams and drainageways. The soils formed in material weathered from interbedded clay shale, shale, siltstone, and sandstone (fig. 6).

This association makes up about 21 percent of the county. About 34 percent of the association is Wharton soils, 22 percent is Rayne soils, and 16 percent is Cavode soils. Minor soils make up 28 percent.

The Wharton soils are deep and moderately well drained. They formed in material weathered from clay shale. Most areas of Wharton soils are suited to crops,

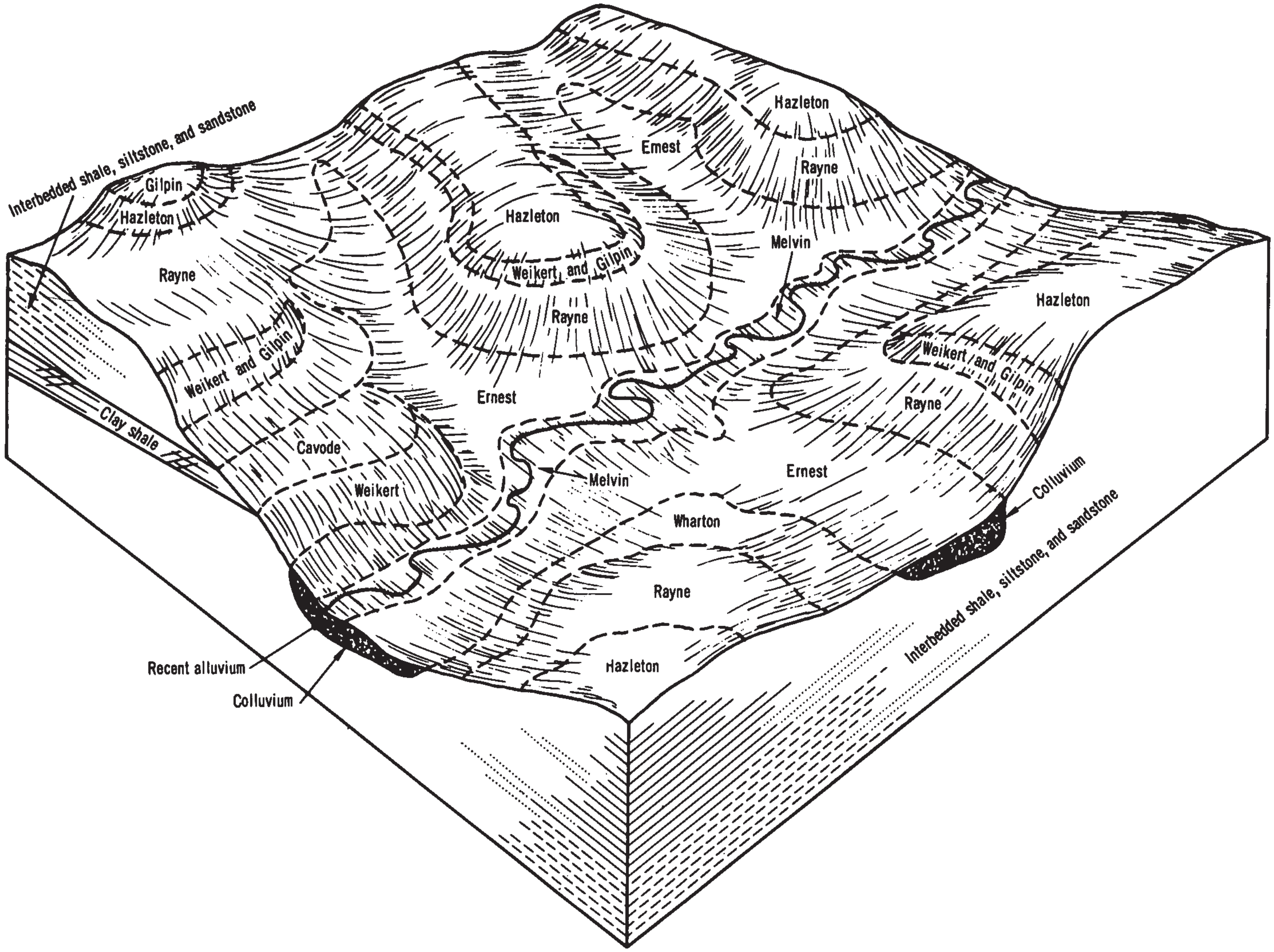

Figure 5.—**Soils and underlying material in the Rayne-Ernest-Hazleton association.**

but wet spots are common and can be a nuisance during wet periods.

The Rayne soils are deep and well drained. They formed in material weathered from interbedded shale, siltstone, and sandstone.

The Cavode soils are deep and somewhat poorly drained. They formed in material weathered from clay shale. These soils have a seasonal high water table, and wet spots are common.

Among the minor soils are Gilpin, Weikert, Ernest, Upshur, and Vandergrift soils.

The more gentle slopes in this association make farming with modern machinery less difficult than in some of the other associations. Many areas need artificial drainage; if they are drained, they are suited to general field crops. In many places slow permeability and a seasonal high water table are limitations for onlot sewage disposal.

Use and Management of the Soils

The first part of this section explains the system of capability classification used by the Soil Conservation Service and discusses management of the soils by capability units. The second part gives estimated yields of crops under two levels of management. Other parts of the section discuss the suitability of the soils for woodland and wildlife habitat, give information about engineering uses of the soils, and list limitations of the soils for community development.

Capability Grouping

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The

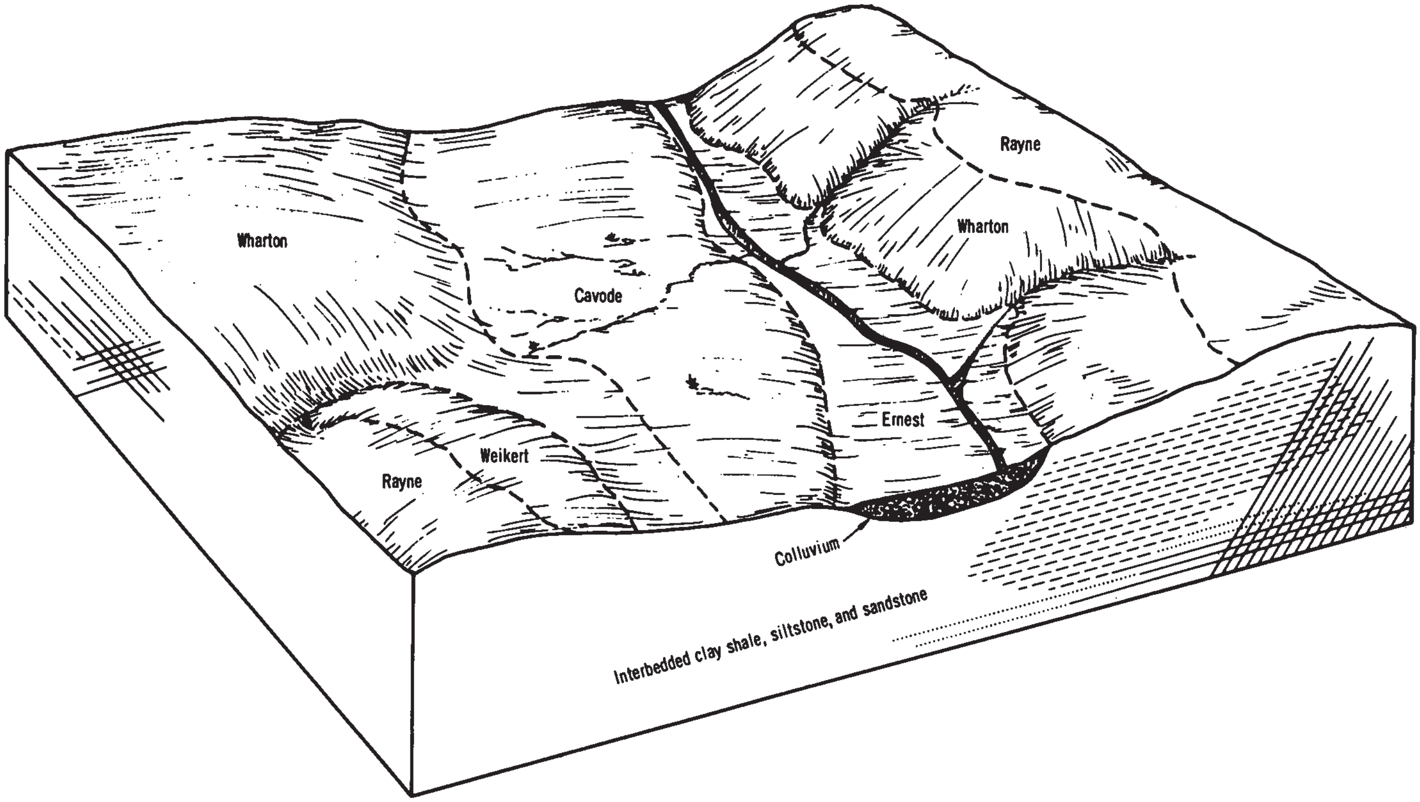

Figure 6.—**Soils and underlying material in the Wharton-Rayne-Cavode association.**

classification does not apply to most horticultural crops or to rice and other crops that require special management. The soils are classified according to degree and kind of permanent limitation. Major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils and possible but unlikely major reclamation projects are not considered in the classification.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit.

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. Classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat. (None in Armstrong County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply or to esthetic purposes. (None in Armstrong County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, or *s*, 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.

In class I, there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w* and *s* because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, woodland, or wildlife habitat.

CAPABILITY UNITS are soil groups within each subclass. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs. The Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units [1]

Good soil management requires the selection of a suitable cropping system and the application of conservation practices that will maintain the productivity of the soil and control wetness and erosion. The conservation practices needed depend on the nature of the soil and the intensity of the cropping system.

On sloping soils, contour stripcropping, terraces, and sod waterways can conserve soil and water. On sloping, wet soils, graded strips, terraces, and grassed waterways can remove surface water and control erosion. Subsurface water generally can be removed by random tile drains or open ditches where suitable outlets are available.

Winter cover crops, stubble mulching, minimum tillage, and green manure crops help to maintain and improve the organic-matter content and soil structure and to reduce erosion. Such practices are needed most if the cropping system is intensive or if the soils are cultivated continuously.

Lime and fertilizer should be applied according to the need indicated by soil tests and according to the kind of crop.

Additional help in managing the soils can be obtained from the local representatives of the Soil Conservation Service, the County Extension Service, or the State Agricultural Experiment Station.

The capability units in Armstrong County are discussed in the following pages. The numbers of the units are not consecutive because not all of the capability units in Pennsylvania are represented in Armstrong County. The names of soil series are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. The capability unit of each soil in the county is listed in the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–1

This unit consists of deep, well-drained, nearly level soils of the Pope series. These soils formed in alluvium derived from shale, siltstone, and sandstone. Permeability is moderately rapid, and the available moisture capacity is high. Surface runoff is slow, and the hazard of erosion is slight.

The soils of this unit are suited to most crops commonly grown in the county and to many specialty crops, such as vegetables. The soils are suitable for intensive cultivation. Seeding a cover crop with the intertilled crops in fall helps to maintain an adequate content of organic matter and to protect the soil in winter when the hazard of flooding is greatest.

CAPABILITY UNIT IIe–1

This unit consists of deep, well-drained, gently sloping soils of the Allegheny, Hazleton, and Rayne series. The Hazleton and Rayne soils formed in material weathered from sandstone, shale, and siltstone. The Allegheny soils formed in loamy alluvial sediment. Permeability is moderate to moderately rapid, and the available moisture capacity is low to high. Surface runoff is medium, and the hazard of erosion is moderate.

These soils are suited to most crops commonly grown in the county, including row crops, hay, and pasture (fig. 7). Under intensive cropping, an adequate content of organic matter must be maintained. Stripcropping, cover crops, and diversions help to control erosion if the soils are farmed.

CAPABILITY UNIT IIe–2

Only Gilpin-Weikert complex, 3 to 8 percent slopes, is in this unit. This complex consists of shallow to moderately deep, well-drained, gently sloping soils. The Gilpin soil is shaly only in the substratum, but the Weikert soil is shaly throughout. Both soils formed in material weathered from interbedded acid shale, siltstone, and fine-grained sandstone. The available moisture capacity is low to moderate, and permeability is moderate to moderately rapid. Runoff is medium, and the hazard of erosion is moderate.

These soils are suited to most crops commonly grown in the county, but short periods of drought damage most crops. Maintaining an adequate content of organic matter helps to increase the supply of moisture available for plants. The use of a proper cropping system stripcropping, cover crops, and diversions help to control erosion if these soils are cultivated.

CAPABILITY UNIT IIe–3

This unit consists of moderately deep, moderately well drained and somewhat poorly drained, gently sloping soils of the Ernest, Gilpin, Rainsboro, Vandergrift, and Wharton series. Except for the Gilpin soils, these soils have a seasonal high water table. The Ernest and Rainsboro soils have a subsoil that is firm and brittle in the lower part; this causes springs and seep areas. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is medium, and the hazard of erosion is moderate.

These soils are best suited to crops that tolerate some seasonal wetness. Draining wetter areas with random tile drains increases their suitability for farming. A proper cropping system, stripcropping, cover crops, grassed waterways, and diversions help to control erosion.

CAPABILITY UNIT IIw–1

This unit consists of deep, moderately well drained,

[1] ROBERT L. BOND, State resource conservationist, Soil Conservation Service, helped prepare this section.

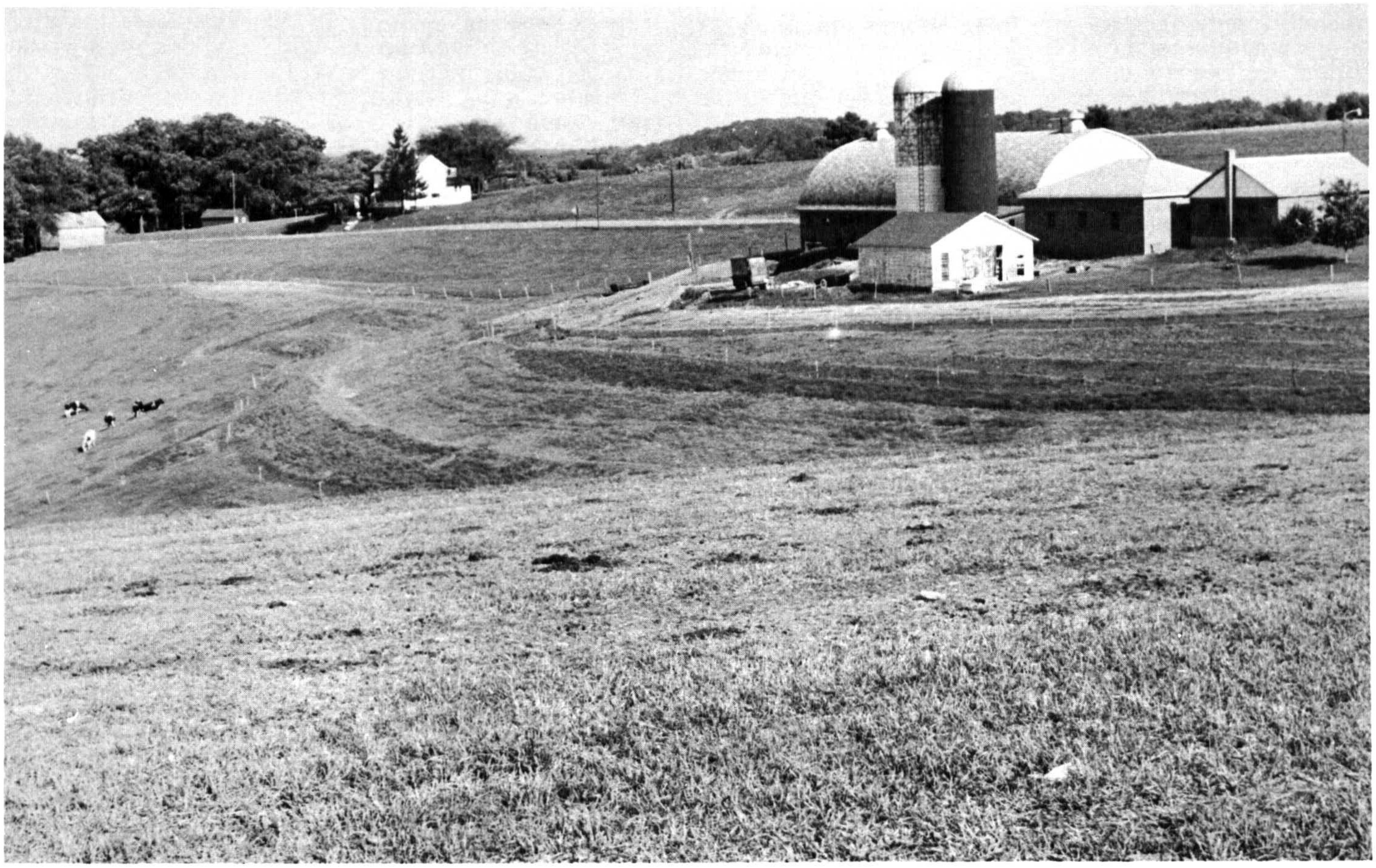

Figure 7.—**Hay on Hazleton channery loam, 3 to 8 percent slopes. This soil is in capability unit IIe–1. Permanent pasture is on steeper Hazleton soils on the left in the background. The steeper soils are in capability unit IVe–1.**

nearly level soils of the Steff series. These soils formed in alluvium derived from shale, siltstone, and sandstone. Steff loam is subject to more frequent flooding than Steff loam, high bottom. The soils have a seasonal high water table. The available moisture capacity is high, and permeability is moderate. Runoff is slow, and the hazard of erosion is slight.

The soils of this unit are suited to crops that tolerate some wetness. They can be intensively cultivated, and random tile or other artificial drainage increases their suitability for crops. Growing cover crops helps to maintain an adequate content of organic matter.

CAPABILITY UNIT IIw–2

This unit consists of deep, moderately well drained, nearly level soils of the Ernest and Rainsboro series. These soils have a seasonal high water table. The available moisture capacity is moderate, and permeability is moderately slow and slow. Runoff is slow, and the hazard of erosion is slight.

These soils are best suited to crops that tolerate some seasonal wetness. Artificial drainage increases their suitability for most crops. If the soils are cultivated, a proper cropping system and cover crops help to maintain an adequate content of organic matter.

CAPABILITY UNIT IIIe–1

This unit consists of deep, well-drained, sloping soils of the Allegheny, Hazleton, and Rayne series. The Allegheny soils are on stream terraces, and the Hazleton and Rayne soils are on uplands. The available moisture capacity is moderate to high, and permeability is moderate to moderately rapid. Runoff is medium, and the hazard of erosion is moderate.

The soils of this unit are suited to all crops commonly grown in the county. A cropping system that includes several years of hay and stripcropping, cover crops, and diversions help to slow runoff and control erosion.

CAPABILITY UNIT IIIe–2

This unit consists of shallow to moderately deep, well-drained, gently sloping to sloping soils of the Gilpin and Weikert series. These soils formed in material weathered from interbedded acid shale, siltstone, and fine-grained sandstone. The Weikert soils are more shaly throughout than the Gilpin soils. The available moisture capacity is low to moderate, and permeability is moderate to moderately rapid. Runoff is medium, and the hazard of erosion is moderate.

These soils are better suited to shallow-rooted crops that tolerate drought than to deep-rooted crops that require a large amount of water. A cropping system that includes several years of hay, stripcropping, cover crops, and diversions on the longer slopes helps to slow runoff and control erosion. Frequent, light applications of lime and fertilizer are generally more beneficial than heavier, less frequent applications.

CAPABILITY UNIT IIIe-3

This unit consists of moderately deep and deep, well-drained, gently sloping soils of the Gilpin and Upshur series. These soils are on uplands. The Upshur soils are more difficult to manage than Gilpin soils because of the content of clay in the subsoil. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is medium, and the hazard of erosion is moderate.

The soils of this unit are suited to all crops commonly grown in the county. A suitable cropping system, stripcropping, and diversions on long slopes help to slow runoff, control erosion, and maintain good tilth.

CAPABILITY UNIT IIIe-4

This unit consists of moderately deep and deep, well-drained to somewhat poorly drained, sloping soils of the Cavode, Ernest, Gilpin, Rainsboro, Vandergrift, and Wharton series. Except for the Gilpin soils, these soils have a seasonal high water table. Ernest and Rainsboro soils are firm and brittle in the lower part of the subsoil. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is medium, and the hazard of erosion is moderate.

These soils are best suited to crops that tolerate seasonal wetness and that can be used in a cropping system that includes several years of hay. Artificial drainage increases the suitability for crops, especially on the somewhat poorly drained soils. Diversions on the longer slopes help to slow runoff and control erosion.

CAPABILITY UNIT IIIw-1

Melvin silty clay loam is the only soil in this unit. It is a deep, poorly drained soil on flood plains. The water table is near the surface for long periods, and the soil is often covered by water during wet periods. The available moisture capacity is high, and permeability is moderate. Runoff is slow, and the hazard of erosion is slight.

This soil is best suited to crops and trees that tolerate wetness. Artificial drainage increases the suitability for crops.

CAPABILITY UNIT IIIw-2

Cavode silt loam, 3 to 8 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained, gently sloping soil on uplands. This soil has a seasonal high water table. The available moisture capacity is moderate, and permeability is slow. Springs and seep areas are common. Runoff is medium, and the hazard of erosion is moderate.

This soil is best suited to crops that tolerate seasonal wetness. Artificial drainage increases its suitability for crops. Stripcropping, grassed waterways, and diversions on long slopes help to control erosion.

CAPABILITY UNIT IVe-1

Hazleton channery loam, 15 to 25 percent slopes, is the only soil in this unit. It is a deep, well-drained, moderately steep soil on uplands. The available moisture capacity is low, and permeability is moderately rapid. Runoff is rapid, and the hazard of erosion is severe.

This soil is best suited to crops that require a minimum amount of tillage. A cropping system that includes several years of hay or pasture and limited cultivation of intertilled crops helps to maintain good soil tilth. Stripcropping, grassed waterways, and diversions on long slopes help to control erosion.

CAPABILITY UNIT IVe-2

This unit consists of shallow to moderately deep, sloping to moderately steep soils of the Gilpin and Weikert series. These soils are on uplands. They formed in material weathered from interbedded shale, siltstone, and fine-grained sandstone. The Weikert soils are shaly throughout. The available moisture capacity is low to moderate, and permeability is moderate to moderately rapid. Runoff is rapid, and the hazard of erosion is high.

These soils are best suited to crops that tolerate drought and that require limited tillage. A cropping system of long-term hay or pasture and only limited use of intertilled crops helps to control erosion. Stripcropping, diversions, and grassed waterways also help to control erosion (fig. 8).

CAPABILITY UNIT IVe-3

This unit consists of moderately deep and deep, well-drained to somewhat poorly drained, moderately steep soils of the Cavode, Ernest, Gilpin, Vandergrift, and Wharton series. Except for the Gilpin soils, these soils have a seasonal high water table. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is rapid, and the hazard of erosion is high.

The soils of this unit are best suited to crops that tolerate some seasonal wetness and that require limited tillage. A cropping system of long-term hay and intertilled crops helps to control erosion. Stripcropping, diversions, and grassed waterways on the longer slopes also help to control runoff and erosion.

CAPABILITY UNIT IVe-4

This unit consists of moderately deep and deep, well-drained, sloping soils of the Gilpin and Upshur series. These soils are on uplands. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is medium, and the hazard of erosion is moderate.

The soils of this unit are suited to a cropping system that includes crops that require little cultivation and several years of hay or pasture. The Upshur soils are difficult to manage because of the high content of clay in the subsoil. Stripcropping, diversions, and grassed waterways on the longer slopes help to control runoff and erosion.

CAPABILITY UNIT VIe-1

This unit consists of moderately deep and deep, well-drained, moderately steep soils of the Gilpin and Upshur series. The available moisture capacity is moderate to high, and permeability is moderate to slow. Runoff is rapid, and the hazard of erosion is high.

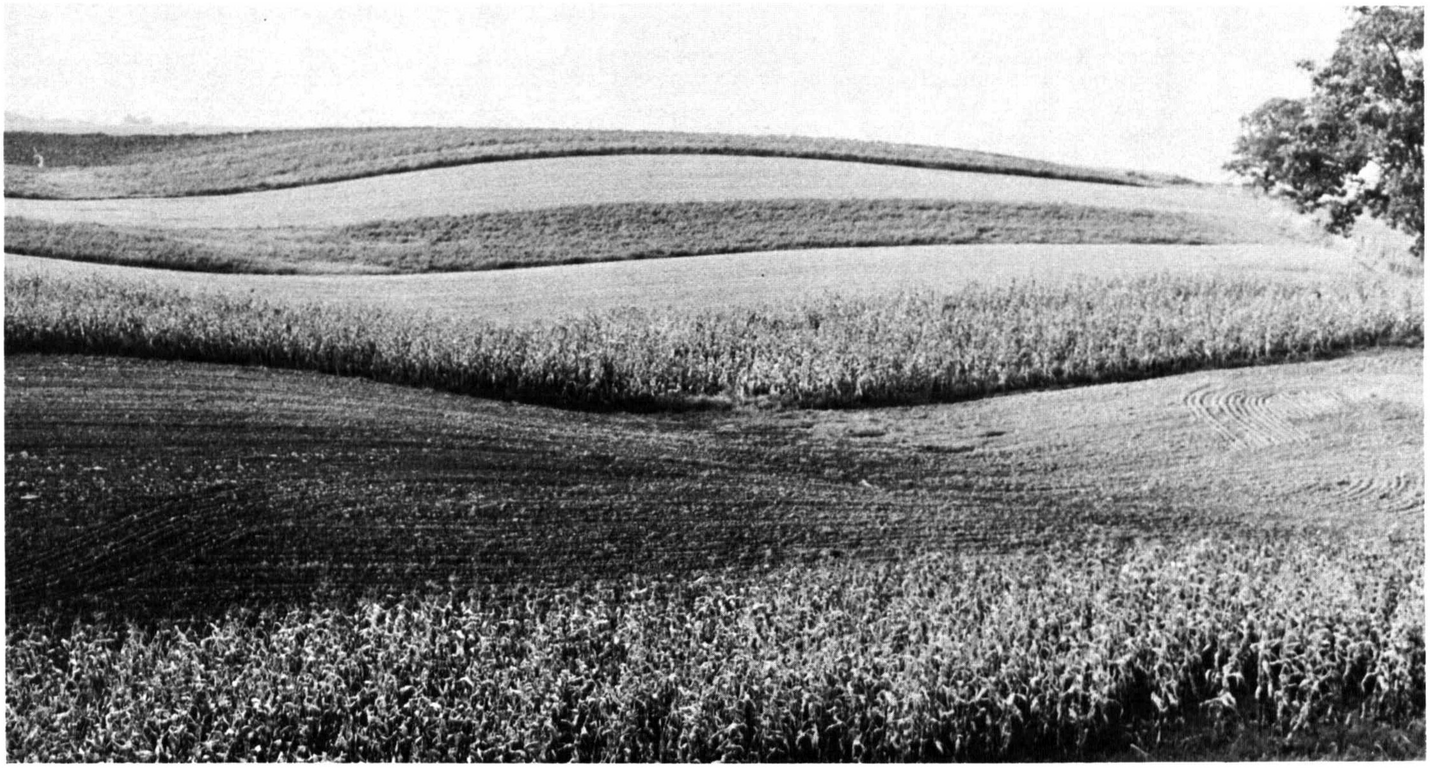

Figure 8.—Stripcropping on Gilpin-Weikert complex, 15 to 25 percent slopes.

These soils are best suited to continuous hay or pasture or to woodland, wildlife habitat, or recreation. A continuous plant cover maintains soil tilth and helps to control erosion.

CAPABILITY UNIT VIs-1

This unit consists of moderately deep and deep, well-drained and moderately well drained, nearly level to moderately steep soils of the Ernest, Gilpin, Hazleton, and Rayne series. These soils are on uplands. Most areas are wooded and have stones on the surface. The available moisture capacity is moderate to high, and permeability is moderately slow to moderately rapid. Runoff is moderate to rapid, and the hazard of erosion is moderate to high.

The soils of this unit are best suited to woodland, wildlife habitat, and recreation. Thinning forests and selective harvesting help to maintain the desired trees.

CAPABILITY UNIT VIIe-1

This unit consists of shallow to deep, well-drained, steep and very steep soils of the Gilpin, Upshur, and Weikert series. The available moisture capacity is low to high, and permeability is slow to moderately rapid. Runoff is rapid, and the hazard of erosion is high.

These soils are best suited to trees, wildlife habitat, and watershed protection. Conifers that tolerate drought grow well on areas that need good cover. A continuous plant cover helps to control erosion.

Estimated crop yields

Table 1 shows the estimated yields for representative field and forage crops grown in the county. These estimates are averages for a period of 10 years or more.

The estimated yields are given under two levels of management. In columns A are the yields to be expected under management commonly used by farmers in the county. In columns B are yields that can be obtained in an average growing season under improved management.

Under improved management farmers use most of the adapted crop varieties, fertilization rates, and insect and disease control measures currently recommended. Management practices are applied at the proper time and in such a way as to be most effective. Soil and water conservation practices such as minimum tillage, contour tillage, stripcropping, crop residue management, diversions, drainage, and waterways are followed. Irrigation is not considered in these yields.

The yields in columns B are not intended to be maximum yields obtainable; they vary for the different soils, but usually represent an increase over present yields for the county. It is expected that yields, especially under improved management, will increase 10 to 25 percent by 1985 as a result of the development of new crop varieties and improved technology. Yields increased about 2 percent per year in Pennsylvania during the 1960's.

Mine dumps, Strip mines, Upshur-Gilpin silt loams, 25 to 35 percent slopes, Urban land, and Weikert and Gilpin soils, 25 to 70 percent slopes, were not included in the table because they are not suited to the crops specified.

TABLE 1.—*Estimated average yields per acre of*

[In columns A are estimated yields under management commonly used in the county, and in columns B are estimated yields under Mine dumps, Strip mines, Upshur-Gilpin silt loams, 25 to 35 percent slopes, Urban land, and Weikert and Gilpin

Soil	Corn				Oats		Wheat	
	Grain		Silage					
	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*	*Bu*	*Bu*
Allegheny silt loam, 3 to 8 percent slopes	75	120	15	24	65	75	35	45
Allegheny silt loam, 8 to 15 percent slopes	70	110	14	22	60	70	30	40
Cavode silt loam, 3 to 8 percent slopes	50	85	10	17	50	65	----	35
Cavode silt loam, 8 to 15 percent slopes	45	80	9	16	45	60	----	30
Cavode silt loam, 15 to 25 percent slopes	40	75	8	15	40	55	----	25
Ernest silt loam, 0 to 3 percent slopes	55	100	11	20	55	65	30	40
Ernest silt loam, 3 to 8 percent slopes	55	100	11	20	55	65	30	40
Ernest silt loam, 8 to 15 percent slopes	50	90	10	18	50	60	25	35
Ernest silt loam, 15 to 25 percent slopes	45	80	9	16	45	55	25	35
Ernest very stony silt loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----
Ernest very stony silt loam, 8 to 25 percent slopes	----	----	----	----	----	----	----	----
Gilpin-Weikert complex, 3 to 8 percent slopes	40	60	8	12	45	55	20	25
Gilpin-Weikert complex, 8 to 15 percent slopes	35	50	7	10	40	50	15	20
Gilpin-Weikert complex, 15 to 25 percent slopes	----	----	----	----	----	----	----	----
Hazleton channery loam, 3 to 8 percent slopes	75	110	15	22	60	70	35	45
Hazleton channery loam, 8 to 15 percent slopes	70	100	14	20	55	65	30	40
Hazleton channery loam, 15 to 25 percent slopes	55	85	11	17	45	55	25	35
Hazleton very stony loam, 8 to 25 percent slopes	----	----	----	----	----	----	----	----
Melvin silty clay loam	70	100	14	20	50	60	----	----
Pope fine sandy loam	105	135	21	27	75	80	45	50
Pope loam	105	135	21	27	75	80	40	45
Rainsboro silt loam, 0 to 3 percent slopes	60	100	12	20	55	65	30	40
Rainsboro silt loam, 3 to 8 percent slopes	60	95	12	19	55	65	30	40
Rainsboro silt loam, 8 to 15 percent slopes	55	90	11	18	50	60	30	35
Rayne silt loam, 3 to 8 percent slopes	75	110	15	22	65	75	35	45
Rayne silt loam, 8 to 15 percent slopes	70	100	14	20	60	70	30	40
Rayne-Gilpin very stony silt loams, 8 to 25 percent slopes	----	----	----	----	----	----	----	----
Steff loam	100	130	20	26	65	75	35	40
Steff loam, high bottom	100	130	20	26	70	80	40	45
Upshur-Gilpin silt loams, 3 to 8 percent slopes	75	95	15	19	60	65	35	40
Upshur-Gilpin silt loams, 8 to 15 percent slopes	70	90	14	18	55	60	30	35
Upshur-Gilpin silt loams, 15 to 25 percent slopes	----	----	----	----	----	----	----	----
Weikert shaly silt loam, 3 to 8 percent slopes	35	50	7	10	45	55	20	25
Weikert shaly silt loam, 8 to 15 percent slopes	30	45	6	9	40	50	15	20
Wharton silt loam, 3 to 8 percent slopes	55	90	11	18	55	65	30	40
Wharton silt loam, 8 to 15 percent slopes	50	80	10	16	50	60	25	35
Wharton-Gilpin silt loams, 3 to 8 percent slopes	55	90	11	18	55	65	35	40
Wharton-Gilpin silt loams, 8 to 15 percent slopes	50	80	10	16	55	60	30	35
Wharton-Gilpin silt loams, 15 to 25 percent slopes	45	70	9	14	50	55	25	30
Wharton-Vandergrift complex, 3 to 8 percent slopes	55	90	11	18	55	65	30	40
Wharton-Vandergrift complex, 8 to 15 percent slopes	50	80	10	16	50	60	25	35
Wharton-Vandergrift complex, 15 to 25 percent slopes	45	70	9	14	45	55	20	30

[1] Cow-acre-days is a term used to express the carrying capacity of pasture. It is the number of animal units carried multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that

Use of the Soils as Woodland [2]

Armstrong County originally had a dense cover of trees, but clearing for houses and farms and cutting for commercial purposes eliminated the virgin stand of timber. Now the commercial woodland occupies 50 percent of the land area and consists of second- and third-growth stands.

The principal forest types that make up the present woodland and the proportionate extent of each in the county are as follows (*6*) [3].

	Percent of total commercial woodland
White pine	5 percent
Eastern white pine makes up 50 percent or more of the stand. Other species	

[2] By V. C. MILES, woodland specialist, Soil Conservation Service.

[3] Italic numbers in parentheses refer to Literature Cited, page 71.

field and forage crops under two levels of management

improved management. Dashes in columns indicate that the soil is not suited to the specified crop at the given level of management. soils, 25 to 70 percent slopes, were not included in the table because they are not suited to the specified crops]

Hay				Pasture			
Alfalfa-grass mixture		Trefoil-grass or clover-grass mixture		Bluegrass		Tall grass-legume mixture	
A	B	A	B	A	B	A	B
Tons	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
2.6	4.5	2.0	3.5	80	160	130	255
2.5	4.0	1.9	3.0	75	135	125	230
----	----	1.5	3.0	60	135	75	170
----	----	1.5	3.0	60	135	75	170
----	----	1.3	2.5	50	115	65	145
2.0	3.5	1.6	3.0	65	135	100	200
2.1	3.5	1.7	3.0	70	135	105	200
2.0	3.5	1.7	3.0	70	135	100	200
1.9	3.0	1.6	2.5	65	115	95	170
----	----	----	----	55	110	----	----
----	----	----	----	50	100	----	----
1.5	2.5	1.2	2.0	50	90	75	145
1.4	2.5	1.1	2.0	45	90	70	145
----	----	----	----	35	60	----	----
2.6	4.0	2.0	3.5	80	160	130	230
2.5	3.5	1.9	3.0	75	135	125	200
2.4	3.5	1.7	3.0	70	135	120	200
----	----	----	----	55	105	----	----
----	----	2.0	2.5	80	115	100	145
3.4	5.0	2.7	3.5	110	160	170	285
3.0	4.5	2.5	3.5	100	160	150	255
2.2	3.5	1.8	3.0	70	135	110	200
2.3	3.5	1.8	3.0	70	135	115	200
2.0	3.0	1.7	3.0	70	135	100	170
2.6	4.5	2.0	3.5	80	160	130	255
2.5	4.5	2.0	3.5	80	160	125	255
----	----	----	----	65	110	----	----
2.5	4.0	2.5	3.5	100	160	125	230
3.0	4.5	2.7	3.5	110	160	150	255
2.7	4.0	2.1	3.0	85	135	135	230
2.6	4.0	2.1	3.0	85	135	135	230
----	----	----	----	70	120	----	----
1.5	2.5	1.2	2.0	50	90	75	145
1.4	2.0	1.1	2.0	45	90	70	145
2.1	3.5	1.7	3.0	70	135	105	200
2.0	3.5	1.7	3.0	70	135	105	200
2.1	3.5	1.6	3.0	65	135	105	200
2.0	3.5	1.5	3.0	60	135	100	200
1.9	3.0	1.4	2.5	55	115	90	170
2.1	3.5	1.7	3.0	70	135	105	200
2.0	3.5	1.7	3.0	70	135	105	200
1.9	3.0	1.5	2.5	60	115	100	170

provides 30 days of grazing for 2 cows has a carrying capacity of 60 cow-acre-days.

are yellow-poplar, northern red oak, and white oak.

Elm-ash-red maple---------- 25 percent
White ash, American elm and red maple are dominant. Slippery elm, yellow birch, blackgum, sycamore and hemlock are also present.

Maple-beech-birch ---------- 18 percent
Sugar maple, beech, and yellow birch are dominant. Other species are basswood, red maple, hemlock, northern red oak, ash, white pine, black birch, and yellow-poplar.

Aspen-birch ---------------- 20 percent
Quaking aspen, bigtooth aspen, and gray birch are dominant. Other species are pin cherry, red maple,

yellow birch, white pine, and sugar maple.

Oak-hickory ---------------- 30 percent
White oak, red oak, hickory, and in places, black oak, are dominant. Other species are yellow-poplar, shagbark hickory, white ash, red maple, beech, and blackgum, with an understory of flowering dogwood.

Other oak types------------- 2 percent

Sawtimber makes up about 53 percent of the acreage in commercial forest, poletimber 17 percent, and seedlings and saplings 25 percent. The remaining 5 percent is classified as nonstocked (*6*).

Generally, the soils of Armstrong County can support good stands of yellow-poplar, ash, red oak, and sugar maple. Trees grow slowly on the shallow soils and on the poorly drained, deep soils.

Of the existing forest in the county, 50 percent is on soils that are excellent, very good, or good woodland sites, 42 percent is on soils that are fair, and 8 percent is on soils that are poor.

Returns from soils that are excellent, very good, or good growing sites generally justify the cost of management, but the potential yield, the quality of the stand, the species, and the market potential must be considered. The species and the number of poor-quality stems make investment inadvisable for some areas, and converting such areas to their potential capacity may not be economically justifiable.

Returns from fair sites are the most difficult to estimate. To determine what intensity of management is justifiable, it is necessary to evaluate thoroughly the species and quality of the stand and to investigate the market potential.

Returns from poor sites generally do not justify the cost of management. In most places, however, woodland is the most practical use for these soils because they cannot be used profitably for crops or pasture.

In table 2, the soils of Armstrong County are rated as to site quality and maangement problems, and suitable trees for each soil are listed.

Site quality.—Ratings in this column indicate the general ability of the soils to produce timber. The ratings are based on sample plots located within the county and in adjacent counties. Other soils in the county that have characteristics similar to those of the soils studied were assumed to have approximately the same rating. The ratings are based on the average height attained by the dominant and codominant trees at the age of 50 years. Foresters using this rating can determine the volume of timber that normal stands will produce at different ages.

Yield information on oak is based on data by G. L. Schnur (*17*). A site index of 85 or better is rated excellent (published data for oak does not go beyond site index 80), and the expected yield at age 50 is 13,750 or more board feet per acre (International rule). A site index of 75 to 84 is rated very good, and the expected yield at age 50 is about 13,750 board feet per acre. A site index of 65 to 74 is rated good, and the expected yield at age 50 is 9,750 board feet per acre. A site index of 55 to 64 is rated fair, and the expected yield at age 50 is about 6,300 board feet per acre. A site index of less than 54 is rated poor, and the expected yield at age 50 is less than 3,250 feet per acre.

Yield information for yellow-poplar is based on data from E. F. McCarthy(*12*). A site index of 95 or more is rated excellent, and the expected yield at age 50 is 32,150 board feet per acre. A site index of 85 to 95 is rated very good, and the expected yield at age 50 is about 24,400 board feet per acre. A site index of 75 to 85 is rated good, and the expected yield at age 50 is 17,620 board feet per acre. A site index of 65 to 75 is rated fair, and the expected yield at age 50 is 11,400 board feet per acre. A site index of 55 to 65 is rated poor, and expected yield at age 50 is 5,600 board feet per acre.

The site index for other trees, such as white pine, sugar maple, and ash, vary somewhat, but the better sites have the taller trees of the same species. More information on site index for other tree species can be obtained from the Soil Conservation Service and the Pennsylvania Department of Environmental Resources, Bureau of Forestry.

Erosion hazard.—The ratings in this column indicate the amount or intensity of practices required to reduce or control erosion on the different soils. A rating of *slight* indicates that the risk of erosion is low when wood products are harvested, and that few, if any, practices are needed to control erosion. A rating of *moderate* indicates that measures to control erosion are needed on skid trails and logging roads immediately after wood products are harvested. A rating of *severe* means that erosion, especially gullying, is a severe hazard when wood products are harvested. Harvesting and other operations should be done across the slope as much as possible, skid trails and logging roads should be laid out on as low grades as possible, and water-disposal systems should be carefully maintained during logging. Measures to control erosion are needed on logging roads and skid trails immediately after logging.

Equipment limitations.—Ratings in this column are based on the characteristics of the soils and topographic features that restrict or prohibit the use of equipment for harvesting trees or planting seedlings. Steepness of slope, stoniess, and wetness are the principal soil limitations that restrict the use of equipment. A rating of *slight* indicates there are few limitations. A rating of *moderate* indicates that some problems exist, such as stones and boulders, moderately steep slopes, or wetness of the soil part of the year. A rating of *severe* indicates that prolonged wetness of the soil, steepness, or stoniness severely limits the use of equipment. If the rating is severe, track-type equipment is best for general use, and winches or similar special equipment are needed for some kinds of work.

Seedling mortality.—Seedling mortality refers to the loss of naturally occurring or planted tree seedlings resulting from unfavorable characteristics of the soils. A rating of *slight* indicates that less than 25 percent of the planted seedlings are likely to die; adequate restocking ordinarily results from natural regeneration. A rating of *moderate* indicates that between 25 and 50 percent of the planted seedlings are likely to die, and some replanting is ordinarily needed. Natural regeneration cannot always be relied upon for adequate and early restocking. A rating of *severe* indicates that more than 50 percent of planted seedlings are likely to die, and special preparation of the seedbed, superior planting techniques, and considerable replanting are needed for adequate and immediate restocking. Restocking cannot be expected to result from natural regeneration.

Plant competition.—Plant competition refers to the rate at which brush, grass, and undesirable trees are likely to invade the stand on different kinds of soil. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration and early growth or interfere with adequate development of planted seedlings. It is *moderate* if competing plants delay natural or artificial regeneration but do not prevent the natural development of a fully stocked, normal stand. Competition is *severe* if adequate natural or artificial regeneration can be obtained only by intensive site preparation and maintenance that includes weeding.

Windthrow hazard.—The ratings for windthrow hazard are based on the factors that control the development of tree roots. A rating of *slight* indicates that normally no trees are blown down by the wind. A rating of *moderate* indicates that some trees are expected to be blown down during periods of high wind if the soil is excessively wet. A rating of *severe* indicates that many trees are expected to be blown down during periods of moderate or high wind if the soil is wet.

Suitable trees.—The trees listed in this column are fast growing and have high economic value. Trees that should be favored in existing stands and trees suitable for planting are listed.

Wildlife[4]

The kind and abundance of wildlife depend on the kind of soil. The soil affects wildlife through its influence on vegetation, which provides food and cover. If the natural soil is altered by drainage or by other practices used in managing farms or woodland, the kind and pattern of vegetation change. Because of the change in vegetation, there may also be a change in the kind and number of wildlife.

All the soils in Armstrong County can produce some kind of wildlife habitat. Crops are more valuable than wildlife on soils in capability classes I, II, III, IV, although wildlife may be plentiful on these soils. Soils in classes VI and VII generally are used for wildlife habitat; they are better suited to wildlife habitat and woodland than to crops.

Many practices that are used primarily to improve the soils and to increase crop production also benefit wildlife. Contour stripcropping and crop rotation provide a mixture of cover and increase the amount of food and cover that wildlife can use. During winter, cover crops and crop residue are used by wildlife for food and cover. Diversion terraces and grassed waterways provide travel lanes and nesting places. Food and cover for wildlife are increased by fertilizing and liming the soils.

Practices used primarily to benefit wildlife supplement the practices used primarily to increase crop yields. Planting grasses and legumes along field borders provides nesting places and food for wildlife. Hedgerows planted on cropland furnish travel lanes, food, and cover, and they also fence the field and give some protection to the soils. Small patches of corn, small grain, and soybeans that are planted to supply food for wildlife are particularly valuable in abandoned or idle areas, especially if these patches are located near good cover or between wooded areas and open fields.

Habitat for wetland wildlife can be made or improved by digging ponds in pastures or by installing special structures for water control in marshy areas to form shallow water impoundments.

Ponds can be stocked with fish, and they can be used by migratory waterfowl as resting places. If shrubs and trees are planted around ponds, they will attract many other kinds of wildlife. Because many of the soils in the county are not suitable as sites for ponds, the site should be selected with care.

Shallow impoundments are breeding grounds and feeding areas for waterfowl and shorebirds. They also attract muskrat, mink, and other furbearers.

Pollution and erosion sediment are the greatest dangers to fish in the county. Fish are killed by industrial waste, sewage, insecticides, and herbicides. Sediment is particularly damaging. As sediment is washed into rivers and streams, it settles and covers spawning beds and recently hatched fish. The sediment destroys food and food-producing areas. By filling pools, sediment causes water temperature to rise to a point that is harmful to fish. Much of the sediment is eroded from streambanks. This erosion is commonly caused by overgrazing, which should be controlled. Streambanks can be protected by vegetation. To significantly reduce sediment, the entire watershed should be protected.

Kinds of wildlife

White-tailed deer are abundant throughout Armstrong County. They live where there is a combination of brush or young trees, fewer mature trees, and small open areas.

Black bears have been seen recently in the rugged hills adjacent to the Allegheny River and its major tributaries, mainly within the Weikert-Gilpin soil association.

Wild turkeys inhabit parts of the county, and their population seems to be increasing. They live mainly in rugged woodland, unbroken by farms, within the Weikert-Gilpin soil association in Nichols Run, West Winfield, and Mahoning Townships.

Gray and fox squirrels inhabit Armstrong County. Fox squirrels are found where cornfields are interspersed with woodland. Gray squirrels are more widely distributed. They inhabit most of the county, especially woodland where oaks and hickory are dominant. The distribution and abundance of both species vary from year to year, depending on the amount of food available.

Ruffed grouse are distributed throughout the county, especially within the Weikert-Gilpin and the Gilpin-Weikert-Ernest soil associations. Idle land, strip mines, and woodland provide brushy areas and grapevines that make good habitat for grouse.

Part of the southern half of the county is classified

[4] By CLAYTON L. HEINEY, wildlife biologist, Soil Conservation Service.

TABLE 2.—*Soil*

[Mine dumps (Ms) and Strip mines (Sm) are not listed in the table. For information about revegetating these

Soil series and map symbols	Site quality	Management problems		
		Erosion hazard	Equipment limitations	Seedling mortality
Allegheny: AlB, AlC	Very good	Slight	Slight	Slight
Cavode: CaB, CaC, CaD	Very good	Slight for CaB, moderate for CaC, and severe for CaD.	Moderate	Moderate
Ernest: EnA, EnB, EnC, EnD, ErB, ErD.	Very good	Slight for EnA, EnB, and ErB, moderate for EnC and ErD, and severe for EnD.	Slight for EnA, EnB, EnC and ErB, and moderate for EnD and ErD.	Slight
Gilpin: GwB, GwC, GwD	Good	Slight	Slight for GwB and GwC, and moderate for GwD.	Moderate
Hazleton: HaB, HaC, HaD, HlD.	Good	Slight	Slight for HaB and HaC, and moderate for HaD and HlD.	Slight
Melvin: Me	Fair	Slight	Severe	Severe
Pope: Pm, Po	Excellent	Slight	Slight	Slight
Rainsboro: RaA, RaB, RaC.	Good	Slight for RaA and RaB, and moderate for RaC.	Slight	Slight
Rayne: RnB, RnC, RpD	Very good	Slight for RnB and RnC, and moderate for RpD.	Slight for RnB and RnC and moderate for RpD.	Slight for RnB and RnC, and moderate for RpD.
Steff: Se, Sf	Excellent	Slight	Slight	Slight
Upshur: UgB, UgC, UgD, UgE.	Good	Slight for UgB, moderate for UgC, and severe for UgD and UgE.	Moderate for UgB and UgC, and severe for UgD and UgE.	Slight
Urban land: Ur. Not suited to commercial trees.				
Weikert: WeB, WeC, WkF.	Fair for WeB and WeC, and good for WkF.	Slight for WeB and WeC, and moderate for WkF.	Slight for WeB and WeC, and severe for WkF.	Moderate for WkF, and severe for WeB and WeC.
Wharton: WrB, WrC, WtB, WtC, WtD, WvB, WvC, WvD.	Very good	Slight for WrB, WtB, and WvB, moderate for WrC, WtC, and WvC, and severe for WtD and WvD.	Slight for WrB, WrC, WtB, WtC, WvB, and WvC, and moderate for WtD and WvD.	Slight

interpretations for woodland

land types, see "A Guide for Revegetation of Bituminous Strip Mine Spoils in Pennsylvania" (*16*)]

Management problems—Continued			Suitable trees—	
Plant competition		Windthrow hazard	To favor in existing stands	For planting or seeding
Conifers	Hardwoods			
Severe	Moderate	Slight	Yellow-poplar, red oak, sugar maple, black walnut, ash.	Yellow-poplar, larch, Virginia pine, black walnut, Norway spruce, white pine.
Severe	Severe	Moderate	Yellow-poplar, ash, white pine, red oak, sugar maple.	Yellow-poplar, Norway spruce, white pine, larch, white spruce.
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white spruce, white pine.
Moderate	Slight	Slight	Red oak, ash, sugar maple, yellow-poplar, Virginia pine.	Yellow-poplar, red pine, Norway spruce, larch, Virginia pine, white pine.
Moderate	Slight	Slight	Red oak, ash, yellow-poplar, black oak, sugar maple, white pine.	Yellow-poplar, red pine, Norway spruce, larch, Virginia pine, white pine.
Severe	Severe	Moderate	Red maple, sycamore	White pine, white spruce.
Severe	Moderate	Slight	Yellow-poplar, red oak, sugar maple, black walnut, ash, white pine.	Yellow-poplar, larch, Norway spruce, black walnut, red pine, white pine.
Moderate	Slight	Slight	Red oak, sugar maple, yellow-poplar, ash.	Yellow-poplar, Norway spruce, white pine, larch, Virginia pine, red pine.
Severe	Moderate	Slight	Red oak, ash, Virginia pine, black oak, sugar maple, yellow-poplar.	Yellow-poplar, red pine, Norway spruce, larch, Virginia pine, white pine.
Severe	Moderate	Slight	Red oak, ash, white pine, yellow-poplar, sugar maple, black walnut.	Yellow-poplar, larch, white pine, black walnut, Norway spruce.
Moderate	Slight	Slight	Red oak, ash, sugar maple, Virginia pine, white pine, yellow-poplar.	Yellow-poplar, Norway spruce, red pine, white pine, larch, Virginia pine.
Slight for WeB and WeC, and moderate for WkF.	Slight	Moderate for WeB and WeC, and slight for WkF.	Red oak, chestnut oak, Virginia pine, black oak (WeB, WeC); red oak, ash, Virginia pine, yellow-poplar, sugar maple (WkF).	Red pine, Virginia pine, white pine (WeB, WeC); larch, red pine, Norway spruce, yellow-poplar, Virginia pine, white pine (WkF).
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple, white pine.	Yellow-poplar, larch, red pine, Norway spruce, white pine.

as second class pheasant range. Local populations of pheasant are established, and there is some natural reproduction. Survival is low, however, and annual stocking is necessary. The largest pheasant population is within the Wharton-Rayne-Cavode soil association near Worthington and Cowansville, where small grain is the main crop.

Cottontail rabbits are abundant throughout Armstrong County. Farmland on the rolling hills and small timber operations provide ideal habitat for rabbits. The urban areas also support a large population of rabbits because the shrubbery and flower gardens provide good habitat.

Bobwhite quail inhabit parts of the Gilpin-Weikert-Ernest soil association where weeds and brush grow on idle land.

A large population of mourning doves lives within the Wharton-Rayne-Cavode soil association, which is mostly clean farmed. Smaller populations of doves are scattered elsewhere in the county.

Woodcock inhabit the bottom land where alders are dominant within the Rainsboro-Melvin-Steff soil association. Loamy, lighter textured soils produce the best habitat for woodcock.

Many species of migrating waterfowl, such as whistling swans and Canada geese, can be found on the Allegheny River and other water areas in spring and fall. Goldeneyes, scaup, and buffle heads winter on the river. Woodducks nest along Crooked Creek, where old oak and walnut trees furnish good habitat.

Red and gray fox are distributed throughout Armstrong County. Red fox inhabit farms, and gray fox occupy woodland. Mange and other diseases have decimated their population in recent years.

Muskrat and mink are common along waterways. One beaver colony is located on the Allegheny River below lock number 9, and another is located on Glade Run below Cowansville, where ironwood, aspen, and old apple trees furnish food. Raccoons and woodchucks are abundant throughout the county.

The Allegheny River provides excellent fishing for muskellunge, northern pike, large and smallmouth bass, walleyes, and other warm-water fish. The fishing is especially good below the locks, where concentrations of dissolved oxygen are highest.

Keystone Lake also provides good warm-water fishing. Put-and-take trout fishing is maintained on thirteen streams and on two lakes.

Suitability of the soils for wildlife habitat

In table 3, the soils of Armstrong County are rated according to their suitability for six kinds of wildlife food and cover, two kinds of water developments, and three groups of wildlife (*1*).

On *well suited* soils, habitat generally is easily created, improved, or maintained. Few limitations effect management, and results are satisfactory.

On *suited* soils, habitat can be created, improved, or maintained, but limitations are moderate. A moderate intensity of management and fairly frequent attention may be needed to obtain satisfactory results.

On *poorly suited* soils, habitat generally can be created, improved, or maintained, but limitations are severe. Habitat management may be difficult and expensive and require intensive effort. Satisfactory results are questionable.

On *unsuitable* soils, it is impractical to create, improve, or maintain habitat because of very severe limitations. Unsatisfactory results are probable.

Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife.

The elements of wildlife habitat and the kinds of wildlife in table 3 are defined in the following paragraphs.

Grain and seed crops are domestic grains or seed-producing annual herbaceous plants that are planted to produce food for wildlife. Examples are corn, sorghum, wheat, millet, buckwheat, soybeans, and sunflower.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted to furnish food and cover for wildlife. Examples are fescue, brome, bluegrass, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, and sericea lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses or forbs that generally are established naturally and that provide food and cover mainly for upland wildlife. Examples are ragweed, wheatgrass, wildrye, oatgrass, pokeweed, strawberry, beggarweed, goldenrod, and dandelion.

Hardwood plants are deciduous trees, shrubs, and woody vines that produce fruit, nuts, buds, catkins, twigs, or foliage that are used as food by wildlife. They commonly are established naturally, but they may be planted. Examples are oak, beech, cherry hawthorn, dogwood, viburnums, holly, maple, birch, and poplar. Smaller plants include grape, honeysuckle, blueberry, briers, greenbrier, raspberry, and rose.

Coniferous plants are cone-bearing trees and shrubs that are important to wildlife primarily as cover but that also furnish food in the form of browse, seeds, or cones. These trees and shrubs commonly are established naturally, but they may be planted. Examples are pine, spruce, white-cedar, hemlock, fir, redcedar, juniper, and yew.

Wild herbaceous wetland plants are annual and perennial grasses and grasslike plants on moist or wet sites. These plants do not include submerged or floating aquatic plants that produce the food and cover used mainly by wetland wildlife. Examples of wetland food plants are smartweed, wild millet, bulrushes, sedges, wildrice, switchgrass, reed canarygrass, and cattails.

Shallow water developments are areas of water that have been made by building low dikes or levees, by digging shallow excavations, or by building devices to control the water of marshy streams or channels.

Shallow excavated ponds are dugout areas or a combination of dugout areas and low dikes that hold water of suitable quality, depth, and supply for fish or wildlife. Such a pond should have a surface area of at least one-quarter acre and an average depth of 6 feet or more in at least one-fourth of the area. Also required is a water table that is permanently high or another source of unpolluted water of low acidity.

Each rating for the kinds of wildlife in table 3 is based on the ratings of the elements of wildlife habitat.

Openland wildlife are birds and mammals that inhabit fields, meadows, pastures, and nonforested, over-grown land. Examples are quail, ring-necked pheasant, mourning dove, woodcock, cottontail rabbit, meadow lark, killdeer, and field sparrow.

Woodland wildlife are birds and mammals that inhabit woodland. Examples are ruffed grouse, wild turkey, wood thrush, warbler, vireo, deer, squirrel, and raccoon.

Wetland wildlife are birds and mammals that inhabit swamps, marshes, and open water areas. Examples are ducks, geese, heron, snipe, rail, coot, muskrat, mink, and beaver.

Engineering Uses of the Soils [5]

This section is useful to planning commissions, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation on which structures are built.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreation areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the soils on which they are built, to help predict performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 4 shows estimated soil properties significant to engineering. Table 5 gives interpretations for various engineering uses. Table 6 shows the results of engineering laboratory tests on soil samples.

This information, along with the soil map and data in other parts of this publication, can be used to make interpretations in addition to those given in tables 4 and 5, and it also can be used to make useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil can include small areas of other kinds of soil that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms in this soil survey have special meaning to soil scientists. The Glossary defines many of the terms commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*3*) used by SCS engineers, the Department of Defense, and others, and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*2*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 6; the estimated classification, without group index numbers, is given in table 4 for all soils mapped in the survey area.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 4. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 4.

Depth to seasonal water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

[5] JOHN JAQUISH, engineer, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Soil suitability*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees and plants
Allegheny: AlB, AlC	Suited	Well suited	Well suited	Well suited
Cavode:				
CaB	Suited	Suited	Well suited	Well suited
CaC	Suited	Suited	Well suited	Well suited
CaD	Poorly suited	Suited	Well suited	Well suited
Ernest:				
EnA	Well suited	Well suited	Well suited	Well suited
EnB, EnC	Suited	Well suited	Well suited	Well suited
EnD	Poorly suited	Suited	Well suited	Well suited
ErB, ErD	Unsuited	Poorly suited	Poorly suited	Suited
Gilpin: GwB, GwC, GwD	Unsuited	Poorly suited	Poorly suited	Unsuited
Hazleton:				
HaB, HaC, HaD	Suited	Well suited	Well suited	Well suited
HlD	Unsuited	Poorly suited	Poorly suited	Suited
Melvin: Me	Poorly suited	Suited	Suited	Suited
Mine dumps: Ms. Too variable to be rated.				
Pope: Pm, Po	Suited	Well suited	Well suited	Well suited
Rainsboro:				
RaA	Well suited	Well suited	Well suited	Well suited
RaB, RaC	Suited	Well suited	Well suited	Well suited
Rayne:				
RnB, RnC	Suited	Well suited	Well suited	Well suited
RpD	Poorly suited	Suited	Well suited	Well suited
Steff:				
Se	Suited	Well suited	Well suited	Well suited
Sf	Well suited	Well suited	Well suited	Well suited
Strip mines: Sm. Too variable to be rated.				
Upshur:				
UgB, UgC	Suited	Well suited	Well suited	Suited
UgD	Poorly suited	Suited	Well suited	Suited
UgE	Unsuited	Suited	Well suited	Suited
Urban land: Ur. Too variable to be rated.				
Weikert: WeB, WeC, WkF	Unsuited	Poorly suited	Poorly suited	Unsuited
Wharton:				
WrB, WrC, WvC	Suited	Well suited	Well suited	Well suited
WtB, WtC	Suited	Well suited	Well suited	Suited
WtD	Poorly suited	Suited	Well suited	Suited
WvB	Suited	Well suited	Well suited	Well suited
WvD	Poorly suited	Suited	Well suited	Well suited

Depth to bedrock is the distance from the surface of the soil to the rock layer.

Soil texture is described in table 4 in the standard terms used by the Department of Agriculture. These terms take into account the relative percentage of sand, silt, and clay in the soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis *for wildlife habitat*

Elements of wildlife habitat—continued				Kinds of wildlife		
Coniferous plants	Wild herbaceous wetland plants	Shallow water developments	Shallow excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Poorly suited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Suited	Well suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Unsuited	Unsuited	Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Suited	Poorly suited	Suited	Suited	Poorly suited	Suited	Suited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Suited	Well suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Well suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Unsuited	Unsuited	Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Well suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Unsuited	Unsuited	Unsuited	Suited	Well suited	Unsuited.

of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available moisture capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crops.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH values and terms used to describe soil reaction are explained in the Glossary.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at

TABLE 4.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The the first column. The symbol > means

Soil series and map symbols	Depth to— Seasonal water table	Depth to— Bedrock	Depth from surface	Classification Unified	Classification AASHTO	USDA texture	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm)	Percentage passing sieve— No. 10 (2.0 mm)
	Feet	*Feet*	*Inches*				*Percent*		
Allegheny: AlB, AlC	>3	>6	0-9	ML, CL	A-4, A-6	Silt loam	0-15	90-100	90-100
			9-40	ML, CL, SM	A-4, A-6	Loam, sandy clay loam.	0-15	70-100	70-95
			40-52	SM, SC, GM, GC	A-2, A-4, A-6	Very gravelly loam, clay loam.	0-45	50-95	35-70
			52-84	GM, GC, SM, SC	A-2	Very shaly clay.	0-45	45-75	35-60
Cavode: CaB, CaC, CaD	½-1½	3½-6	0-5	ML, CL	A-4, A-6	Silt loam	0-5	90-100	90-100
			5-26	ML, CL	A-4, A-6, A-7	Silty clay loam.	0-5	80-95	75-95
			26-48	ML, CL, GM, GC, SM, SC	A-2, A-4, A-6	Shaly silty clay loam, shaly clay.	0-10	60-90	25-85
			48	----------	----------	Acid gray shale bedrock.			
Ernest: EnA, EnB, EnC, EnD, ErB, ErD.	1½-3	>6	0-8	ML, CL	A-4, A-6	Silt loam	0-15	75-100	70-100
			8-50	ML, CL	A-4, A-6, A-7	Silt loam, silty clay loam, shaly silt loam.	0-15	75-100	70-100
			50-74	ML, CL, GM, GC, SM	A-4, A-6	Shaly silt loam, shaly silty clay.	5-25	70-95	60-95
*Gilpin: GwB, GwC, GwD. For the Weikert part, see the Weikert series.	>3	1½-3½	0-26	ML	A-4	Silt loam, silty clay loam.	0-20	85-100	60-90
			26-34	SM, SC, GM, GC	A-2, A-4	Shaly silt loam, channery loam.	0-35	40-70	20-65
			34	----------	----------	Grayish-brown, rippable shale bedrock.			
Hazleton: HaB, HaC, HaD, HlD.	>3	3½-5	0-17	GM, ML	A-2, A-4	Channery loam, channery sandy loam.	0-30	50-85	40-75
			17-36	GM, ML	A-2, A-4	Very channery loam.	10-40	50-85	40-80
			36-48	SM, GM	A-2, A-4	Very channery loamy sand, very channery loam.	10-50	45-85	35-75
			48	----------	----------	Grayish-brown, fractured sandstone.			

significant in engineering

soils in such mapping units may have different properties, and for this reason it is necessary to refer to other series as indicated in more than; the symbol < means less than]

Percentage passing sieve—Continued		Permeability	Available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosivity to—	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
		Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
85–100	70–90	0.6–2.0	0.18–0.20	4.5–6.5	----------	----------	Low -------	Low -------	Moderate.
65–95	45–95	0.6–2.0	0.12–0.16	4.5–5.5	10–15	110–125	Low -------	Low -------	Moderate.
25–50	15–40	0.6–6.0	0.06–0.12	4.5–5.5	5–10	125–130	Low -------	Low -------	Moderate.
25–50	15–30	0.6–2.0	0.05–0.08	4.5–5.5	5–10	125–130	Low -------	Low -------	Moderate.
85–95	80–90	0.6–2.0	0.18–0.20	4.0–6.5	----------	----------	Low -------	High -------	Moderate.
70–90	60–90	<0.2	0.10–0.14	4.0–5.0	15–18	100–110	Moderate ---	High -------	High.
25–80	25–75	<0.2	0.08–0.12	4.0–5.0	12–15	115–120	Moderate ---	High -------	High.
70–95	60–95	0.6–2.0	0.14–0.20	4.5–6.5	----------	----------	Low -------	Moderate ---	Moderate.
70–95	65–95	0.2–0.6	0.10–0.14	4.5–5.5	15–19	102–112	Moderate ---	High -------	Moderate.
50–95	40–95	0.2–0.6	0.08–0.12	4.5–5.5	12–17	114–120	Moderate ---	High -------	Moderate.
60–85	60–85	0.6–2.0	0.16–0.18	4.5–6.5	----------	----------	Low -------	Low -------	Moderate.
15–55	15–50	0.6–2.0	0.07–0.13	4.5–5.5	11–14	114–120	Low -------	Moderate ---	Moderate.
35–65	15–55	2.0–6.0	0.08–0.12	4.0–6.0	----------	----------	Low -------	Low -------	High.
40–75	20–55	2.0–6.0	0.06–0.12	4.0–5.0	10–15	115–123	Low -------	Low -------	High.
25–65	15–40	2.0–6.0	0.03–0.06	4.0–5.0	9–13	115–125	Low -------	Low -------	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		USDA texture	Coarse fraction greater than 3 inches	Percentage passing sieve—	
	Seasonal water table	Bedrock		Unified	AASHTO			No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Feet*	*Inches*				*Percent*		
Melvin: Me	[1] 0–½	4–6+	0–9	ML, CL	A-4, A-6	Silty clay loam.		90–100	90–100
			9–52	CL, ML	A-4, A-6, A-7	Silty clay loam, silt loam, loam.		85–100	95–100
			52–60	ML, CL, GM, GC, SC	A-2, A-4, A-6	Very gravelly sandy clay loam.	0–10	45–75	25–60
Mine dumps: Ms. Properties are too variable to be estimated.									
Pope: Pm, Po	[1] >3	>5	0–42	ML, CL, SM, GM	A-2, A-4	Silt loam, loam, fine sandy loam.	0–5	75–100	70–100
			42–60	SM, SC	A-2	Gravelly loamy sand.	0–10	75–100	55–100
Rainsboro: RaA, RaB, RaC	1½–3	>6	0–8	ML	A-4	Silt loam		90–100	85–100
			8–60	ML, CL, MH	A-4, A-6, A-7	Silty clay loam, silt loam.	0–10	90–100	85–100
			60–76	ML, CL	A-4, A-6	Clay loam, sandy clay loam.	0–15	75–100	70–100
*Rayne: RnB, RnC, RpD. For the Gilpin part of RpD, see the Gilpin series.	>3	3½–5	0–6	ML	A-4	Silt loam	0–20	85–100	80–90
			6–60	ML, CL, SC, SM, GM, GC	A-2, A-4, A-6	Shaly silty clay loam, very shaly silt loam.	0–30	40–75	30–60
			60			Grayish brown, rippable shale bedrock.			
Steff: Se, Sf	[1] 1½–3	>5	0–45	ML	A-4	Silty clay loam, silt loam, loam.		95–100	90–100
			45–70	SM, ML, GM	A-2, A-4	Sandy loam, fine sandy loam, gravelly sandy loam.		60–85	45–70
Strip mines: Sm. Properties are too variable to be estimated.									
*Upshur: UgB, UgC, UgD, UgE. For the Gilpin part, see the Gilpin series.	>3	3½–6	0–6	ML, CL	A-4, A-6	Silt loam		95–100	90–100
			6–36	CH, CL, ML	A-6, A-7	Silty clay, clay.		95–100	90–100
			36–58	GM, GC, SM, SC	A-2, A-4	Very shaly silty clay.	0–15	50–80	25–60
			58			Red shale bedrock.			

significant in engineering—Continued

Percentage passing sieve—Continued		Permeability	Available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosivity to—	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
		Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
85–100	70–95	0.6–2.0	0.18–0.20	6.1–7.3			Low	High	Low.
85–100	70–90	0.6–2.0	0.14–0.18	5.6–6.5	12–18	105–110	Low	High	Low.
25–55	15–55	0.6–2.0	0.06–0.10	6.1–7.3	8–14	108–122	Low	High	Low.
55–100	30–80	2.0–6.0	0.12–0.16	4.5–7.0	10–18	106–120	Low	Low	Low.
50–100	15–30	2.0–6.0	0.05–0.08	4.5–6.0	5–9	110–120	Low	Low	Moderate.
80–100	70–100	0.2–2.0	0.14–0.18	5.6–6.5			Low	Moderate	Low.
80–100	70–100	0.2–0.6	0.09–0.14	4.5–6.0	15–20	100–115	Moderate	High	Moderate.
65–100	55–95	0.2–0.6	0.10–0.14	5.1–6.0	12–20	105–120	Moderate	High	Moderate.
70–85	60–85	0.6–2.0	0.16–0.18	4.5–7.0			Low	Low	Low.
25–55	15–55	0.6–2.0	0.06–0.12	4.5–5.5	13–15	114–118	Low	Moderate	Moderate.
80–100	60–90	0.6–2.0	0.15–0.20	4.5–6.5	10–19	104–120	Low	Moderate	Moderate.
45–60	20–55	0.6–2.0	0.06–0.10	4.5–5.5	8–12	115–122	Low	Low	Moderate.
80–95	70–95	0.2–0.6	0.18–0.20	4.5–6.5			Moderate	Moderate	Moderate.
85–100	80–95	<0.2	0.12–0.14	5.1–6.0	18–22	100–110	High	High	Moderate.
25–50	15–40	<0.2	0.05–0.08	5.6–6.5	15–18	110–115	High	High	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		USDA texture	Coarse fraction greater than 3 inches	Percentage passing sieve—	
	Seasonal water table	Bedrock		Unified	AASHTO			No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Feet*	*Inches*				*Percent*		
Urban land: Ur. Properties are too variable to be estimated.									
Vandergrift ---. Mapped only with Wharton soils.	½–2	3½–6	0–14	ML, CL	A–4, A–6, A–7	Silty clay loam.	---	95–100	90–100
			14–56	ML, CL, CH	A–4, A–6 A–7	Silty clay, clay, silty clay loam.	0–5	90–100	85–100
			56–66	ML, CL, MH, SM	A–2, A–4, A–6, A–7	Silty clay loam, shaly silty clay loam.	0–5	90–100	50–100
			66	---	---	Shale and siltstone bedrock.			
*Weikert: WeB, WeC, WkF. For the Gilpin part of WkF, see the Gilpin series.	>3	1–1½	0–15	GM, ML	A–1, A–2, A–4	Shaly silt loam.	0–10	50–75	40–65
			15–18	GM, GP–GM	A–1, A–2	Very shaly silt loam.	0–20	25–55	20–40
			18	---	---	Rippable shale bedrock.			
*Wharton: WrB, WrC, WtB, WtC, WtD, WvB, WvC, WvD. For Gilpin part of WtB, WtC, WtD, see the Gilpin series. For the Vandergrift part of WvB, WvC, WvD, see the Vandergrift series.	1½–3	4–6	0–11	ML, CL	A–4, A–6	Silt loam ---	0–5	95–100	85–100
			11–52	ML, CL, MH, CH	A–4, A–6, A–7	Silty clay loam, silty clay.	0–5	95–100	85–100
			52–58	ML, CL, MH, CH, GM, GP	A–2, A–4, A–6, A–7	Very shaly silty clay.	0–10	40–85	35–80
			58	---	---	Shale bedrock.			

[1] Subject to flooding by stream overflow.

successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase of moisture content. The highest dry density obtained in the compactive test is termed *maximum* dry density. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Shrink-swell potential is the relative change in volume of soil material to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or with material having this rating (fig. 9).

Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protec-

significant in engineering—Continued

Percentage passing sieve—Continued		Permeability	Available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosivity to—	
No. 40 (0.42 mm)	No. 200 (0.075 mm)							Steel	Concrete
		Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
85–100	85–95	0.6–2.0	0.15–0.17	5.1–6.5	----------	----------	Moderate ---	High -------	Moderate.
80–100	70–100	<0.2	0.10–0.16	5.1–6.0	15–22	102–115	High -------	High -------	Moderate.
40–95	15–90	<0.2–0.6	0.04–0.14	5.1–7.3	13–18	104–116	High -------	High -------	Moderate.
35–60	20–55	2.0–6.0	0.08–0.14	4.5–6.0	----------	----------	Low -------	Low -------	Moderate.
10–35	5–25	2.0–6.0	0.04–0.08	4.5–5.5	11–15	115–122	Low -------	Low -------	Moderate.
80–95	70–95	0.6–2.0	0.16–0.20	4.5–6.0	----------	----------	Moderate ---	Moderate ---	Moderate.
85–100	85–95	<0.2	0.13–0.16	4.0–5.0	16–22	102–112	Moderate ---	High -------	High.
30–70	20–60	<0.2	0.04–0.06	4.0–5.0	14–18	110–118	Moderate ---	High -------	High.

tive measures for steel or more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations of the soils

The interpretations in table 5 are based on the estimated engineering properties of the soils shown in table 4, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Armstrong County. In table 5 ratings are used to summarize suitability of the soils as a source of topsoil, sand and gravel, and roadfill. Soil suitability is rated as *good, fair, poor,* and *unsuited.* For other uses, table 5 lists those soil features that should be considered in planning, installation, and maintenance.

Following are explanations of the columns in table 5.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as for preparing a seedbed; the natural fertility of the material, or the response of plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and content of stone fragments affect suitability, and also considered in the ratings is damage that will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 5 provide evidence about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining

TABLE 5.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The as indicated in

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Roadfill	Roads and highways	Ponds: Reservoir area
Allegheny: AlB, AlC	Fair: coarse fragments.	Poor: too many fines.	Fair: ML, CL, GM, and GC material.	Features generally favorable.	Moderate permeability.
Cavode: CaB, CaC, CaD	Fair: silty clay loam below a depth of 5 inches.	Unsuited: too many fines.	Fair: seasonal high water table; moderate shrink-swell potential.	Seasonal high water table; fair to poor stability; high frost heave potential; bedrock at a depth of 3½ to 6 feet.	Bedrock at a depth of 3½ to 6 feet.
Ernest: EnA, EnB, EnC, EnD, ErB, ErD.	Good: poor for very stony phase.	Unsuited: too many fines.	Fair: too many fines.	Seasonal high water table; seepage above fragipan; high frost heave potential; stony in some areas.	Features generally favorable.
*Gilpin: GwB, GwC, GwD. For the Weikert part, see the Weikert series.	Good	Unsuited: too many fines.	Poor: bedrock at a depth of 1½ to 3½ feet.	Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Pervious bedrock at a depth of 1½ to 3½ feet.
Hazleton: HaB, HaC, HaD, HlD.	Fair: channery; poor for very stony phase.	Poor: too many fines.	Good	Features generally favorable; stony in some areas; bedrock at a depth of 3½ to 5 feet.	Moderately rapid permeability.
Melvin: Me	Poor: high water table.	Unsuited: too many fines.	Poor: high water table; too many fines.	Flooding; high water table; poor stability; high frost heave potential.	Flooding
Mine dumps: Ms. Too variable for interpretations to be made.					
Pope: Pm, Po	Good	Poor: too many fines; good in substratum in some areas.	Good	Flooding; moderate frost heave potential.	Flooding; moderately rapid permeability.
Rainsboro: RaA, RaB, RaC.	Good	Unsuited: too many fines; good in substratum in some areas.	Fair: too many fines.	Seasonal high water table; high frost heave potential.	Permeable layers in substratum in some areas.

engineering properties of the soils

soils in such mapping units may have different properties and limitations, and for this reason, it is necessary to refer to other series the first column]

Soil features affecting—continued					
Ponds—continued: Embankments	Drainage for crops and pasture	Sprinkler irrigation	Terraces, diversions, and waterways	Winter grading	Pipeline construction and maintenance
Medium to low shear strength; susceptible to piping; fair to poor compaction characteristics.	Well drained	High available moisture capacity.	Siltation in channels.	Features generally favorable.	Features generally favorable.
Medium to low shear strength; susceptible to piping; fair compaction characteristics.	Slow permeability; seasonal high water table.	Seasonal high water table; slow permeability.	Seasonal high water table; erodible.	Seasonal high water table; forms large clods when frozen.	Seasonal high water table; bedrock at a depth of 3½ to 6 feet; high corrosion potential.
Medium to low shear strength; susceptible to piping; fair to good compaction characteristics; stony in some areas.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Erodible; seepage above fragipan; seasonal high water table.	Seasonal high water table.	Seasonal high water table; high corrosion potential.
Bedrock at a depth of 1½ to 3½ feet; stony in some areas.	Well drained	Bedrock at a depth of 1½ to 3½ feet; moderate available moisture capacity.	Bedrock at a depth of 1½ to 3½ feet.	Features generally favorable.	Bedrock at a depth of 1½ to 3½ feet.
Fair compaction characteristics; stony in some areas.	Well drained	Low to moderate available moisture capacity; stony in some areas.	Siltation in channels; stony in some areas.	Features generally favorable.	Stony in some areas; bedrock at a depth of 3½ to 5 feet.
Medium to low shear strength; susceptible to piping; fair to good compaction characteristics.	Flooding; high water table; outlets difficult to locate.	High water table; flooding.	Nearly level; flooding; high water table.	Forms large clods when frozen; high water table; flooding.	High water table; flooding; high frost heave potential; high corrosion potential for uncoated steel.
Susceptible to piping; fair compaction characteristics.	Well drained	Flooding	Nearly level; flooding.	Flooding	Flooding; moderate frost heave potential.
Low shear strength; susceptible to piping; fair compaction characteristics.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Seepage above fragipan; seasonal high water table.	Seasonal high water table; forms large clods when frozen.	Seasonal high water table; seepage above fragipan; high corrosion potential for uncoated steel.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—	
	Topsoil	Sand and gravel	Roadfill	Roads and highways	Ponds: Reservoir area
*Rayne: RnB, RnC, RpD. For the Gilpin part of RpD, see the Gilpin series.	Good: poor on very stony phase.	Unsuited: too many fines.	Fair: shaly; too many fines.	Features generally favorable; stony in some areas; bedrock at a depth of 3½ to 5 feet.	Permeable material; bedrock at a depth of 3½ to 5 feet.
Steff: Se, Sf	Good	Unsuited: too many fines; good to fair in substratum in some areas.	Fair: too many fines.	Flooding; seasonal high water table; high frost heave potential.	Flooding
Strip mines: Sm. Too variable for interpretations to be made.					
*Upshur: UgB, UgC, UgD, UgE. For the Gilpin part, see the Gilpin series.	Fair: silty clay below a depth of 6 inches.	Unsuited: too many fines.	Poor: high shrink-swell potential.	Unstable material; slippage hazard; high shrink-swell potential; bedrock at a depth of 3½ to 6 feet.	Bedrock at a depth of 3½ to 6 feet.
Urban land: Ur. Too variable for interpretations to be made.					
Vandergrift. Mapped only with Wharton soils.	Fair: silty clay loam.	Unsuited: too many fines.	Poor: high shrink-swell potential.	Unstable material; slippage hazard; high shrink-swell potential; bedrock at a depth of 3½ to 6 feet.	Features generally favorable.
*Weikert: WeB, WeC, WkF. For the Gilpin part of WkF, see the Gilpin series.	Poor: shaly; limited quantity.	Unsuited: too many fines; bedrock at a depth of 1 to 1½ feet.	Poor: bedrock at a depth of 1 to 1½ feet.	Bedrock at a depth of 1 to 1½ feet.	Pervious bedrock at a depth of 1 to 1½ feet.
*Wharton: WrB, WrC, WtB, WtC, WtD, WvB, WvC, WvD. For the Gilpin part of WtB, WtC, and WtD, see the Gilpin series. For the Vandergrift part of WvB, WvC, and WvD, see the Vandergrift series.	Good	Unsuited: too many fines.	Fair: moderate shrink-swell potential.	Seasonal high water table; fair to poor stability; slips when saturated; moderate frost heave potential.	Bedrock at a depth of 4 to 6 feet.

of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Roads and highways have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. They are graded to shed water and have ordinary provisions for drainage. Most cuts and fills are less than 6 feet deep.

properties of the soils—Continued

Soil features affecting—continued					
Ponds—continued: Embankments	Drainage for crops and pasture	Sprinkler irrigation	Terraces, diversions, and waterways	Winter grading	Pipeline construction and maintenance
Medium to low shear strength.	Well drained	Features generally favorable; stony in some areas.	Erodible; stony in some areas.	Features generally favorable.	Stony in some areas; bedrock at a depth of 3½ to 5 feet.
Medium to low shear strength.	Seasonal high water table; flooding.	Seasonal high water table.	Nearly level; flooding; seasonal high water table.	Seasonal high water table; flooding.	Flooding; seasonal high water table.
Low shear strength; medium to high compressibility; poor compaction characteristics.	Well drained	Slow permeability	Erodible; high content of clay.	Poor workability	High shrink-swell potential; slippage hazard; bedrock at a depth of 3½ to 6 feet; high corrosion for uncoated steel.
Low shear strength; medium to high compressibility; poor compaction characteristics.	Slow permeability; seasonal high water table.	Slow permeability; seasonal high water table.	Erodible; seasonal high water table; high content of clay.	Poor workability; seasonal high water table.	High shrink-swell potential; slippage hazard; bedrock at a depth of 3½ to 6 feet; high corrosion potential for uncoated steel.
Bedrock at a depth of 1 to 1½ feet.	Well drained	Very low available moisture capacity; bedrock at a depth of 1 to 1½ feet.	Bedrock at a depth of 1 to 1½ feet; very low available moisture capacity.	Bedrock at a depth of 1 to 1½ feet.	Bedrock at a depth of 1 to 1½ feet.
Low shear strength; medium to high compressibility; poor compaction characteristics.	Slow permeability; seasonal high water table.	Seasonal high water table; slow permeability.	Seasonal high water table; high content of clay.	Seasonal high water table.	Seasonal high water table; high content of clay; slippage hazard; high corrosion potential.

Soil properties that most affect design and construction of roads and highways are the load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect the ease of excavation and the amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and the depth to fractured or permeable bedrock or other permeable material.

TABLE 6.—*Engineering*

[Tests performed by the Pennsylvania Department of Transportation, Soil Testing Laboratory, Harrisburg, according to

Soil series and location	Parent material	Engineering report number	Depth from surface	Moisture density[1]	
				Maximum dry density	Optimum moisture
			Inches	*Pounds per cubic foot*	*Percent*
Melvin:					
2 miles east of Kittanning along Cowanshannock Creek, in Rayburn Township. (Modal)	Alluvium from shale, siltstone, sandstone, and limestone.	68–20497	22–35	106	18
		68–20498	52–60	122	13
Pope:					
2 miles southeast of Elderton, in Plum Creek Township. (Modal)	Alluvium from shale, siltstone, and sandstone.	68–20503	20–29	106	18
		68–20504	48–61	117	13
Rainsboro:					
3½ miles southwest of West Mosgrove and 1½ miles north of Allegheny River, in East Franklin Township. (Modal)	Loess and loamy sediments.	68–20511	40–50	113	15
		68–20512	60–70	117	14
Steff:					
1½ miles southeast of Elderton and 100 yards south of U.S. Highway 422 along Crooked Creek, in Plum Creek Township. (Modal)	Alluvium from shale, siltstone, and sandstone.	68–20501	25–33	104	19
		68–20502	60–70	122	12
Vandergrift:					
2.5 miles south-southwest of Dayton and ½ mile west of intersection of T547 and 03128, in Wayne Township. (Modal)	Shale and siltstone.	68–20507	21–34	102	22
		68–20508	56–63	114	15

[1] Based on AASHTO Designation: T 99–57 (*2*).

[2] Mechanical analysis according to AASHTO Designation: T 88–57 (*2*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that

Embankments require soil material resistant to seepage and piping and a favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure, depth to rock or other layers that influence rate of water movement, depth to the water table, slope, stability in ditchbanks, susceptibility to stream overflow, and availability of outlets for drainage.

Irrigation is affected by such soil features as slope; susceptibility to stream overflow, water erosion, or soil blowing; texture; content of stones; accumulation of salt and alkali; depth of the root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; the amount of water held available to plants; and the need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material, presence of stones or rock outcrops, and the steepness of slopes. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation, and the ease of establishing and maintaining vegetation.

Winter grading involves moving, mixing, and compacting soil for road building when temperatures are below freezing. It is affected by such soil features as texture, depth to the seasonal water table, plasticity, slope, and stoniness.

Pipeline construction and maintenance are influenced by such soil features as slope, depth to bedrock, height and duration of the water table, stoniness or rockiness, flooding, and corrosivity.

Engineering test data

Table 6 contains engineering test data for some of the major soil series in Armstrong County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are *test data*

standard procedures of the American Association of State Highway and Transportation Officials (AASHTO) (*2*)]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—							
3 in.	¾ in.	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	Unified
										Percent			
-------	-------	100	99	98	84	75	60	42	32	36	14	A-6(10)	CL
100	85	68	59	44	30	27	18	12	10	30	9	A-2-4(0)	SC
-------	-------	-------	-------	100	79	68	55	32	20	33	8	A-4(8)	ML-CL
-------	-------	-------	100	99	30	22	13	6	4	[3]NP	[3]NP	A-2-4(0)	SM
-------	-------	100	99	99	93	85	46	22	17	27	6	A-4(8)	ML-CL
-------	100	99	99	95	81	75	56	28	18	21	3	A-4(8)	ML
-------	-------	-------	100	99	82	73	48	29	21	34	8	A-4(8)	ML
100	97	73	63	52	24	19	13	7	4	21	1	A-2-4(0)	SM
-------	-------	100	99	99	98	97	89	72	59	66	35	A-7-5(20)	CH
-------	100	98	93	85	72	67	51	28	17	34	11	A-6(8)	ML-CL

coarser than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data in this table are not suitable for naming textural classes for soils.

[3] NP means nonplastic.

based on data obtained by mechanical analysis and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine compaction (or moisture-density) characteristics have been explained for table 4.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from semisolid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; and the liquid limit, from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Use of the Soils for Community Development

This section provides information of special interest to persons or organizations who plan community development and recreation facilities. This information is a scientific basis for developing land-use plans for Armstrong County. Interpretive maps can be made from the soil maps and information in table 7 to help determine the degree and kind of limitation of the soils of any given area.

This information and the soil maps give general guidance, but the mapping and written information are restricted in detail by the map scale and should be used only in planning more detailed field investigation to determine the in-place condition of the soil at any specific site.

Only soil features are evaluated in this section, since the ease or difficulty of making improvements is largely controlled by the characteristics of the soils. Economic factors and location, however, often determine the ultimate use of an area, regardless of the soil limitations involved.

Table 7 lists all the soils in the county and shows the kind and estimated degree of their limitations for selected uses. Ratings of limitations used in the table are slight, moderate, and severe. A rating of *slight* means that soil properties are generally favorable, and limitations are so minor that they can easily be overcome. A rating of *moderate* means that limitations can be overcome or modified by planning, special design, or special maintenance. A rating of *severe* means that limitations require costly soil reclamation, special design, intense maintenance, or a combination of these.

Figure 9.—**The high shrink-swell potential of Vandergrift soils make them susceptible to landslides.**

Following are explanations of the columns in table 7.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material to a depth of 6 feet is evaluated. The soil properties considered are those that affect both the absorption of effluent and the construction and operation of the system. Properties that affect absorption are permeability, depth to water table, depth to rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and has sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is free from flooding. The soil properties considered are those that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, and slope and, if the floor needs to be leveled, depth to and kind of bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Buildings with basements, as rated in table 7, are not more than three stories high with an excavation for a basement that is less than 6 feet deep. The features that affect the rating for buildings with basements are those that relate to capacity to support load and to resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

For lawns and landscaping suitable soil material is needed in an amount sufficient for desirable trees and other plants to survive and grow. The need for lime and fertilizer is not considered. Among the factors considered are depth to seasonal high water table, slope, depth to bedrock, soil texture, presence of stones or rocks, and the hazard of flooding.

The main features affecting use of soils for streets and parking lots are depth to seasonal high water table, slope, depth to and kind of bedrock, stoniness, and hazard of flooding. For rural roads, slope limitations are generally less severe than shown on the table.

In a trench type sanitary landfill, refuse is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have restricted permeability, can withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 7 apply only to a depth of about 6 feet, and therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. Each site should be investigated before it is selected.

Camp areas are used intensively for tents and small camp trailers, travel trailers, and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils are nearly level, well drained, free of surface rocks and coarse fragments, and free from flooding during periods of heavy use. They have a surface that is firm after rains.

The ratings for buildings without basements apply to washrooms, bathhouses, picnic shelters, service buildings, and vacation cottages.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Picnic areas are natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increase the cost of leveling sites or of building access roads.

Playgrounds are athletic fields used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, and a surface that is firm after rains but not dusty when dry. They are free of flooding during periods of heavy use. If grading and leveling are required, depth to rock is important.

Among the factors considered in the ratings for golf fairways are depth to seasonal high water table, slope, depth to bedrock, texture, presence of rocks or stones, and hazard of flooding. Traps, roughs, and greens are special features not considered in the ratings.

Descriptions of the Soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, information given for the soil series also applies to the mapping units in that series. Thus, for complete information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, or the sequence of layers from the surface down to rock or other underlying material. For each series, two descriptions of the profile are given. The first is brief and in familiar terms. The second is detailed and is included for those who need to make thorough and precise studies of soils. The profile described is representative of the mapping units in a series. If the profile of a given mapping unit is different from the one described for the series, these differences are given in the description of the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless stated otherwise.

As mentioned in the section "How This Survey Was Made," not all mapping units are in a soil series. Urban land, for example, does not belong to a soil series; nevertheless, it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page where each capability unit is described is listed in the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 8. Many of the terms used in describing soils are defined in the Glossary, and more detailed information about terminology and the methods of soil mapping can be obtained from the Soil Survey Manual (*18*).

Allegheny Series

The Allegheny series consists of deep, well-drained, gently sloping and sloping soils on terraces. These soils formed in loamy alluvium derived from sandstone, siltstone, and shale. The native vegetation consists of mixed hardwoods, mainly scarlet oak, red oak, white oak, black oak, tulip-poplar, black cherry, and elm. Some sassafras, dogwood, and basswood are also present.

In a representative profile the plow layer is dark-brown silt loam about 9 inches thick. The subsoil is brown, friable heavy loam about 31 inches thick. The substratum, between depths of 40 and 52 inches, is yellowish-brown very gravelly loam; below that, to a depth of 84 inches, it is gray very shaly clay.

The available moisture capacity is high, and permeability is moderate. Most areas of these soils have been cleared and are used for crops, pasture, and hay. Some areas are used for urban development, and some are idle. Slope limits these soils for some uses.

Representative profile of Allegheny silt loam, 3 to 8 percent slopes, in a recreation area near the dam of

TABLE 7.—*Limitations of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Buildings with basements	Lawns and landscaping	Streets and parking lots	Sanitary landfill (Trench)
Allegheny:						
AlB	Slight	Severe: moderately rapid permeability in substratum.	Slight	Slight	Moderate: slope.	Slight
AlC	Moderate: slope.	Severe: slope; moderately rapid permeability in substratum.	Moderate: slope.	Moderate: slope.	Severe: slope	Moderate: slope.
Cavode:						
CaB	Severe: seasonal high water table; slow permeability.	Moderate: slope.	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table.
CaC	Severe: seasonal high water table; slow permeability.	Severe: slope	Severe: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: slope	Severe: seasonal high water table.
CaD	Severe: seasonal high water table; slow permeability; slope.	Severe: slope	Severe: seasonal high water table.	Severe: slope	Severe: slope	Severe: seasonal high water table; slope.
Ernest:						
EnA	Severe: seasonal high water table; moderately slow permeability.	Slight	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
EnB	Severe: seasonal high water table; moderately slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
EnC	Severe: seasonal high water table; moderately slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table; slope.
EnD	Severe: seasonal high water table; moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
ErB	Severe: seasonal high water table; moderately slow permeability.	Moderate: slope; stony.	Moderate: seasonal high water table; stony.	Moderate: stony.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; stony.
ErD	Severe: seasonal high water table; slope; moderately slow permeability.	Severe: slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Gilpin:						
GwB	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Moderate: bedrock at a depth of 1 to 1½ feet.	Moderate: bedrock at a depth of 1 to 1½ feet.	Moderate: rippable bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.

for community development

Camp areas		Buildings without basements	Paths and trails	Picnic areas	Playgrounds	Golf fairways
Tents and camp trailers	Travel trailers					
Slight	Moderate: slope.	Slight	Slight	Slight	Moderate: slope.	Slight.
Moderate: slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope.
Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table; slope; slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; seasonal high water table.	Severe: slope	Severe: slope; seasonal high water table.	Severe: slope.
Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight	Slight	Slight	Moderate: moderately slow permeability; seasonal high water table.	Slight.
Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight	Slight	Slight	Moderate: moderately slow permeability; slope; seasonal high water table.	Slight.
Moderate: moderately slow permeability; slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: slope	Severe: slope	Severe: slope.
Moderate: moderately slow permeability; stony.	Moderate: moderately slow permeability; stony; slope.	Slight	Moderate: stony.	Slight	Moderate: moderately slow permeability; slope; stony; seasonal high water table.	Moderate: stony.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; stony.	Severe: slope	Severe: slope	Severe: slope.
Moderate: shaly.	Moderate: shaly; slope.	Moderate: bedrock at a depth of 1 to 1½ feet.	Moderate: shaly.	Moderate: shaly.	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.

TABLE 7.—*Limitations of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Buildings with basements	Lawns and landscaping	Streets and parking lots	Sanitary landfill (Trench)
GwC	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: slope; bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Moderate: slope; bedrock at a depth of 1 to 1½ feet.	Moderate: slope; bedrock at a depth of 1 to 1½ feet.	Severe: slope	Severe: bedrock at a depth of 1 to 1½ feet.
GwD	Severe: slope; bedrock at a depth of 1 to 1½ feet.	Severe: slope; bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 1 to 1½ feet.
Hazleton: HaB	Moderate: bedrock at a depth of 3½ to 5 feet.	Severe: moderately rapid permeability.	Moderate: bedrock at a depth of 3½ to 5 feet.	Slight	Moderate: hard bedrock at a depth of 3½ to 5 feet; slope.	Severe: bedrock at a depth of 3½ to 5 feet; moderately rapid permeability.
HaC	Moderate: bedrock at a depth of 3½ to 5 feet; slope.	Severe: moderately rapid permeability; slope.	Moderate: slope; bedrock at a depth of 3½ to 5 feet.	Moderate: slope.	Severe: slope	Severe: bedrock at a depth of 3½ to 5 feet; moderately rapid permeability.
HaD	Severe: slope	Severe: moderately rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 3½ to 5 feet; moderately rapid permeability.
HlD	Severe: slope	Severe: moderately rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 3½ to 5 feet; moderately rapid permeability.
Melvin: Me	Severe: flooding; high water table.	Severe: flooding.	Severe: flooding; high water table.	Severe: flooding; high water table.	Severe: flooding; high water table.	Severe: flooding; high water table.
Mine dumps: Ms. Onsite investigation required.	Variable	Variable	Variable	Variable	Variable	Variable
Pope: Pm	Moderate: flooding.	Severe: moderately rapid permeability; flooding.	Severe: flooding.	Slight	Moderate: flooding.	Severe: flooding; moderately rapid permeability.
Po	Severe: flooding.	Severe: flooding; moderately rapid permeability.	Severe: flooding.	Moderate: flooding.	Severe: flooding; moderately rapid permeability.	Severe: flooding; moderately rapid permeability.

for community development—Continued

Camp areas: Tents and camp trailers	Camp areas: Travel trailers	Buildings without basements	Paths and trails	Picnic areas	Playgrounds	Golf fairways
Moderate: shaly; slope.	Severe: slope	Moderate: bedrock at a depth of 1 to 1½ feet; slope.	Moderate: shaly.	Moderate: slope; shaly.	Severe: bedrock at a depth of 1 to 1½ feet; shaly; slope.	Severe: bedrock at a depth of 1 to 1½ feet.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; shaly.	Severe: slope	Severe: slope; bedrock at a depth of 1 to 1½ feet; shaly.	Severe: slope; bedrock at a depth of 1 to 1½ feet.
Moderate: channery.	Moderate: channery; slope.	Slight	Moderate: channery.	Moderate: channery.	Severe: channery.	Moderate: channery.
Moderate: channery; slope.	Severe: slope	Moderate: slope.	Moderate: channery.	Moderate: channery; slope.	Severe: channery; slope.	Moderate: channery; slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: channery; slope.	Severe: slope	Severe: channery; slope.	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; channery; stony.	Severe: slope	Severe: channery; slope.	Severe: slope.
Severe: high water table.	Severe: high water table.	Severe: high water table; flooding.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Variable; slope; coarse texture.	Variable; slope; coarse texture.	Variable; slope	Variable; slope; coarse texture.	Variable; slope; coarse texture.	Variable; slope; coarse texture.	Variable; slope; coarse texture.
Slight	Slight	Moderate: flooding.	Slight	Slight	Slight	Slight.
Moderate: flooding.	Moderate: flooding.	Severe: flooding.	Slight	Moderate: flooding.	Moderate: flooding.	Moderate: flooding.

TABLE 7.—*Limitations of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Buildings with basements	Lawns and landscaping	Streets and parking lots	Sanitary landfill (Trench)
Rainsboro:						
RaA	Severe: seasonal high water table; moderately slow permeability.	Slight	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
RaB	Severe: seasonal high water table; moderately slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
RaC	Severe: seasonal high water table; moderately slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table; slope.
Rayne:						
RnB	Moderate: bedrock at a depth of 3½ to 5 feet.	Moderate: slope; bedrock at a depth of 3½ to 5 feet; moderate permeability.	Moderate: bedrock at a depth of 3½ to 5 feet.	Slight	Moderate: slope.	Moderate: rippable bedrock at a depth of 3½ to 5 feet.
RnC	Moderate: bedrock at a depth of 3½ to 5 feet; slope.	Severe: slope	Moderate: slope; bedrock at a depth of 3½ to 5 feet.	Moderate: slope.	Severe: slope	Moderate: slope; bedrock at a depth of 3½ to 5 feet.
RpD	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 1½ to 3½ feet.
Steff:						
Se	Severe: flooding; seasonal high water table.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: flooding.
Sf	Moderate: seasonal high water table; flooding.	Severe: flooding.	Severe: flooding.	Slight	Moderate: seasonal high water table; flooding.	Severe: flooding.
Strip mines: Sm. Onsite investigation required.	Variable	Variable	Variable	Variable	Variable	Variable
Upshur:						
UgB	Severe: bedrock at a depth of 1½ to 3½ feet; slow permeability.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; hazard of landslides in cuts.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: slope; bedrock at a depth of 1½ to 3½ feet; hazard of landslides in cuts.	Severe: bedrock at a depth of 1½ to 3½ feet.
UgC	Severe: bedrock at a depth of 1½ to 3½ feet; slow permeability.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope; hazard of landslides in cuts.	Moderate: slope; bedrock at a depth of 1½ to 3½ feet.	Severe: slope; hazard of landslides in cuts.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.

for community development—Continued

Camp areas: Tents and camp trailers	Camp areas: Travel trailers	Buildings without basements	Paths and trails	Picnic areas	Playgrounds	Golf fairways
Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight	Slight	Slight	Moderate: seasonal high water table; moderately slow permeability.	Slight.
Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight	Slight	Slight	Moderate: moderately slow permeability; slope; seasonal high water table.	Slight.
Moderate: moderately slow permeability; slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope.
Slight	Moderate: slope.	Slight	Slight	Slight	Moderate: slope.	Slight.
Moderate: slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; stony.	Severe: slope	Severe: slope	Severe: slope.
Moderate: flooding.	Moderate: flooding.	Severe: flooding.	Slight	Moderate: flooding.	Moderate: seasonal high water table; flooding.	Moderate: flooding.
Slight	Slight	Moderate: flooding.	Slight	Slight	Moderate: seasonal high water table.	Slight.
Variable: slope; coarse texture.	Variable: slope; coarse texture.	Variable: slope	Variable: slope; coarse texture.	Variable: slope; coarse texture.	Variable; slope; coarse texture.	Variable; slope; coarse texture.
Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight	Slight	Slight	Moderate: slope; slow permeability.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: slow permeability; slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope; bedrock at a depth of 1½ to 3½ feet.

TABLE 7.—*Limitations of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Buildings with basements	Lawns and landscaping	Streets and parking lots	Sanitary landfill (Trench)
UgD	Severe: slope; bedrock at a depth of 1½ to 3½ feet; slow permeability.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.	Severe: slope; hazard of landslides in cuts.	Severe: slope	Severe: slope; hazard of landslides in cuts.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.
UgE	Severe: slope; bedrock at a depth of 1½ to 3½ feet; slow permeability.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.	Severe: slope; hazard of landslides in cuts.	Severe: slope	Severe: slope; hazard of landslides in cuts.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.
Urban land: Ur. Properties are variable. Onsite investigation required.						
Weikert: WeB	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Moderate: bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.	Moderate: slope; rippable bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.
WeC	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: slope; bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Moderate: slope; bedrock at a depth of 1 to 1½ feet.	Severe: bedrock at a depth of 1 to 1½ feet.	Severe: slope	Severe: bedrock at a depth of 1 to 1½ feet.
WkF	Severe: slope; bedrock at a depth of 1 to 1½ feet.	Severe: slope; bedrock at a depth of 1 to 1½ feet; moderately rapid permeability.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 1 to 1½ feet.
Wharton: WrB	Severe: seasonal high water table; slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
WrC	Severe: seasonal high water table; slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table; slope.
WtB	Severe: seasonal high water table; slow permeability; bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; seasonal high water table.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: slope; bedrock at a depth of 1½ to 3½ feet; seasonal high water table.	Severe: bedrock at a depth of 1½ to 3½ feet.

for community development—Continued

Camp areas: Tents and camp trailers	Camp areas: Travel trailers	Buildings without basements	Paths and trails	Picnic areas	Playgrounds	Golf fairways
Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: shaly.	Moderate: shaly; slope.	Moderate: bedrock at a depth of 1 to 1½ feet.	Moderate: shaly.	Moderate: shaly.	Severe: bedrock at a depth of 1 to 1½ feet; shaly.	Severe: bedrock at a depth of 1 to 1½ feet.
Moderate: shaly; slope.	Severe: slope	Moderate: bedrock at a depth of 1 to 1½ feet; slope.	Moderate: shaly.	Moderate: shaly; slope.	Severe: bedrock at a depth of 1 to 1½ feet; slope; shaly.	Severe: bedrock at a depth of 1 to 1½ feet.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope; shaly; bedrock at a depth of 1 to 1½ feet.	Severe: slope; bedrock at a depth of 1 to 1½ feet.
Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight	Slight	Slight	Moderate: seasonal high water table; slow permeability.	Slight.
Moderate: slow permeability; slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope.
Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight	Slight	Slight	Moderate: slope; seasonal high water table; slow permeability; bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.

TABLE 7.—*Limitations of the soils*

Soil series and map symbols	Septic tank absorption fields	Sewage lagoons	Buildings with basements	Lawns and landscaping	Streets and parking lots	Sanitary landfill (Trench)
WtC	Severe: bedrock at a depth of 1½ to 3½ feet; seasonal high water table; slow permeability.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; seasonal high water table.	Moderate: slope; bedrock at a depth of 1½ to 3½ feet.	Severe: slope	Severe: bedrock at a depth of 1½ to 3½ feet; slope.
WtD	Severe: slope; bedrock at a depth of 1½ to 3½ feet; slow permeability; seasonal high water table.	Severe: slope; bedrock at a depth of 1½ to 3½ feet.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; bedrock at a depth of 1½ to 3½ feet.
WvB	Severe: seasonal high water table; slow permeability.	Moderate: slope; bedrock at a depth of 3½ to 6 feet.	Severe: seasonal high water table; hazard of landslides in cuts.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope; hazard of landslides in cuts.	Severe: seasonal high water table.
WvC	Severe: seasonal high water table; slow permeability.	Severe: slope	Severe: seasonal high water table; hazard of landslides in cuts.	Moderate: slope; seasonal high water table.	Severe: slope; hazard of landslides in cuts; seasonal high water table.	Severe: seasonal high water table.
WvD	Severe: slope; slow permeability; seasonal high water table.	Severe: slope	Severe: slope; seasonal high water table; hazard of landslides in cuts.	Severe: slope	Severe: slope; seasonal high water table; hazard of landslides in cuts.	Severe: slope; seasonal high water table.

Crooked Creek Reservoir, 200 feet west of the main parking lot:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, nonsticky and slightly plastic; 10 percent coarse fragments; very strongly acid; clear, smooth boundary.

B2t—9 to 40 inches, brown (7.5YR 5/4) heavy loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on peds; 5 percent coarse fragments; very strongly acid; clear, smooth boundary.

IIC1—40 to 52 inches, yellowish-brown (10YR 5/4) very gravelly loam; massive; friable, nonsticky and nonplastic; some black staining; 65 percent coarse fragments; very strongly acid; abrupt, smooth boundary.

IIIC2—52 to 84 inches, gray (10YR 5/1) very shaly clay; massive; firm, sticky and plastic; 75 percent coarse fragments; very strongly acid.

The solum is 30 to 40 inches thick. The depth to the IIIC horizon ranges from 40 to 72 inches or more. Coarse fragments make up as much as 10 percent of the A and B horizons and as much as 75 percent of the C horizons. The Ap horizon is brown or dark brown to dark grayish brown. The B horizon ranges from strong brown to dark yellowish brown and is heavy loam or sandy clay loam. The IIC horizon ranges from clay loam and sandy loam to very gravelly loam.

Allegheny soils are associated with the moderately well drained Rainsboro soils. Drainage of the Allegheny soils is similar to that of the Hazleton, Rayne, Gilpin, and Weikert soils, but all of those soils are on uplands.

AlB—Allegheny silt loam, 3 to 8 percent slopes. This soil has the profile described as representative of the series. Areas of this soil range from 10 to 35 acres. Surface runoff is medium, and the hazard of erosion is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of a sandy loam soil and of nearly level Allegheny soils.

This soil is suited to the crops grown in the county. Except for the erosion hazard, this soil has few limitations for most uses. Capability unit IIe-1.

AlC—Allegheny silt loam, 8 to 15 percent slopes. This soil is similar to the one described as representative of the series, but its surface layer is about 6 inches thick.

for community development—Continued

Camp areas: Tents and camp trailers	Camp areas: Travel trailers	Buildings without basements	Paths and trails	Picnic areas	Playgrounds	Golf fairways
Moderate: slow permeability; slope.	Severe: slope	Moderate: slope.	Slight	Moderate: slope.	Severe: slope	Moderate: slope; bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope.	Severe: slope	Severe: slope	Severe: slope.
Moderate: slow permeability; seasonal high water table; moderately fine textured surface layer.	Moderate: slow permeability; slope; seasonal high water table; moderately fine textured surface layer.	Moderate: seasonal high water table.	Moderate: moderately fine textured surface layer; seasonal high water table.	Moderate: moderately fine textured surface layer; seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: slow permeability; slope; seasonal high water table; moderately fine textured surface layer.	Severe: slope	Moderate: slope; seasonal high water table.	Moderate: moderately fine textured surface layer; seasonal high water table.	Moderate: moderately fine textured surface layer; slope; seasonal high water table.	Severe: slope; seasonal high water table.	Moderate: slope; seasonal high water table.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope; seasonal high water table; moderately fine textured surface layer.	Severe: slope	Severe: slope; seasonal high water table.	Severe: slope.

Areas of this soil range from 6 to 20 acres and are irregular in shape. Surface runoff is medium, and the hazard of erosion is moderate to high if the soil is cultivated.

Included with this soil in mapping were a few areas of Rainsboro soils and a few areas of a soil that has a sandy loam profile.

This soil is suited to the crops grown in the county and to hay, pasture, trees, and wildlife. Slope is a limitation for many uses. Capability unit IIIe–1.

Cavode Series

The Cavode series consists of deep, somewhat poorly drained, gently sloping to moderately steep soils. These soils are on uplands on ridgetops, benches, and some foot slopes. They formed in material that weathered from acid clay shale interbedded with some thin siltstone. The native vegetation is mixed hardwoods that include red oak, black oak, white oak, and red maple.

In a representative profile, in a wooded area, the surface layer is very dark brown silt loam about 5 inches thick. It is covered with a 2-inch mat of decaying leaves and twigs. The subsoil extends to a depth of 30 inches. The upper 7 inches of the subsoil is mottled, yellowish-brown, friable silty clay loam. The middle part is mottled, light brownish-gray, firm silty clay loam about 14 inches thick. The lower 4 inches is mottled, light brownish-gray, friable shaly silty clay loam. The substratum, at a depth of 30 to 48 inches, is gray, firm shaly silty clay loam. Acid, gray shale is at a depth of about 48 inches.

The available moisture capacity is moderate, and permeability is slow. A seasonal water table rises to within 6 to 18 inches of the surface in wet periods. Seep areas and wet-weather springs are common. If they are adequately drained, these soils are suited to most of the crops grown in the county. Many areas of these soils have been cleared and are used for crops. Other areas are wooded or are idle and reverting to

TABLE 8.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Allegheny silt loam, 3 to 8 percent slopes	1,180	0.3
Allegheny silt loam, 8 to 15 percent slopes	2,920	.7
Cavode silt loam, 3 to 8 percent slopes	9,860	2.4
Cavode silt loam, 8 to 15 percent slopes	7,660	1.8
Cavode silt loam, 15 to 25 percent slopes	1,060	.3
Ernest silt loam, 0 to 3 percent slopes	770	.2
Ernest silt loam, 3 to 8 percent slopes	18,960	4.5
Ernest silt loam, 8 to 15 percent slopes	26,030	6.2
Ernest silt loam, 15 to 25 percent slopes	6,380	1.5
Ernest very stony silt loam, 0 to 8 percent slopes	380	.1
Ernest very stony silt loam, 8 to 25 percent slopes	1,110	.3
Gilpin-Weikert complex, 3 to 8 percent slopes	7,020	1.7
Gilpin-Weikert complex, 8 to 15 percent slopes	7,730	1.8
Gilpin-Weikert complex, 15 to 25 percent slopes	42,440	10.1
Hazleton channery loam, 3 to 8 percent slopes	5,380	1.3
Hazleton channery loam, 8 to 15 percent slopes	3,460	.8
Hazleton channery loam, 15 to 25 percent slopes	4,810	1.1
Hazleton very stony loam, 8 to 25 percent slopes	600	.1
Melvin silty clay loam	9,520	2.3
Mine dumps	910	.2
Pope fine sandy loam	1,040	.2
Pope loam	2,100	.5
Rainsboro silt loam, 0 to 3 percent slopes	1,620	.4
Rainsboro silt loam, 3 to 8 percent slopes	6,480	1.5
Rainsboro silt loam, 8 to 15 percent slopes	3,270	.8
Rayne silt loam, 3 to 8 percent slopes	23,640	5.6
Rayne silt loam, 8 to 15 percent slopes	19,530	4.7
Rayne-Gilpin very stony silt loams, 8 to 25 percent slopes	1,290	.3
Steff loam	5,520	1.3
Steff loam, high bottom	850	.2
Strip mines	23,380	5.6
Upshur-Gilpin silt loams, 3 to 8 percent slopes	370	.1
Upshur-Gilpin silt loams, 8 to 15 percent slopes	520	.1
Upshur-Gilpin silt loams, 15 to 25 percent slopes	730	.2
Upshur-Gilpin silt loams, 25 to 35 percent slopes	490	.1
Urban land	1,740	.4
Weikert shaly silt loam, 3 to 8 percent slopes	3,140	.7
Weikert shaly silt loam, 8 to 15 percent slopes	1,600	.4
Weikert and Gilpin soils, 25 to 70 percent slopes	114,010	27.2
Wharton silt loam, 3 to 8 percent slopes	13,460	3.2
Wharton silt loam, 8 to 15 percent slopes	7,310	1.7
Wharton-Gilpin silt loams, 3 to 8 percent slopes	3,060	.7
Wharton-Gilpin silt loams, 8 to 15 percent slopes	7,820	1.9
Wharton-Gilpin silt loams, 15 to 25 percent slopes	10,290	2.5
Wharton-Vandergrift complex, 3 to 8 percent slopes	1,190	.3
Wharton-Vandergrift complex, 8 to 15 percent slopes	1,780	.4
Wharton-Vandergrift complex, 15 to 25 percent slopes	540	.1
Water	4,890	1.2
Total	419,840	100.0

woodland. The seasonal water table, slow permeability, and slope are limitations for some uses.

Representative profile of Cavode silt loam, 3 to 8 percent slopes, in a wooded area 1½ miles north of Tidal along Route T490:

O2—2 to 1 1/2 inches, recent leaf litter.

O1—1 1/2 inches to 0, black (N 2/0) partly decayed leaf litter.

A1—0 to 5 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; very friable, slightly sticky and nonplastic; very strongly acid; gradual, smooth boundary.

B21t—5 to 12 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine, faint, brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; friable, slightly sticky and plastic; thin, discontinuous clay films on peds; 5 percent shale fragments; very strongly acid; gradual, wavy boundary.

B22tg—12 to 26 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; thick, continuous clay films on peds; 10 percent shale fragments; very strongly acid; gradual, wavy boundary.

B3g—26 to 30 inches, light brownish-gray (2.5Y 6/2) shaly silty clay loam; many, medium, distinct, gray (10YR 5/1) and strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; friable, sticky and plastic; 20 percent shale fragments; very strongly acid; gradual, wavy boundary.

Cg—30 to 48 inches, gray (5Y 6/1) shaly silty clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/8) mottles; masive; firm, slightly sticky and plastic; 40 percent shale fragments; very strongly acid; clear, wavy boundary.

R—48 inches +, acid, gray shale bedrock.

The solum is 30 to 52 inches thick. The depth to bedrock ranges from 40 to 72 inches. Coarse fragments make up as much as 15 percent of the A1 and B2 horizons and 10 to 80 percent of the B3g and Cg horizons. In some places, there is an Ap horizon that is dark grayish brown to brown. The B horizon ranges from silty clay loam to clay. Mottles in the B horizon range from gray to yellowish brown and yellowish red. The B21t horizon is brown to yellowish brown. The B22tg and B3g horizons are gray to light brownish gray.

Cavode soils occur near the deep, well drained Rayne soils; the moderately deep, well drained Gilpin soils; the shallow, well drained Weikert soils; and the deep, moderately well drained Wharton soils. Drainage of the Cavode soils is similar to that of the Vandergrift and Ernest soils, but the Vandergrift soils have a reddish B horizon and the Ernest soils have a Bx horizon.

CaB—Cavode silt loam, 3 to 8 percent slopes. This soil has the profile described as representative of the series. It is on ridgetops and benches in areas 8 to 30 acres in size. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of soils that are medium acid to neutral in the substratum. Also included were some areas of a Cavode soil that has many stones scattered on the surface. These areas are indicated on the detailed soil map by the symbol for very stony areas. Also included were small areas of Wharton soils.

This soil is suited to crops that tolerate wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. A seasonal water table and slow permeability are limitations for many uses. Capability unit IIIw–2.

CaC—Cavode silt loam, 8 to 15 percent slopes. This soil has a profile similar to the one described as representative of the series, but it is not so deep to bedrock. Areas of this soil range from 6 to 20 acres, are irregular in shape, and are on benches and side slopes. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of soils that are medium acid to neutral in the substratum. Also included were some areas of a Cavode soil that has many stones scattered on the surface. These areas are shown on the soil map by the symbol for very stony areas. Also included were small areas of Wharton soils.

This soil is suited to crops that tolerate wetness and to trees and wildlife. Artificial drainage increases the range of suitable crops. A seasonal water table and slow permeability are limitations for many uses. Capability unit IIIe–4.

CaD—Cavode silt loam, 15 to 25 percent slopes. This soil is similar to the one described as representative of the series, but its surface layer has about 10 percent shale fragments. Areas of this soil range from 4 to 15 acres, are irregular in shape, and are on hillsides and some toe slopes. Surface runoff is rapid, and the erosion hazard is high if the soil is cultivated.

Included with this soil in mapping were some small areas of Wharton soils and a few areas of very stony Cavode soils.

This soil is suited to crops that require limited cultivation and that tolerate some wetness. It is also suited to trees and wildlife. Artificial drainage increases its suitability for a wider range of crops. A seasonal water table, slow permeability, and slope are limitations for most uses. Capability unit IVe–3.

Ernest Series

The Ernest series consists of deep, moderately well-drained, nearly level to moderately steep soils. These soils formed in colluvial material that weathered from acid gray shale, siltstone, and some fine sandstone. This material moved downslope from nearby uplands mainly to foot slopes and benches. The native vegetation consists of mixed hardwoods, including oaks, red maple, some sugar maple, black cherry, and hemlock.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of 50 inches. In the upper 7 inches, the subsoil is yellowish-brown, friable heavy silt loam. The part below that is mottled, strong-brown, friable light silty clay loam about 9 inches thick. The next part is mottled, brown, firm and brittle shaly heavy silt loam about 12 inches thick. In the lowermost part, the subsoil is mottled, brown, very firm and brittle, shaly heavy silt loam about 14 inches thick. The substratum, between depths of 50 and 74 inches or more, is yellowish-brown, firm shaly silt loam.

The available moisture capacity is moderate, and permeability is moderately slow. A seasonal water table rises to within 18 to 36 inches of the surface in wet periods. If these soils are adequately drained, they are suited to most of the crops grown in the county. Most areas of these soils have been cleared and are used for crops. A few areas are wooded or are idle and reverting to woodland. The seasonal water table, moderately slow permeability, and slope are limitations for many uses.

Representative profile of Ernest silt loam, 8 to 15 percent slopes, in a pasture 2½ miles north of Spring Church at the intersection of Routes T460 and T349:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; 5 percent coarse fragments; very strongly acid; clear, smooth boundary.

B1t—8 to 15 inches, yellowish-brown (10YR 5/4) heavy silt loam; moderate, medium and fine, subangular blocky structure; friable, sticky and plastic; thin, discontinuous clay films on peds; 5 percent shale fragments; very strongly acid; clear, wavy boundary.

B2t—15 to 24 inches, strong-brown (7.5YR 5/6) light silty clay loam; few, medium, faint, yellowish-brown (10YR 5/6) and pinkish-gray (7.5YR 6/2) mottles; moderate, medium and coarse, subangular blocky structure; friable, sticky and plastic; thick, continuous clay films on peds; 10 percent shale fragments; very strongly acid; clear, smooth boundary.

Bx1—24 to 36 inches, brown (7.5YR 5/4) shaly heavy silt loam; many, prominent, medium and coarse, pinkish-gray (7.5YR 6/2) and yellowish-brown (10YR 5/6) mottles; strong, very coarse, prismatic structure parting to subangular blocky; firm, brittle, sticky and plastic; thick, discontinuous clay films on peds; 20 percent shale fragments; very strongly acid; clear, smooth boundary.

Bx2—36 to 50 inches, brown (10YR 5/3) shaly heavy silt loam; many, medium to coarse, prominent, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/4 and 10YR 5/6) mottles; strong, very coarse, prismatic structure; very firm, brittle, sticky and plastic; thick, continuous clay films on peds; 20 percent shale fragments; very strongly acid; clear, wavy boundary.

C—50 to 74 inches, yellowish-brown (10YR 5/6) shaly silt loam; massive; firm, slightly sticky and nonplastic; 30 percent shale fragments; very strongly acid; clear, wavy boundary.

The solum is 36 to 60 inches thick. The depth to the Bx horizon ranges from 20 to 28 inches. The depth to bedrock is more than 6 feet. Coarse fragments make up 5 to 20 percent of the B1t and B2t horizons and as much as 30 percent of the Bx and C horizons. The Ap horizon is brown, dark brown, dark grayish brown, or dark yellowish brown. The soil material above the Bx1 horizon is silt loam or silty clay loam. The Bx horizon is silt loam, silty clay loam, or clay loam. The C horizon ranges from silt loam to silty clay.

Ernest soils are near the deep, well drained Rayne soils; the moderately deep, well drained Gilpin soils; the shallow, well drained Weikert soils; the deep, moderately well drained Wharton soils; and the deep, somewhat poorly drained Cavode soils. Drainage of the Ernest soils is similar to that of the deep, moderately well drained to somewhat poorly drained Vandergrift soils and the deep, moderately well drained Rainsboro soils. In contrast to Ernest soils, the Wharton and Vandergrift soils lack a Bx horizon, and the Rainsboro soils occupy terraces and have fewer coarse fragments in the upper B horizon.

EnA—Ernest silt loam, 0 to 3 percent slopes. This soil has a profile similar to the one described as repre-

***Figure 10.*—Ernest silt loam, 3 to 8 percent slopes, is in the foreground, and beyond the trees is Gilpin channery silt loam, 15 to 25 percent slopes.**

sentative of the series, but its surface layer is generally thicker. Areas of this soil range from 10 to 35 acres and occupy toe slopes and some benches. Runoff is slow, and the hazard of erosion is slight.

Included in mapping were some wet areas where the water table is closer to the surface and remains there for a longer period. Soils in these areas are mottled with strong brown, brown, or reddish yellow in the upper part of the subsoil. They are shown on the soil map by the symbol for wet spots.

This soil is suited to crops that tolerate some wetness and to trees and wildlife. Artificial drainage can make the soil suitable for a wider range of crops. A seasonal water table and moderately slow permeability are limitations for many uses. Capability unit IIw–2.

EnB—Ernest silt loam, 3 to 8 percent slopes. This soil has a profile similar to the one described as representative of the series, but the upper part of its subsoil is generally slightly thinner. Areas of this soil range from 6 to 20 acres and occupy lower slopes and benches (fig. 10). Runoff is medium, and the hazard of erosion is moderate if the soil is cultivated.

Included with this soil in mapping were some wet areas of soils in which the water table is closer to the surface and remains there for a longer period. In these wet areas the upper part of the subsoil is mottled with strong brown, brown, or reddish yellow. The areas are shown on the soil map by the symbol for wet spots. Also included were some small areas of soils that are coarser textured throughout their profile.

This soil is suited to crops that tolerate some wetness and to trees and wildlife. Artificial drainage can make the soil suitable to a wider range of crops. A seasonal water table and moderately slow permeability are limitations for many uses. Capability unit IIe–3.

EnC—Ernest silt loam, 8 to 15 percent slopes. This soil has the profile described as representative of the series. Areas of this soil range from 6 to 25 acres and occupy benches and lower slopes. Runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included in mapping were a few seep areas that are shown on the soil map by the symbol for a wet spot. Also included were some small areas of soil that is coarser textured throughout the profile.

This soil is suited to crops that tolerate some seasonal wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. A seasonal water table and moderately slow permeability are limitations for many uses. Capability unit IIIe–4.

EnD—Ernest silt loam, 15 to 25 percent slopes. This soil is similar to the one described as representative of the series, but its depth to bedrock is generally 4 to 8 inches less and it has more coarse fragments in the subsoil. Areas of this soil range from 10 to 35 acres and occupy lower foot slopes. Runoff is medium to rapid, and the erosion hazard is high if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that is not so deep to bedrock and some small areas of a soil that has a higher content of sand.

This soil is suited to crops that require limited cultivation and that tolerate some wetness. It is also suited to hay, pasture, trees, and wildlife. Slope, a seasonal water table, and moderately slow permeability are limitations for most uses. Capability unit IVe–3.

ErB—Ernest very stony silt loam, 0 to 8 percent slopes. This soil is similar to the one described as representative of the series, but its surface layer is covered by a 1- to 2-inch layer of decaying leaves and twigs. Stones cover 2 to 10 percent of the surface. Areas of this soil range from 10 to 20 acres and occupy benches and depressions in woodlands. Runoff is slow to medium and the erosion hazard is moderate if the soil is cleared.

Included in mapping were a few areas of a soil in which the water table is nearer the surface in wet seasons. These areas are shown on the soil map by the symbol for a wet spot.

This soil is well suited to most hardwoods and conifers that tolerate some wetness. It also is suited to recreation uses and wildlife. Stones, a seasonal water table, and moderately slow permeability limit these soils for most uses. Capability unit VIs–1.

ErD—Ernest very stony silt loam, 8 to 25 percent slopes. This soil is similar to the one described as representative of the series, but its surface layer is covered by a 1- to 2-inch layer of decaying leaves and twigs. Stones cover 2 to 10 percent of the surface. Areas of this soil range from 12 to 30 acres, are irregular in shape, and occupy benches and foot slopes. Runoff is slow to rapid, and the erosion hazard is moderate to high if the soil is cleared.

Included with this soil in mapping were a few small areas of a soil that has more sand throughout the profile than typical Ernest soils.

This soil is suited to most hardwoods and conifers that tolerate some wetness. It also is suited to recreation uses and wildlife. Slope, stones, a seasonal water table, and moderately slow permeability are limitations for most uses. Capability VIs–1.

Gilpin Series

The Gilpin series consists of moderately deep, well-drained, gently sloping to very steep soils on uplands. These soils formed in material that weathered from acid shale, siltstone, and fine-grained sandstone. They occur primarily on ridgetops and side slopes in dissected uplands. The native vegetation consists of hardwoods, mainly mixed oaks and red maples. Some black cherry and tulip-poplar are also present.

In a representative profile, in a pasture, the surface layer is dark-brown silt loam about 4 inches thick. The subsoil is yellowish brown and 22 inches thick. The upper part of the subsoil is silt loam, and the lower part is heavy silt loam. The substratum is yellowish-brown, friable shaly silt loam 8 inches thick. Grayish-brown, rippable shale bedrock is at a depth of about 34 inches.

The available moisture capacity and permeability are moderate. Some areas of these soils have been cleared and are used for hay, pasture, and crops. Other areas are idle or reverting to woodland. The steep and very steep soils are wooded. Moderate depth to bedrock and slope are limitations for most uses.

Representative profile of Gilpin silt loam, in an area of Gilpin-Weikert complex, 8 to 15 percent slopes, in a pasture on the west side of Route 03021, 3 miles southeast of Cowansville and 2 miles northwest of the Allegheny River:

A1—0 to 4 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, granular structure; very friable, slightly sticky and nonplastic; 5 percent coarse fragments; strongly acid; clear, smooth boundary.

B21—4 to 9 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; 5 percent coarse fragments; strongly acid; gradual, wavy boundary.

B22t—9 to 26 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces; 10 percent coarse fragments; strongly acid; gradual, wavy boundary.

C—26 to 34 inches, yellowish-brown (10YR 5/6) shaly silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; 30 percent coarse fragments; very strongly acid; gradual, wavy boundary.

R—34 inches +, grayish-brown, rippable shale bedrock.

The solum is 20 to 30 inches thick. The depth to bedrock ranges from 20 to 40 inches. Coarse fragments make up 5 to 40 percent of the solum and 30 to 90 percent of the C horizon. The Al horizon ranges from black to dark brown and from silt loam to channery loam or shaly silt loam. In some places, there is an Ap horizon that is brown to dark brown. The B21t horizon ranges from yellowish brown to strong brown and is heavy silt loam, heavy loam, or light silty clay loam. The C horizon ranges from shaly silt loam to channery or very channery loam.

Gilpin soils occur near the deep, well drained Rayne soils; the deep, moderately well drained Wharton soils; the shallow, well drained Weikert soils; and the deep, somewhat poorly drained Cavode soils. The Gilpin soils have drainage similar to that of the Hazleton soils but have less sand in the B horizon.

GwB—Gilpin-Weikert complex, 3 to 8 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Gilpin soil makes up about 50 to 55 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but its surface layer is silt loam about 8 inches thick. The Weikert soil makes up about 35 to 40 percent of the complex. It has a profile similar to the one described as representative of the Weikert series, but it has a thicker subsoil. These soils occur on ridges and on knobs in areas 4 to 10 acres in size. Surface runoff is medium, and the hazard of erosion is moderate if the soils are cultivated.

Included with these soils in mapping were a few areas of Rayne soils.

Soils of this complex are suited to crops that tolerate some droughtiness and to pasture (fig. 11), hay, trees, and wildlife. Moderate depth to bedrock is the major limitation for use of the Gilpin soil. Coarse fragments

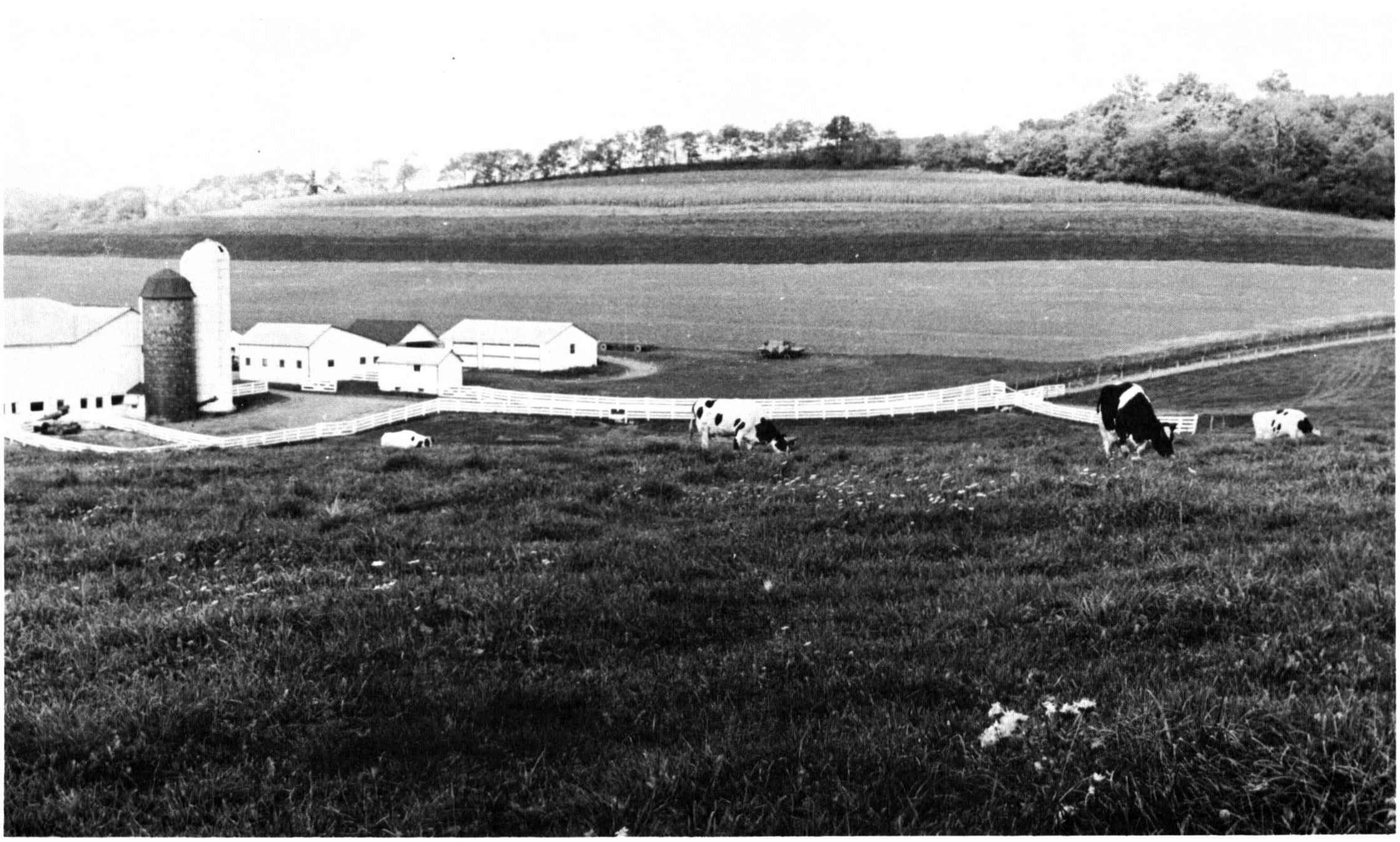

Figure 11.—**Pasture in the foreground is on the Gilpin-Weikert complex, 3 to 8 percent slopes. The buildings are on Ernest silt loam, 8 to 15 percent slopes, and the stripcropping in the background is on the Gilpin-Weikert complex, 15 to 25 percent slopes.**

and depth to bedrock are limitations of the Weikert soil for many uses. Capability unit IIe–2.

GwC—Gilpin-Weikert complex, 8 to 15 percent slopes. These soils are so intermingled that it was neither practical nor feasible to map them separately. The Gilpin soil makes up about 50 to 55 percent of the complex. It has the profile described as representative of the Gilpin series. The Weikert soil, makes up about 35 to 40 percent of the complex. These soils occur on ridges and hillsides in irregularly shaped areas, 6 to 20 acres in size. Surface runoff is medium, and hazard of erosion is moderate if the soils are cultivated.

Included with these soils in mapping were a few small areas of Rayne soils.

Soils of this complex, are suited to crops that tolerate some droughtiness and to pasture, hay, trees, and wildlife. Moderate depth to bedrock and slope are the major limitations of the Gilpin soil. Coarse fragments, slope, and depth to bedrock are limitations of the Weikert soil for most uses. Capability unit IIIe–2.

GwD—Gilpin-Weikert complex, 15 to 25 percent slopes. These soils are so intermingled that it was neither practical nor feasible to map them separately. The Gilpin soil makes up about 40 to 55 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but it is not so deep to bedrock. The Weikert soil makes up about 35 to 50 percent of the complex. It has a profile similar to the one described as representative of the Weikert series, but its surface layer is thinner and has more thin, flat fragments of sandstone. Areas of these soils are long and narrow and range from 12 to 40 acres. Surface runoff is rapid, and the hazard of erosion is high if these soils are cultivated.

Included with these soils in mapping were a few areas of steep Gilpin and Weikert soils and a few small areas of Rayne soils.

Soils of this complex are suited to crops that tolerate some droughtiness and to hay, pasture, trees, and wildlife. Slope and moderate depth to bedrock are the major limitations of the Gilpin soil. Coarse fragments, slope, and shallow depth to bedrock are limitations of the Weikert soil for most uses. Capability unit IVe–2.

Hazleton Series

The Hazleton series consists of deep, well-drained, gently sloping to moderately steep soils on uplands. These soils formed in material that weathered from acid, gray and brown sandstone. They are mainly on ridgetops and hillsides in dissected areas. The native vegetation is red oak, black oak, white oak, scarlet oak, red maple, black cherry, and sassafras.

In a representative profile, in a cultivated area, the surface layer is dark-brown channery loam about 7 inches thick. The subsoil extends to a depth of 36 inches. In the upper 10 inches it is dark yellowish-brown, friable channery loam. In the lower 19 inches it is yellowish-brown, friable very channery loam. The substratum extends to a depth of 48 inches; it is yellowish-brown, very channery loamy sand. Grayish-brown fractured sandstone is at a depth below 48 inches.

The available moisture capacity is low to moderate, and permeability is moderately rapid. Some areas of these soils have been cleared and are used for crops, hay, and pasture. Other areas are idle or reverting to woodland. The steeper areas are wooded. Steep slopes limit these soils for most uses.

Representative profile of Hazleton channery loam, 3 to 8 percent slopes, in a cultivated area, 2 miles northwest of Cowansville:

Ap—0 to 7 inches, dark-brown (10YR 3/3) channery loam; weak, fine, granular structure; very friable, slightly sticky and nonplastic; 15 percent coarse fragments; very strongly acid; abrupt, smooth boundary.

B2—7 to 17 inches, dark yellowish-brown (10YR 4/4) channery loam; moderate, coarse, subangular blocky structure; friable, nonsticky and nonplastic; 30 percent coarse fragments; extremely acid; clear, wavy boundary.

B3—17 to 36 inches, yellowish-brown (10YR 5/4) very channery loam; weak, medium, subangular blocky structure; friable, slightly sticky and nonplastic; 60 percent coarse fragments; extremely acid; gradual, wavy boundary.

C—36 to 48 inches, yellowish-brown (10YR 5/6) very channery loamy sand; single grained; loose; 80 percent coarse fragments; extremely acid; gradual, wavy boundary.

R—48 inches +, grayish-brown, fractured sandstone.

The solum is 25 to 40 inches thick. The depth to bedrock ranges from 40 to 60 inches. Coarse fragments make up 15 to 70 percent of the A and B horizons and 35 to 80 percent of the C horizon. The Ap horizon is dark brown to dark grayish brown. The B horizon is brown to dark yellowish brown. The B2 horizon is loam or sandy loam, and the B3 and C horizons range from loam to loamy sand.

Hazleton soils are similar in drainage to the deep Rayne soils, the moderately deep Gilpin soils, and the shallow Weikert soils. Unlike the Rayne soils, they lack a Bt horizon, and they are less silty and more sandy. Hazleton soils are deeper to bedrock than the Gilpin and Weikert soils.

HaB—Hazleton channery loam, 3 to 8 percent slopes. This soil has the profile described as representative of the series. It is on ridges in areas that are 8 to 20 acres in size. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that is less than 40 inches deep to bedrock. Also included were some areas of Hazleton soils that have many stones scattered on the surface. These areas are indicated on the soil map by the symbol for very stony areas.

This soil is suited to the crops grown in the county and to trees and wildlife. It has few limitations for most uses. Capability unit IIe–1.

HaC—Hazleton channery loam, 8 to 15 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface layer generally is about 2 inches thinner. This soil is on ridges and benches in areas that range from 10 to 20 acres. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that is less than 40 inches deep to bedrock.

This soil is suited to most of the crops grown in the county and to trees and wildlife. Slope is the major limitation for most uses. Capability unit IIIe–1.

HaD—Hazleton channery loam, 15 to 25 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface layer is a few inches thinner and it is not so deep to bedrock. Areas of this soil range from 10 to 60 acres. They are irregular in shape and on hillsides. Surface runoff is rapid, and the erosion hazard is severe if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that is less than 40 inches deep to bedrock.

This soil is suited to limited cultivation and to hay, pasture, trees, and wildlife. Coarse fragments and slope are limitations for many uses. Capability unit IVe–1.

HlD—Hazleton very stony loam, 8 to 25 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface is covered by a 2-inch layer of decaying leaves and twigs and 5 to 10 percent of this surface material is covered by stones. Areas of this soil, on hillsides, range from 5 to 60 acres and are irregular in shape. All areas are wooded.

Included with this soil in mapping were a few acres of a soil that is less than 40 inches deep to bedrock.

This soil is suited to pasture, trees, and wildlife. Slope and stones are limitations for most uses. Capability unit VIs–1.

Melvin Series

The Melvin series consists of deep, poorly drained, nearly level soils on flood plains. These soils formed in alluvium that derived from shale, siltstone, sandstone, and some limestone. The native vegetation consists of alder, sycamore, and spice bush.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown, silty clay loam about 9 inches thick. The subsoil, between depths of 9 and 35 inches, is mottled, grayish-brown, firm silty clay loam. The substratum extends to a depth of 60 inches. In the upper 9 inches the substratum is mottled, grayish-brown, firm clay loam; in the middle part it is mottled, grayish-brown, firm loam about 8 inches thick; and in the lower 8 inches it is mottled, dark-brown, friable, very gravelly sandy clay loam.

The available moisture capacity is high, and permeability is moderate. These soils have a water table at or near the surface during much of the year. Flooding by stream overflow is most common late in winter or early in spring. Most areas are idle, but some are used for crops, hay, or pasture. The high water table and flooding are limitations for most uses.

Representative profile of Melvin silty clay loam, in a cultivated field, 2 miles east of Kittanning along Cowanshannock Creek in Rayburn Township [Sample No. S68–Pa–03–3 (1–6) in tables 10 and 11 in the section "Laboratory Data." Engineering data are reported in table 5 under Pennsylvania report numbers 68–20497 and 68–20498]:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silty clay loam; moderate, medium, granular structure;

firm, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.

B21g—9 to 22 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; moderate, medium and coarse, prismatic structure; firm, slightly sticky and plastic; a few 3- and 4-inch-wide pockets of material from the Ap horizon in the upper part; medium acid; clear, wavy boundary.

B22g—22 to 35 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, prismatic structure; firm, sticky and plastic; slightly acid; clear, wavy boundary.

C1g—35 to 44 inches, grayish-brown (10YR 5/2) clay loam; many, medium, strong-brown (7.5YR 5/6) mottles; massive; firm, sticky and plastic; slightly acid; clear, wavy boundary.

C2g—44 to 52 inches, grayish-brown (10YR 5/2) loam; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; massive; firm, slightly sticky and plastic; slightly acid; clear, wavy boundary.

IIC3—52 to 60 inches, dark-brown (10YR 4/3) very gravelly sandy clay loam; many, medium, distinct, grayish-brown (10YR 5/2) and strong-brown (7.5YR 5/6) mottles; massive; friable, slightly sticky and plastic; few, thin, discontinuous clay films in pores and few thin patches on top of pebbles; common black coatings; 70 percent coarse fragments; neutral.

The solum is 25 to 40 inches thick. The depth to bedrock ranges from 4 to more than 20 feet. Reaction is medium acid to neutral in the upper part of the solum, and slightly acid or neutral in the loam part and in the C horizon. The Ap horizon ranges from dark gray to dark brown and is 6 to 10 inches thick. The B horizon ranges from dark gray to grayish brown and from silt loam to silty clay loam. The C horizon, below a depth of 40 inches, commonly has stratified layers of clay, silt, sand, or gravel.

Melvin soils are near the deep, moderately well drained Steff soils and the deep, well drained Pope soils on the flood plains.

Me—Melvin silty clay loam. This nearly level soil is the only Melvin soil in the county. It is on flood plains. Surface runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping were a few areas of somewhat poorly drained soils. Also included were a few areas of a soil that is not subject to flooding and that has a fine-textured subsoil.

This soil is suited to crops that tolerate wetness and to hay, pasture, trees, and wildlife. A high water table and flooding are limitations for most uses. Capability unit IIIw-1.

Mine Dumps

Ms—Mine dumps. This land type consists of piles of low-grade coal, carbonaceous shale, and ash from deep mining operations. These piles vary in size and shape but commonly are cone-shaped with a nearly level to very steep slope. Mine dumps are extremely acid and generally lack vegetation. They are highly susceptible to erosion and are a source of sediment that pollutes streams. Furthermore, the leach water contains high amounts of iron and sulphur. Areas of Mine dumps are difficult to revegetate because few plants can survive the extreme acidity of the material. Mine dumps may have some use as fill, but they are not suited for use as construction sites. Not placed in a capability unit.

Pope Series

The Pope series consists of deep, well-drained, nearly level soils on flood plains. These soils formed in alluvium that derived from shale, siltstone, and sandstone. The native vegetation is mixed hardwoods, mainly oaks, maple, tulip-poplar, and black cherry and some hemlock and white pine.

In a representative profile, in a cultivated area, the surface layer is dark yellowish-brown loam about 8 inches thick. The subsoil is yellowish brown; between depths of 8 and 26 inches it is friable loam and between depths of 26 and 42 inches it is very friable fine sandy loam. The substratum is brown, loose gravelly loamy sand that extends to a depth of 60 inches.

The available moisture capacity is high, and permeability is moderately rapid. These soils are well suited to all crops grown in the county, especially truck crops and other specialty crops. Most areas of these soils have been cleared and are used for crops, urban development, hay, pasture, and recreation, but a few areas are idle. Flooding by stream overflow limits these soils for many uses.

Representative profile of Pope loam, in an abandoned field, 1 mile northwest of Washington along Buffalo Creek:

Ap—0 to 8 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, granular structure; very friable, nonsticky and slightly plastic; many roots; 5 percent gravel; strongly acid; abrupt, smooth boundary.

B21—8 to 26 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common roots; 2 percent gravel; strongly acid; clear, wavy boundary.

B22—26 to 42 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, fine, subangular blocky structure; very friable, nonsticky and nonplastic; few roots; 5 percent gravel; strongly acid; clear, smooth boundary.

IIC—42 to 60 inches, brown (10YR 4/3) gravelly loamy sand; single grained; loose; 40 percent gravel; strongly acid.

The solum is 30 to 50 inches thick. The depth to bedrock is more than 5 feet. The Ap horizon is loam or fine sandy loam and ranges from grayish brown to dark yellowish brown. The B horizon ranges from sandy loam to silt loam and from brown to reddish yellow. Thin, stratified layers of coarser material are common. The IIC horizon is sandy loam or sandy clay loam, and at a depth below 40 inches, includes loamy sand. Stratified layers are common.

Pope soils are near the moderately well drained Steff soils and the poorly drained Melvin soils. They are similar in drainage to the Allegheny, Rayne, Hazleton, Gilpin, and Weikert soils; all of these soils are on uplands, except the Allegheny soils. The Allegheny soils are on terraces and are not subject to flooding.

Pm—Pope fine sandy loam. This soil has a profile similar to the one described as representative of the series, but it has more sand. Areas of this nearly level soil are 10 to 20 acres in size and, in contrast to Pope loam, are in the higher places on the flood plains. Flooding is less frequent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping were some areas of a gently sloping soil.

This Pope soil is well suited to all crops grown in the county and to hay, pasture, and trees. The hazard of flooding is the major limitation for use of this soil. Capability unit I-1.

Po—Pope loam. This soil has the profile described as representative of the series. It is on the flood plains in areas that are 4 to 8 acres in size. Surface runoff is slow, and the erosion hazard is slight.

Included in mapping were a few small areas of moderately well drained Steff soils.

This soil is well suited to hay and pasture and to crops that are fully grown before streams overflow. It is especially well suited to truck crops. Flooding limits this soil for most uses. Capability unit I–1.

Rainsboro Series

The Rainsboro series consists of deep, moderately well drained, nearly level to sloping soils on undulating to rolling stream terraces. These soils formed in loess and underlying loamy sediment that commonly grades to sandy or gravelly material. The native vegetation consists of mixed hardwoods, mainly oaks, ash, black cherry, and yellow-poplar.

In a representative profile, in a cultivated area, the plow layer is dark grayish-brown silt loam 8 inches thick. The subsoil is yellowish-brown silt loam that extends to a depth of 60 inches. In the upper 13 inches the subsoil is friable, in the next 7 inches it is mottled and firm, and in the lower 32 inches it is mottled, firm to very firm, and brittle (a fragipan). The substratum is between depths of 60 and 70 inches or more. The upper part is strong-brown, friable clay loam, and the lower part is yellowish-red, friable sandy clay loam.

The available moisture capacity is moderate, and permeability is moderately slow. A seasonal water table rises to within 18 inches of the surface in wet periods. If the soils are adequately drained, they are suited to most of the crops grown in the county. Most areas have been cleared and are used for crops. Some areas have been quarried for sand and gravel. The seasonal water table and moderately slow permeability are limitations for many uses.

Representative profile of Rainsboro silt loam, 0 to 3 percent slopes, in a hayfield, 3½ miles southwest of West Mosgrove and 1½ miles north of the Allegheny River [Sample No. S68Pa–03–11–(1–9) in tables 10 and 11 in the section "Laboratory Data." Engineering data are reported in table 5 under Pennsylvania report numbers 68–20511 and 68–20512]:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; friable, slightly sticky and slightly plastic; medium acid; abrupt, smooth boundary.

B21t—8 to 15 inches, yellowish-brown (10YR 5/6) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few thin clay films on ped faces and many in pores; some material from the Ap horizon in pores and on ped faces; medium acid; clear, wavy boundary.

B22t—15 to 21 inches, yellowish-brown (10YR 5/6) silt loam; few, faint, light-gray (10YR 7/2) skeletons on ped faces; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common thin clay films on ped faces and in pores; thin iron and manganese coatings; medium acid; clear, wavy boundary.

B23t—21 to 28 inches, yellowish-brown (10YR 5/6) silt loam; few, fine, distinct, pale-brown (10YR 6/3), light-gray (10YR 7/1), and pinkish-gray (7.5YR 6/2) mottles; light yellowish-gray (10YR 6/2) and light-gray (10YR 7/2) prism faces; weak, coarse, prismatic structure parting to weak, thin, platy; firm in place, friable when displaced, slightly sticky and slightly plastic; moderately thick clay films on ped faces; few thin iron and manganese coatings; strongly acid; clear, smooth boundary.

Bx1—28 to 40 inches, yellowish-brown (10YR 5/6) silt loam; few, fine, faint, strong-brown (7.5YR 5/6) and pale-brown (10YR 6/3) mottles; pinkish-gray (7.5YR 6/2) prism faces; moderate, very coarse, prismatic structure parting to thick, platy; firm, brittle, slightly sticky and slightly plastic; thick clay films on peds; few thin iron and manganese coatings; few rounded pebbles, 1/4 inch to 3 inches; very strongly acid; clear, wavy boundary.

IIBx2—40 to 50 inches, yellowish-brown (10YR 5/4) silt loam; light-gray (10YR 7/1) and dark grayish-brown (10YR 4/2) prism faces; moderate, very coarse, prismatic structure; very firm, brittle, slightly sticky and slightly plastic; thick clay films in pores and on prism faces; few thin iron and manganese coatings; 5 percent rounded pebbles, 1/4 inch to 3 inches in size; strongly acid; diffuse, wavy boundary.

IIBx3—50 to 60 inches, yellowish-brown (10YR 5/4) silt loam; light-gray (10YR 7/1) and dark grayish-brown (10YR 4/2) prism faces; moderate, very coarse, prismatic structure; very firm, brittle, slightly sticky and slightly plastic; thick clay films in pores, but thin on ped faces; few thin iron and manganese coatings; 10 percent gravel, 1/2 inch to 2 inches in size; strongly acid; clear, wavy boundary.

IIC1—60 to 70 inches, strong-brown (7.5YR 5/8) clay loam; few fine, faint, yellowish-red clay films; weak, very coarse, prismatic structure parting to weak, medium, platy; friable, slightly sticky and plastic; thick, reddish clay films on prism faces; few thin iron and manganese coatings; 10 percent gravel, up to 3 inches in size; strongly acid; clear, wavy boundary.

IIC2—70 inches +, yellowish-red (5YR 4/8) sandy clay loam; weak, thin, platy structure; friable, slightly sticky and nonplastic; thick iron and manganese coatings; 10 percent gravel, up to 2 inches in size; very strongly acid.

The solum is 60 to 80 inches thick. The depth to the fragipan ranges from 22 to 34 inches. The Ap horizon is dark grayish brown to dark brown. The B2t horizon is silt loam or silty clay loam and has less than 2 percent coarse fragments. It ranges from yellowish brown to dark brown and is commonly mottled with yellowish brown, brown, strong brown, or light gray. Grayish mottles occur below the upper 10 inches of the B2t horizon. The Bx horizon matrix ranges from yellowish brown to strong brown. Grayish and brownish mottles are common in the Bx horizon. The C horizon generally is loamy, but in some places it is stratified sand and gravel.

Rainsboro soils are near the deep, well-drained Allegheny soils. They are similar in drainage to the deep Wharton, Steff, and Ernest soils. In contrast to Rainsboro soils, Ernest soils have more coarse fragments in the upper B horizon, Steff soils are on flood plains, and Wharton soils are on uplands.

RaA—Rainsboro silt loam, 0 to 3 percent slopes. This soil has the profile described as representative of the series. It is on broad terraces in areas 12 to 35 acres in size. Runoff is slow to medium, and the erosion hazard is slight.

Included with this soil in mapping were some areas of Allegheny soils. Also included were some areas of a soil that has a seasonal water table that rises to within 10 to 18 inches of the surface.

This soil is suited to crops that tolerate some wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. The seasonal water table and moderately slow permeability limit this soil for many uses. Capability unit IIw–2.

RaB—Rainsboro silt loam, 3 to 8 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface layer is about 2 inches thiner. It is on undulating terraces in areas 8 to 35 acres in size. Runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included in mapping were some areas of Allegheny soils. Also included were some areas of a soil that is in depressions and has a seasonal water table that rises to within 10 to 18 inches of the surface.

This soil is suited to crops that tolerate some wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. The seasonal water table and moderately slow permeability are limitations for many uses. Capability unit IIe–3.

RaC—Rainsboro silt loam, 8 to 15 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface layer is about 2 inches thinner. Areas of this soil are 6 to 20 acres in size and are narrow and irregular in shape. Runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were some areas of gently sloping Rainsboro soils.

This soil is suited to crops that tolerate seasonal wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. A seasonal water table, slope, and moderately slow permeability are limitations for most uses. Capability unit IIIe–4.

Rayne Series

The Rayne series consists of deep, well drained, gently sloping to moderately steep soils on uplands. These soils formed in material that weathered from interbedded shale, siltstone, and some fine-grained sandstone. They are mainly on ridgetops, but also occur on hillsides. The native vegetation is mixed hardwoods, mainly oaks and red maple and some black cherry, ash, and tulip-poplar.

In a representative profile, in a cultivated area, the surface layer is dark-brown silt loam about 6 inches thick. The subsoil is dark yellowish-brown, friable and firm shaly silt loam about 32 inches thick. The substratum, from a depth of 38 to about 60 inches, is dark yellowish-brown, firm very shaly silt loam. Rippable shale bedrock is at a depth of about 60 inches.

The available moisture capacity and permeability are moderate. Most areas of these soils have been cleared and are used for crops, hay, and pasture. A few areas are wooded or are idle. Slope is a limitation for some uses.

Representative profile of Rayne silt loam, 8 to 15 percent slopes, in a cultivated field, ½ mile south of Bryan, Cowanshannock Township:

Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam, pale brown (10YR 6/3) when dry; moderate, medium and fine, granular structure; very friable, nonsticky and nonplastic; many fine roots; 10 percent shale fragments; strongly acid; gradual, wavy boundary.

B1—6 to 13 inches, dark yellowish-brown (10YR 4/4) shaly silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; 15 percent shale fragments; strongly acid; gradual, wavy boundary.

B2t—13 to 25 inches, dark yellowish-brown (10YR 4/4) shaly silt loam; moderate, medium and coarse, subangular blocky structure; friable, sticky and plastic; few fine roots; thin, discontinuous clay films on ped faces; 20 percent very fine shale fragments; strongly acid; gradual, wavy boundary.

B3t—25 to 38 inches, dark yellowish-brown (10YR 4/4) shaly silt loam; moderate, medium and coarse, subangular blocky structure; firm, slightly sticky and plastic; few fine roots; thin, discontinuous clay films in old pores; 40 percent very fine shale fragments; very strongly acid; diffuse, wavy boundary.

C—38 to 60 inches, dark yellowish-brown (10YR 4/4) very shaly silt loam; massive; firm, slightly sticky and plastic; 80 percent very fine shale fragments; very strongly acid; gradual, wavy boundary.

R—60 inches +, grayish-brown, rippable shale bedrock.

The solum is 36 to 50 inches thick. The depth to rippable bedrock is 40 to 60 inches. Coarse fragments increase with depth. They make up 5 to 15 percent of the Ap and B1 horizons, 10 to 40 percent of the B2t and B3 horizons, and 20 to 80 percent of the C horizon. The Ap horizon is dark grayish brown to brown. The B horizon ranges from yellowish brown to dark yellowish brown and from channery or shaly loam to silty clay loam. The fine earth in the C horizon is silt loam or loam.

Rayne soils are near the moderately deep, well drained Gilpin soils; the shallow, well drained Weikert soils; the deep, moderately well drained Wharton soils; and the deep, somewhat poorly drained Cavode soils. Drainage of the Rayne soils is similar to that of the Hazleton soils. Hazleton soils have a sandy loam B horizon, which the Rayne soils lack.

RnB—Rayne silt loam, 3 to 8 percent slopes. This soil has a profile similar to the one described as representative of the series, but its surface layer is about 2 inches thicker. It is on ridgetops in areas 4 to 35 acres in size. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few acres of nearly level Rayne soils and a few areas of Gilpin soils. Also included were some areas of a soil that is medium acid.

This soil is suited to the crops commonly grown in the county and to trees and wildlife. It has few limitations for most uses. Capability unit IIe–1.

RnC—Rayne silt loam, 8 to 15 percent slopes. This soil has the profile described as representative of the series. It is on ridges and benches in irregularly shaped areas that are 4 to 12 acres in size. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of Gilpin soils and a few areas of a soil that has a medium acid substratum.

This soil is suited to most of the crops grown in the county and to trees and wildlife. Slope is a limitation for some uses. Capability unit IIIe–1.

RpD—Rayne-Gilpin very stony silt loams, 8 to 25 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Rayne soil makes up about 50 to 60 percent of the complex. It has a profile similar to the one described as representative of the Rayne series, but its surface layer is overlain by 1 or 2 inches or partially decayed leaf litter. The Gilpin soil makes up about 30 to 40 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but its surface layer also is overlain by 1 or 2 inches of partially decomposed leaf litter. Stones cover 2 to 5 percent of the surface of these soils. Surface runoff is medium to high, and the hazard of erosion is moderate to high if the soils are cleared.

Included with these soils in mapping were a few areas of Weikert soils and Wharton soils.

Soils of this complex are suited to pasture, trees, and wildlife. Slope and stones are limitations of the Rayne soil for most uses, and moderate depth to bedrock, stones, and slope are limitations of the Gilpin soil. Capability unit VIs–1.

Steff Series

The Steff series consists of deep, moderately well drained, nearly level soils on flood plains. These soils formed in alluvium that derived from shale, siltstone, and sandstone. The native vegetation consists of mixed hardwoods, mainly sycamore, box elders, and spice bush.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown loam about 7 inches thick. The subsoil is about 38 inches thick. In the upper 7 inches the subsoil is dark-brown, friable loam; the middle part is dark-brown, friable silty clay loam about 6 inches thick; and the lower part, between depths of 20 and 45 inches, is mottled, dark-brown and brown, friable silt loam. The substratum is between depths of 45 and 70 inches. In the upper 5 inches it is mottled, brown, friable fine sandy loam. The part below that is brown, friable gravelly sandy loam about 5 inches thick. The next part is brown, very friable sandy loam about 5 inches thick. In the lowermost part, from a depth of 60 to 70 inches or more, the substratum is mottled, yellowish-brown, very friable gravelly sandy loam.

The available moisture capacity is high, and permeability is moderate. These soils have a seasonal water table that rises to within 18 to 36 inches of the surface in wet periods. Flooding by stream overflow is common late in winter and early in spring. If these soils are adequately drained, they are suited to most of the crops grown in the county. Most areas of these soils have been cleared and are used for crops, hay, pasture, urban development, and recreation, but a few areas are idle. The seasonal water table and flooding are limitations for many uses.

Representative profile of Steff loam, in a cultivated field, 1½ miles southeast of Elderton and 100 yards south of U.S. 422 along the flood plain of Crooked Creek [Sample No. S68–Pa–03–5 (1–10) in tables 10 and 11 in the section "Laboratory Data." Engineering data are reported in table 5 under Pennsylvania report numbers 68–20501 and 68–20502]:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium and coarse, granular structure; friable, slightly sticky and slightly plastic; 5 percent coarse fragments; strongly acid; clear, wavy boundary.

B1—7 to 14 inches, dark-brown (10YR 3/3) loam; moderate, medium and coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; 5 percent coarse fragments; strongly acid; clear, wavy boundary.

B21—14 to 20 inches, dark-brown (10YR 4/3) silty clay loam; moderate, coarse prismatic structure; friable, sticky and slightly plastic; few coarse fragments; strongly acid; clear, wavy boundary.

B22—20 to 25 inches, dark-brown (10YR 4/3) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) mottles; moderate, coarse, prismatic structure parting to moderate, coarse and medium, blocky; friable, slightly sticky and slightly plastic; strongly acid; gradual, wavy boundary.

B23—25 to 33 inches, dark-brown (10YR 4/3) silt loam; many, medium, distinct, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; few, thin discontinuous clay films on ped surfaces; strongly acid; gradual, wavy boundary.

B24—33 to 45 inches, brown (10YR 5/3) silt loam; many, medium, distinct, grayish-brown (10YR 5/2) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; strongly acid; clear, wavy boundary.

IIC1—45 to 50 inches, brown (10YR 5/3) fine sandy loam; many, distinct, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/6) mottles; massive; friable, nonsticky and nonplastic; strongly acid; abrupt, wavy boundary.

IIIC2—50 to 55 inches, brown (10YR 5/3) gravelly sandy loam; massive; friable, nonsticky and nonplastic; black coatings on coarse fragments; 35 percent gravel; strongly acid; abrupt, wavy boundary.

IVC3—55 to 60 inches, brown (10YR 5/3) sandy loam with 3/4-inch thick lens of light gray (10YR 6/1); massive; very friable, nonsticky and nonplastic; 5 percent gravel; strongly acid; clear, wavy boundary.

VC4—60 to 70 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; many, medium prominent, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/6) mottles; single grained; very friable, nonsticky and nonplastic; 40 percent gravel, strongly acid.

The solum is 30 to 50 inches thick. The depth to bedrock is more than 5 feet. The Ap horizon ranges from brown to dark grayish brown. The B horizon is silt loam or silty clay loam. The upper part of the B horizon ranges from dark brown to dark yellowish brown, and the lower part ranges from dark brown to light olive brown and is mottled with brown and gray. Stratified layers of sand or gravel are common below a depth of 50 inches.

Steff soils are near the deep, well-drained Pope soils and the deep, poorly drained Melvin soils. They are similar in drainage to the Rainsboro soils, but Rainsboro soils have a Bx horizon and are on stream terraces.

Se—Steff loam. This soil has the profile described as representative of the series. It is on flood plains in nearly level areas that are 4 to 20 acres in size. Surface runoff is slow, and the erosion hazard is slight.

Included with this soil in mapping were a few small areas of Melvin silty clay loam.

This soil is suited to crops that tolerate some wetness and that complete their growing cycle before the flooding season begins. Artificial drainage can make the soil suitable for a wider range of crops. A seasonal water table and flooding limit this soil for many uses. Capability unit IIw–1.

Sf—Steff loam, high bottom. This soil is nearly level and is similar to the one described as representative of the series. It is in higher areas on the flood plain, however, and is less susceptible to flooding. The areas cover 10 to 35 acres. Runoff is slow, and erosion is only a slight hazard.

Included with this soil in mapping were a few areas of a gently sloping soil.

This soil is suited to crops that tolerate some wetness and to trees and wildlife. Artificial drainage can make it suitable for a wider range of crops. A seasonal water table and occasional flooding are limitations for many uses. Capability unit IIw–1.

Strip Mines

Sm—Strip mines. This land type consists of sandstone, boulders, fractured shale, and some soil material that has been disturbed by mining operations. It ranges from nearly level to very steep.

In mining, to get to the underlying minerals, the overburden of soil material and bedrock is removed and piled high. Most strip mine areas are now being graded and revegetated, but many older mine areas have been left unprotected. Revegetating most strip mines is difficult because of the acid reaction, low fertility, and low available moisture capacity of the spoil material. Most stripmining is for the removal of coal, but several areas are mined for limestone. These areas generally are not so acid as the coal areas, and a few have been returned to farming. Strip mines, however, generally are best suited to watershed protection and wildlife habitat. Not placed in a capability unit.

Upshur Series

The Upshur series consists of deep, well-drained, gently sloping to steep soils on uplands. These soils formed in material that weathered from neutral or alkaline red clay shale. Most areas of Upshur soils are affected by the neutral or alkaline underlying material and, except for the Vandergrift soils, are less acid in the substratum than other soils on uplands in Armstrong County. The native vegetation consists of mixed hardwoods, mainly oaks, red maple, and black cherry and some hickory. Locust trees are common in idle areas.

In a representative profile, in a pine plantation, the surface layer is dark-brown silt loam about 6 inches thick. It is covered by a one-inch layer of decaying leaves and twigs. The subsoil is reddish-brown, firm silty clay that extends to a depth of 36 inches. The substratum, between depths of 36 and 58 inches, is reddish-brown, firm very shaly silty clay. Red shale bedrock is at a depth of about 58 inches.

The available moisture capacity is high, and permeability is slow. Many areas of these soils have been cleared and are used for crops, hay, and pasture. Some areas are wooded or are idle and reverting to woodland. Slow permeability and slope are limitations for many uses. Also, these soils are subject to slipping and sliding, especially if the natural slope is disturbed.

Representative profile of Upshur silt loam, in an area of Upshur-Gilpin silt loams, 15 to 25 percent slopes, in a pine plantation 2½ miles east of North Vandergrift and ¾ mile west of the intersection of Routes 03097 and 03125:

O1—1 to 3/4 inch, black (N 2/0) leaf and twig matter.
O2—3/4 inch to 0, very dark gray (10YR 3/1) decayed leaf mold.
Ap—0 to 6 inches, dark-brown (7.5YR 3/2) silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; very strongly acid; abrupt, smooth boundary.
B2t—6 to 36 inches, reddish-brown (2.5YR 4/4) silty clay; strong, medium, blocky structure; firm, sticky and plastic; thin, discontinuous clay films on peds; strongly acid; gradual, wavy boundary.
C—36 to 58 inches, reddish-brown (5YR 4/4) very shaly silty clay; massive; firm, sticky and plastic; 75 percent shale fragments; medium acid; clear, wavy boundary.
R—58 inches +, red shale bedrock.

The solum is 26 to 42 inches thick. The depth to bedrock ranges from 40 to 72 inches. The Ap horizon is dark brown to reddish brown. The B horizon is weak-red to dark reddish-brown silty clay or clay.

Upshur soils are near the moderately deep, well drained Gilpin soils, the moderately well drained to somewhat poorly drained Vandergrift soils, and the moderately well drained Wharton soils. They are similar in drainage to the Hazleton, Rayne, Gilpin, and Weikert soils. Compared with the Upshur soils, however, Hazleton soils have more sand and less silt and are more yellow; Weikert soils are less than 20 inches deep to bedrock; and Gilpin soils have bedrock within a depth of 40 inches and more yellow hues.

In Armstrong County, Upshur soils are mapped in complexes with Gilpin silt loam.

UgB—Upshur-Gilpin silt loams, 3 to 8 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Upshur soil makes up about 50 percent of the complex. It has a profile similar to the one described as representative of the Upshur series, but its surface layer and subsoil are generally thicker. The Gilpin soil makes up about 40 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but its surface layer is 6 to 8 inches thick. These soils are on ridges and benches in areas that cover 6 to 35 acres. Runoff is medium, and the erosion hazard is moderate if the soils are cultivated.

Included with these soils in mapping were some areas of Weikert soils.

Soils of this complex are suited to most crops grown in the county, but they are difficult to manage if farmed because the Upshur soil has a silty clay or clay subsoil. The soils are also suited to trees and wildlife. Slow permeability is the major limitation for most uses. Capability unit IIIe–3.

UgC—Upshur-Gilpin silt loams, 8 to 15 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Upshur soil makes up about 50 percent of the complex. It has a profile similar to the one described as representative of the Upshur series, but it generally has a slightly thicker surface layer and subsoil. The Gilpin soil makes up about 40 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series. These soils are on ridges and benches in areas that cover 8 to 30 acres. Runoff is medium, and the hazard of erosion is moderate if the soils are cultivated.

Included with these soils in mapping were some areas of Weikert soils.

The soils of this complex are suited to limited cultivation of the crops commonly grown in the county. They are also suited to trees and wildlife. They are difficult to manage if farmed because the Upshur soil has a silty clay or clay subsoil. Slow permeability and slope are limitations for most uses. Capability unit IVe–4.

UgD—Upshur-Gilpin silt loams, 15 to 25 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Upshur soil makes up about 40 percent of the complex. It has the profile described as representative of the Upshur series. The Gilpin soil makes up about 50 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but it is not so deep to bedrock. These soils are on hillsides in areas that cover 6 to 35 acres. Runoff is rapid, and the hazard of erosion is high if the soils are cultivated.

Included with these soils in mapping were some areas of Weikert soils.

Soils of this complex are suited to hay, pasture, trees, and wildlife. Slope and slow permeability are limitations for most uses. Capability unit VIe–1.

UgE—Upshur-Gilpin silt loams, 25 to 35 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Upshur soil makes up about 40 percent of the complex. It has a profile similar to the one described as representative of the Upshur series, but it is generally 10 to 18 inches less deep to bedrock. The Gilpin soil makes up about 50 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but it is generally 8 to 14 inches less deep to bedrock. These soils are on hillsides in narrow areas that range from 10 to 60 acres in size. Runoff is rapid, and the hazard of erosion is high if the soils are cultivated.

Included with these soils in mapping were some areas of very steep soils and some areas of Weikert soils.

Soils of this complex are suited to trees and wildlife. Slope and the hazard of erosion are the major limitations for most uses. Capability unit VIIe–1.

Urban Land

Ur—Urban land. Urban land consists of nearly level or gently sloping areas, generally in the larger towns of the county, where buildings and other structures make it difficult or impossible to identify the soils. These areas include land used for buildings, roads, parking lots, shopping centers, schools, and factories. Most of the land has been smoothed and the original soils disturbed, filled, removed, or covered during construction. Most areas are on stream terraces or flood plains, but some are on uplands. Not placed in a capability unit.

Vandergrift Series

The Vandergrift series consists of deep, moderately well drained and somewhat poorly drained, gently sloping to moderately steep soils. These soils formed in material that weathered from nonacid, red and gray shale and siltstone. They are mainly on ridgetops and side slopes of the dissected uplands. The native vegetation consists of mixed hardwoods, mainly red oak, black oak, white oak, locust, walnut, black cherry, ash, and tulip-poplar.

In a representative profile, in a cultivated field, the plow layer is dark yellowish-brown silty clay loam about 9 inches thick. The subsoil extends to a depth of 56 inches. The upper part is brown, friable silty clay loam about 5 inches thick. The part below that is dark-red, firm silty clay about 7 inches thick. The next part is mottled, red and dark-red, firm silty clay about 13 inches thick. In the lowermost part, between depths of 34 and 56 inches, the subsoil is mottled, red and dusky-red, firm silty clay. The substratum extends to a depth of 66 inches. It is mottled, brownish-yellow, friable shaly silty clay loam. Shale and siltstone are below that.

The available moisture capacity is high, and permeability is slow. A seasonal water table rises to within 6 to 24 inches of the surface in wet periods. If the soils are adequately drained, they are suited to many of the crops grown in the county. Many areas of these soils have been cleared and are used for crops, hay and pasture. Some areas are wooded or are idle and reverting to woodland. The seasonal water table, slow permeability, and slope are limitations for many uses. Also, these soils are subject to slipping and sliding, particularly if the natural slope is disturbed.

Representative profile of Vandergrift silty clay loam, in an area of Wharton-Vandergrift complex, 3 to 8 percent slopes, in a cultivated field 2½ miles south of Dayton and ½ mile west of the intersection of Routes T547 and 03128 [Sample No. S68–Pa–03–9 (1–9) in tables 10 and 11 in the section "Laboratory Data." Engineering data are reported in table 5 under Pennsylvania reports 68–20507 and 68–20508]:

Ap—0 to 9 inches, dark yellowish-brown (10YR 3/4) silty clay loam; pale brown (10YR 6/3) when dry; weak, fine and medium, granular structure; friable to firm, slightly sticky and slightly plastic; 4 percent soft shale chips; medium acid; clear, wavy boundary.

B1—9 to 14 inches, brown (7.5YR 4/4) silty clay loam; weak, fine, subangular blocky structure; friable, sticky and plastic; 5 percent coarse fragments of sandstone and shale; medium acid; clear, wavy boundary.

B21t—14 to 21 inches, dark-red (2.5YR 3/6) silty clay; strong, fine and medium, blocky structure; firm, sticky and plastic; thin, continuous clay films on ped faces and lining the pores; 4 percent coarse fragments; strongly acid; gradual, wavy boundary.

B22t—21 to 34 inches, red (10R 4/6) and dark-red (2.5YR 3/6) silty clay; few, fine, prominent, light-gray (10YR 6/1), light brownish-gray (10YR 6/2), and pale-brown (10YR 6/3) mottles; weak, coarse, blocky structure parting to moderate, very fine, blocky; firm, sticky and plastic; common, thin, clay films on ped faces and lining the pores; strongly acid; diffuse, wavy boundary.

B23t—34 to 46 inches, red (10R 4/6) and dusky-red (10R 3/4) silty clay; few, fine, prominent, light-gray (10YR 7/1) mottles; weak, coarse, blocky structure parting to weak, very fine, blocky; firm, slightly sticky and plastic; common thin clay films on ped faces; strongly acid; gradual, wavy boundary.

B24t—46 to 56 inches, dusky-red (10R 3/4) silty clay; common, fine, prominent, light-gray (5Y 7/1) and yellowish-brown (10YR 5/8) mottles; weak, coarse, blocky structure parting to weak, very fine, blocky; firm, slightly sticky and plastic; few thin clay films on ped faces and in pores; medium acid; clear, wavy boundary.

C—56 to 66 inches, brownish-yellow (10YR 6/6) shaly silty clay loam; common, fine, prominent, reddish-brown (5YR 4/3) and light-gray (5Y 7/1) mottles and common black specks; massive to weak, thin, platy structure; friable, slightly sticky and plastic; clay films line pores and root channels; common black coatings; 15 percent shale chips; medium acid; clear, wavy boundary.

R—66 inches +, dark-red (10R 3/6) and dark yellowish-brown (10YR 4/4) shale and siltstone; common black coatings along bedding planes.

The solum is 40 to 60 inches thick. Depth to bedrock ranges from 42 to 72 inches. Coarse fragments make up as much as 10 percent of the A and B horizons and from 5 to 90 percent of the C horizon. The Ap horizon ranges from

Figure 12.—**Typical landscape of Weikert soils. Mahoning Reservoir is on the left.**

dark yellowish brown to dark reddish brown. The B horizon ranges from dark reddish brown to weak red or dusky red and is silty clay loam, silty clay, or clay. Mottles with chroma of 2 or less are in the upper 10 inches of the Bt horizon. The C horizon ranges from reddish brown to weak red or yellowish brown.

Vandergrift soils are near the deep, well drained Upshur soils and the deep, moderately well drained Wharton soils. They are similar in drainage to the Cavode and Ernest soils. Unlike Vandergrift soils, Cavode soils have a light brownish-gray and yellowish-brown Bt horizon and Ernest soils have a Bx horizon.

In Armstrong County, Vandergrift soils are mapped only in complexes with Wharton soils.

Weikert Series

The Weikert series consists of shallow, well drained, gently sloping to very steep soils on uplands. These soils formed in material that weathered from interbedded shale, siltstone, and fine-grained sandstone. They occur in areas of complex topography on dissected hillsides and ridges (fig. 12). The native vegetation consists of mixed hardwoods, mainly red oak, scarlet oak, chestnut oak, white oak, red maple, dogwood, and sassafras.

In a representative profile the surface layer is very dark grayish-brown to brown shaly silt loam about 8 inches thick. It is covered by a 3/4-inch layer of decaying leaves and twigs. The subsoil is yellowish-brown, friable shaly silt loam about 7 inches thick. The substratum, between depths of 15 and 18 inches, is yellowish-brown, very friable, very shaly silt loam. Rippable shale bedrock is at a depth of about 18 inches.

The available moisture capacity is very low, and permeability is moderately rapid. Most areas of these soils are wooded, but some have been cleared and are used for pasture or are idle and reverting to woodland. Shallow depth to bedrock and slope are limitations for most uses.

Representative profile of Weikert shaly silt loam, 8 to 15 percent slopes, in a wooded area 1.1 miles south of Mateer on the west side of State highway 359:

O1—3/4 to 1/4 inch, loose leaf and twig litter.

O2—1/4 inch to 0, decomposed leaf and twig matter.

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) shaly silt loam; moderate, fine, granular structure; very friable, slightly sticky and slightly plastic; very fine roots; 20 percent shale fragments; very strongly acid; clear, wavy boundary.

A2—4 to 8 inches, brown (10YR 5/3) shaly silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; few fine roots; 40 percent shale fragments; very strongly acid; clear, wavy boundary.

B2—8 to 15 inches, yellowish-brown (10YR 5/4) shaly silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine and medium roots; 40 percent shale fragments; very strongly acid; clear, wavy boundary.

C—15 to 18 inches, yellowish-brown (10YR 5/4) very shaly silt loam; massive; very friable, slightly sticky and nonplastic; 80 percent shale fragments; very strongly acid; abrupt, wavy boundary.

R—18 inches, grayish-brown, rippable shale bedrock.

The solum is 8 to 18 inches thick. The depth to bedrock is 12 to 20 inches. Coarse fragments make up 20 to 50 percent of the A and B horizons and as much as 80 percent of the C horizon. In some places there is an Ap horizon that is dark grayish brown to brown. The B horizon ranges from dark yellowish brown to strong brown and from shaly silt loam to channery loam. The C horizon ranges from shaly silt loam to very channery loam.

Weikert soils are near the deep, well drained Rayne and Hazleton soils; the moderately deep, well drained Gilpin soils; the deep, moderately well drained Wharton soils; and the deep, somewhat poorly drained Cavode soils.

WeB—Weikert shaly silt loam, 3 to 8 percent slopes. This soil is similar to the one described as representative of the series, but it has a plow layer about 8 inches thick. It is on ridges and knolls in areas that range from 4 to 12 acres in size. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of Gilpin soils and a few small areas of Weikert soils that have coarse fragments of thin, flat sandstone or siltstone in the surface layer.

This soil is suited to crops that tolerate droughtiness and to hay, pasture, trees, and wildlife. Shallowness to bedrock limits this soil for most uses. Capability unit IIIe–2.

WeC—Weikert shaly silt loam, 8 to 15 percent slopes. This soil has the profile described as representative of the series. It is on ridgetops and hillsides in irregularly shaped areas that range from 8 to 25 acres in size. Surface runoff is rapid and the erosion hazard is moderate to high if the soil is cultivated.

Included with this soil in mapping were a few areas of Gilpin soils and a few areas of Weikert soils that have coarse fragments of thin, flat sandstone or siltstone in the surface layer.

This soil is suited to limited cultivation of crops that tolerate some droughtiness and to hay, pasture, trees, and wildlife. Shallow depth to bedrock and slope are limitations for many uses. Capability unit IVe–2.

WkF—Weikert and Gilpin soils, 25 to 70 percent slopes. The soils of this mapping unit occur together and are commonly intermingled, so it was not practical to map them separately. Some mapped areas are entirely Weikert soil or entirely Gilpin soil; others are a mixture of the two. Slope is the dominant characteristic.

Weikert shaly silt loam makes up 50 to 60 percent of the mapping unit. It has a profile similar to the one described as representative of the Weikert series, but generally it is 2 to 5 inches less deep to bedrock. Gilpin channery silt loam makes up 40 to 50 percent of the unit. It has a profile similar to the one described as representative of the Gilpin series, but it has more coarse fragments. Its surface layer is shaly or channery silt loam. Surface runoff is rapid, and the erosion hazard is high if the soils are cultivated.

Included with these soils in mapping were a few areas each of very stony soils and soils that have a gravelly sandy loam profile. Also included were some areas of sandstone, shale, or limestone outcrops and of Hazleton soils.

The soils of this mapping unit are suited to trees and wildlife habitat. Slope and the hazard of erosion are limitations for most uses. Capability unit VIIe–1.

Wharton Series

The Wharton series consists of deep, moderately well drained, gently sloping to moderately steep soils on uplands. These soils formed in material that weathered from acid clay shale interbedded with siltstone. They are mainly on ridgetops, benches, and concave hillsides. The native vegetation consists of mixed hardwoods, mainly red oak, black oak, scarlet oak, and white oak and some black cherry, tulip-poplar, and ash.

In a representative profile, in a cultivated area, the plow layer is dark-brown, friable silt loam about 8 inches thick. The subsoil extends to a depth of about 52 inches. In the upper 3 inches the subsoil is yellowish-brown, friable heavy silt loam; below that, in the next 12 inches, it is yellowish-brown, friable silty clay loam. Next, it is mottled, yellowish-brown, firm silty clay loam for about 8 inches, and in the lowermost part, which is about 21 inches thick, it is mottled, brown, firm silty clay. The substratum, between depths of 52 and 58 inches, is dark grayish-brown, firm very shaly silty clay. Shale bedrock is at a depth of about 58 inches.

The available moisture capacity is high, and permeability is slow. A seasonal water table rises to within 18 to 36 inches of the surface in wet periods. If the soils are adequately drained, they are suited to most of the crops grown in the county. Most areas of these soils have been cleared and are used for crops. A few areas are wooded or are idle and reverting to woodland. The seasonal water table, slow permeability, and slope are limitations for many uses.

Representative profile of Wharton silt loam, 8 to 15 percent slopes, in a cultivated field, 2½ miles northeast of Washington, ½ mile north of intersection of Routes T437 and T416:

Ap—0 to 8 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; strongly acid; abrupt, smooth boundary.

B1—8 to 11 inches, yellowish-brown (10YR 5/4) heavy silt loam; moderate, medium and fine, subangular blocky structure; friable, slightly sticky and slightly plastic; strongly acid; clear, smooth boundary.

B21t—11 to 23 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium and coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; thin discontinuous clay films on ped faces; very strongly acid; gradual, wavy boundary.

B22t—23 to 31 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct, pinkish-gray (7.5YR 6/2) mottles; strong, medium and coarse, subangular blocky structure; firm, sticky and plastic; thick continuous clay films on ped faces; very strongly acid; gradual, wavy boundary.

B23t—31 to 52 inches, brown (10YR 5/3) silty clay; many, coarse, prominent, gray (10YR 6/1) mottles; strong, coarse, subangular blocky structure; firm, very sticky and plastic; thick continuous clay films on ped faces; 10 percent coarse fragments; very strongly acid; gradual, wavy boundary.

C—52 to 58 inches, dark grayish-brown (10YR 4/2) very shaly silty clay; massive; firm, slightly sticky and slightly plastic; 55 percent coarse fragments; extremely acid; gradual, wavy boundary.

R—58 inches +, rippable, gray shale bedrock.

The solum is 40 to 60 inches thick. The depth to bedrock ranges from 48 to 72 inches. Coarse fragments make up as much as 15 percent of the Ap, B1, B21t, B22t, and B23t horizons and as much as 90 percent of the C horizon. The

Ap horizon is dark grayish brown to brown. The matrix of the B horizon ranges from strong brown or brown to yellowish brown and the soil material ranges from clay loam to silty clay.

Wharton soils are on the same landscape as the deep, well-drained Rayne soils; the moderately deep, well-drained Gilpin soils; the shallow, well-drained Weikert soils; the deep, somewhat poorly drained Cavode soils; and the deep, moderately well drained to somewhat poorly drained Vandergrift soils. Wharton soils are similar in drainage to the Ernest and Rainsboro soils, but those soils have a Bx horizon.

WrB—Wharton silt loam, 3 to 8 percent slopes. This soil is similar to the one described as representative of the Wharton series, but its surface layer is about 2 inches thicker. It is on ridgetops and benches in areas that range from 8 to 30 acres. Surface runoff is medium, and the erosion hazard is moderate if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that has slopes of less than 3 percent and a few areas of a soil that is medium acid or neutral. Some areas of Cavode soils were also included.

This soil is suited to crops that tolerate some wetness and to trees and wildlife habitat. Aritficial drainage can make it suitable for a wider range of crops. A seasonal water table and slow permeability are limitations for many uses. Capability unit IIe–3.

WrC—Wharton silt loam, 8 to 15 percent slopes. This soil has the profile described as representative of the series. It is on ridgetops and benches in areas, ranging from 6 to 20 acres, that are irregular in shape. Surface runoff is medium, and the erosion hazard is high if the soil is cultivated.

Included with this soil in mapping were a few areas of a soil that is medium acid or neutral in the substratum.

This soil is suited to crops that tolerate some wetness and to trees and wildlife habitat. Artificial drainage can make it suitable for a wider range of crops. A seasonal water table, slope, and slow permeability are limitations for most uses. Capability unit IIIe–4.

WtB—Wharton-Gilpin silt loams, 3 to 8 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soil makes up 50 to 60 percent of the complex. It has a profile similar to the one described as representative of the Wharton series, but it is not so deep to bedrock. The Gilpin soil makes up about 30 to 40 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but its surface layer is 6 to 9 inches thick. These soils are on ridgetops and benches. The areas range from 10 to 20 acres and are irregular in shape. Runoff is medium, and the hazard of erosion is moderate if the soils are cultivated.

Included with these soils in mapping were some areas of Cavode soils.

Soils of this complex are suited to most of the crops grown in the county and to trees and wildlife habitat. Artificial drainage can make the Wharton soil suitable for a wider range of crops. A seasonal water table and slow permeability are limitations of the Wharton soil for most uses. Moderate depth to bedrock is the major limitation of the Gilpin soil. Capability unit IIe–3.

WtC—Wharton-Gilpin silt loams, 8 to 15 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soil makes up 45 to 55 percent of the complex. It has a profile similar to the one described as representative of the Wharton series, but its surface layer is about 2 inches thinner. The Gilpin soil makes up 35 to 50 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but it has a few more coarse fragments. These soils are on ridges and benches in irregularly shaped areas that cover 8 to 35 acres. Runoff is medium, and the erosion hazard is moderate if the soils are cultivated.

Included with these soils in mapping were some small areas of Cavode soils and some very small areas of poorly drained soils around seeps and wet-weather springs.

Soils of this complex are suited to most of the crops grown in the county and to trees and wildlife habitat. Artificial drainage can make the Wharton soil suitable for a wider range of crops. A seasonal water table, slow permeability, and slope are limitations of the Wharton soil for most uses, and moderate depth to bedrock and slope are the major limitations of the Gilpin soil. Capability unit IIIe–4.

WtD—Wharton-Gilpin silt loams, 15 to 25 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soils make up 50 to 60 percent of the complex. It has a profile similar to the one described as representative of the Wharton series, but it is not so deep to bedrock. The Gilpin soil makes up about 30 to 40 percent of the complex. It has a profile similar to the one described as representative of the Gilpin series, but it has a few more coarse fragments and is not so deep to bedrock. These soils are on hillsides and foot slopes in areas that are narrow or irregular in shape, covering 12 to 60 acres. Runoff is rapid, and the erosion hazard is high if the soils are cultivated.

Included with these soils in mapping were a few small areas of Weikert soils.

The soils of this complex are suited to limited cultivation of crops and to pasture, hay, trees, and wildlife habitat. Artificial drainage can make the Wharton soil suitable for a wider range of crops. Slope, a seasonal water table, and slow permeability are limitations of the Wharton soil for most uses. Slope and moderate depth to bedrock are the major limitations of the Gilpin soil. Capability unit IVe–3.

WvB—Wharton-Vandergrift complex, 3 to 8 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soil makes up 50 to 55 percent of the complex. It has a profile similar to the one described as representative of the Wharton series, but its surface layer is slightly thicker. The Vandergrift soil makes up 35 to 40 percent of the complex and has the profile described as representative of the Vandergrift series. The soils are on ridges and benches, and the areas range from 8 to 35 acres. The surface layer is silt loam or silty clay loam. Runoff is medium, and the hazard of erosion is moderate if the soils are cultivated.

Included with these soils in mapping were small areas of Cavode soils.

Soils of this complex are suited to crops that tolerate some wetness and to trees and wildlife habitat. Artificial drainage can make them suitable for a wider range of crops. A seasonal water table and slow permeability limit these soils for most uses. Capability unit IIe–3.

WvC—Wharton-Vandergrift complex, 8 to 15 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soil makes up 50 to 60 percent of the complex. It has a profile similar to the one described as representative of the Wharton series. The Vandergrift soil makes up 30 to 40 percent of the complex. It has a profile similar to the one described as representative of the Vandergrift series, but its surface layer is dark reddish-brown. These soils are on ridgetops and benches. Areas of these soils range from 6 to 20 acres, and are irregular in shape. The surface layer is silt loam or silty clay loam. Runoff is medium, and the hazard of erosion is moderate to high if the soils are cultivated.

Included with these soils in mapping were a few small areas of Cavode soils.

Soils of this complex are suited to crops that tolerate some wetness and to trees and wildlife habitat. Artificial drainage can make them suitable for a wider range of crops. A seasonal water table, slow permeability, and slope are limitations for most uses. Capability unit IIIe–4.

WvD—Wharton-Vandergrift complex, 15 to 25 percent slopes. The soils of this mapping unit are so intermingled that it was neither practical nor feasible to map them separately. The Wharton soil makes up 50 to 60 percent of the complex. It has a profile similar to the one described as representative of the Wharton series, but it is not so deep to bedrock. The Vandergrift soil makes up 30 to 40 percent of the complex. It has a profile similar to the one described as representative of the Vandergrift series, but it has a dark reddish-brown surface layer. Areas of these soils range from 10 to 35 acres, and are irregular in shape. The soils occupy hillsides and toe slopes. Their surface layer is silty clay loam or silt loam. Runoff is rapid, and the hazard of erosion is high if the soils are cultivated.

Included with these soils in mapping were a few areas of Upshur soils and Weikert soils.

Soils of this complex are suited to limited cultivation of crops and to pasture, hay, trees, and wildlife habitat. Artificial drainage increases their suitability for crops. Slope, a seasonal water table, and slow permeability are limitations for many uses. Capability unit IVe–3.

Formation and Classification of the Soils

This section discusses the factors of soil formation. It explains the system of soil classification and gives the classification of the soils in Armstrong County.

Factors of Soil Formation

The characteristics of a soil at any given site depend on the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and remained, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are the active forces that change the parent material into a soil that has genetically related horizons. The effects of climate and plant and animal life are influenced by relief and by the nature of the parent material. In some cases the parent material dominates the other factors in profile formation. Finally, time is needed to change the parent material into a soil profile. A long time usually is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one unless conditions are specified for the other four. Many processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It is composed of varying amounts of sand, silt, and clay and has various kinds and amounts of chemicals. All the other soil-forming factors affect parent material, but the parent material determines the chemical and mineralogical composition of the soil.

In Armstrong County most of the soils on uplands formed in material weathered from interbedded shale, sandstone, siltstone, and clay shale. The reddish, clayey Upshur and Vandergrift soils show the dominance of red clay shale in their parent material. The shaly subsoil of Weikert soils shows the dominance of brownish and grayish shale in their parent material. The channery subsoil of Hazleton soils shows the dominance of sandstone in their parent material. The subsoil of soils on flood plains, such as Pope and Steff soils, reflects the stratified nature of alluvium.

Climate

Precipitation, temperature, humidity, and wind have been important in the formation of the soils in Armstrong County. Ample precipitation, gentle relief, and a dense or clayey substratum have caused a high water table in many soils. This water table accounts for the grayish color of the wetter soils. The relatively cool temperature has influenced the acidity of the soils and has produced the yellow colors that are common in some soils in Armstrong County. The climate has also affected the soils through its influence on the vegetation.

Plant and animal life

Vegetation, micro-organisms, earthworms, and other forms of life contribute to soil formation. The kind and quantity of vegetation are important, and these depend on the parent material and the climate.

The climate of Armstrong County favors the growth of both hardwood and softwood trees, and many of the soils formed under forests. Leaves, twigs, roots, and entire plants accumulate on the surface of forest soils. Organic matter is added to the soil as plant remains decompose through the action of micro-organisms, earthworms, and other forms of life. The uprooting of trees also influences soil formation by mixing the soil and loosening the underlying material.

Man also has influenced the direction and rate of soil formation. He has altered the soils by drainage, by changing the vegetation, by tilling and compacting the soils, and by changing the amount of organic matter.

Relief

Relief affects both surface runoff and internal drainage. Surface runoff influences the degree of erosion and, in turn, affects soil depth. Internal drainage affects the weathering of the soil material and of the bedrock. Steep soils commonly have a restricted depth because of runoff and erosion. The steep, shallow Weikert soils, for example, lose soil material almost as fast as it forms. Ernest soils, however, formed in colluvium at the base of steep slopes where the constant downslope movement of soil material increases the depth of the soil.

Time

The effect of climate, relief, and living organisms in changing parent material into soil is governed by the time that these factors have been in action. The degree of horizon development generally indicates the age of a soil. The Pope, Steff, and Melvin soils, which are on flood plains, are younger than most other soils in the county. Organic matter has accumulated on the surface of these soils, but the horizons below that are less distinct than those in most soils on uplands and terraces. The soils on terraces are not so old as soils on uplands, but enough time has passed for horizons to develop. These soils are post-glacial; they began forming when large amounts of silty material washed into the valleys as the glacier melted.

Classification of the Soils

Soils are classified so that their significant characteristics can be more easily remembered. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help in understanding their behavior and their responses to manipulation. First through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in developing rural areas, in engineering work, in managing farms, range, and woodland, and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*20*). Because this system is under continual study, readers interested in developments in the system should refer to the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. In table 9, the soil series of Armstrong County are placed in four categories of the current system, and the six categories are briefly defined in the following paragraphs.

ORDER. Ten soils orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER. Each order is divided into suborders that are based primarily on those soil characteristics that produce classes with the greatest similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of water-logging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and

TABLE 9.—*Classification of the soils*

Series	Family	Subgroup	Order
Allegheny	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Cavode	Clayey, mixed, mesic	Aeric Ochraquults	Ultisols.
Ernest	Fine-loamy, mixed, mesic	Aquic Fragiudults	Ultisols.
Gilpin	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Hazleton	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Melvin	Fine-silty, mixed, nonacid, mesic	Typic Fluvaquents	Entisols.
Pope	Coarse-loamy, mixed, mesic	Fluventic Dystrochrepts	Inceptisols.
Rainsboro	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Rayne	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Steff	Fine-silty, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Upshur	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Vandergrift	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.
Weikert	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Wharton	Clayey, mixed, mesic	Aquic Hapludults	Ultisols.

sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Fluvaquents* (*Fluv*, meaning river or flood plain, *aqu*, for wetness or water, and *ent*, from Entisols.

SUBGROUP. Great groups are divided into subgroups, one representing the central, or typic, segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups can also be made if soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Fluvaquents (a typical Fluvaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families. An example is the fine-silty, mixed, nonacid, mesic family of Typic Fluvaquents.

SERIES. The series is a group of soils in the same family that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. A series is usually given the name of a geographic location near the place where that series was first observed and mapped. An example is the Melvin series, which was first observed in Lauderdale County, Alabama.

The nomenclature for the classes in each of the four highest categories is, for the most part, connotative. The formative elements come chiefly from the classical languages. Many of the roots are familiar and thus help us to visualize the soil. For example, the Melvin series is classified as *Typic Fluvaquents*. One can visualize that the Melvin soils are typical (*typic*), are along a river or flood plain (*Fluv* modified from *fluvius*), are wet (*Aqu* modified from *aqua*), and are young soils (*Ent* meaning recent).

The names are distinctive for the classes in each category, so that a name itself will indicate the category to which a given class belongs. Moreover, the names are designated so that each subgroup by its name is placed in the great group, suborder, and order with which it is identified. For example, the name *Typic Fluvaquents* indicates a class in the subgroup. Furthermore, from the name, one can identify the great group (*Fluvaquents*), the suborder (*Aquents*), and the order (*Entisols*).

Laboratory Data[6]

Physical, chemical, and mineralogical properties of Melvin, Rainsboro, Steff, and Vandergrift soils are given in tables 10 and 11. For each soil, a pit was dug through the solum into the underlying material, and samples were collected from each recognizable horizon for laboratory characterization. The soil profile at each pit is representative of the series in slope, erosion, stoniness, and present use. The profiles are described in the section "Descriptions of the Soils."

Samples were also taken from selected horizons for engineering tests by the Soil Testing Laboratory of the Pennsylvania Department of Transportation. Results of the engineering tests are given in table 5 in the section "Engineering Uses of the Soils." Additional characterization data on soils in Armstrong County are given in Progress Report 316, The Pennsylvania State University, Agricultural Experiment Station, 1971.

Methods of Analysis

Bulk samples, 3 to 4 liters in size, were collected from each soil horizon. The samples were air dried and sieved to remove all coarse fragments larger than 2 millimeters in diameter. Particle-size distribution was determined by the pipette method (*11*) and is presented as the percent of oven-dried weight of the material smaller than 2 millimeters in diameter. The coarse-fragment data are presented as the percent by weight and the volume percent, based on the weight of the coarse fragments and the air-dried material smaller than 2 millimeters in diameter (fine earth).

Bulk density was determined from triplicate clods at a moisture content equilibrated at 1/3 atmosphere tension and at oven dryness. Also, bulk-density determinations at the above moisture contents were made for the material smaller than 2 millimeters in diameter within the clods. The total bulk-density data presented represents the average density of the soil mass, taking into account all coarse fragments found in the bulk sample. This figure was then multiplied by the percent (by weight) of available moisture capacity to get available moisture capacity percent in inches of moisture per inch of soil.

The total bulk density of the sample is also used in calculating the volume percent of coarse fragments.

The clods were also used in determining coefficient of linear extensibility (COLE), which is a measure of the shrink-swell potential of the soils (*8*).

COLE values presented in table 10 are calculated on the basis of the material smaller than 2 millimeters in diameter, and any coarse fragments present in the horizon will act as a diluent and reduce the COLE value. An approximate coarse-fragment correction can be made as follows:

Corrected COLE = Uncorrected COLE × Volume percent of less-than-2 mm. material ÷ 100

For a more precise correction, the nomographs of Holmgren (*9*) should be used.

Moisture determinations were made on triplicate

[6] Laboratory analysis and interpretations were made at the Soil Characterization Laboratory of the Pennsylvania State University by R. P. MATELSKI, R. L. CUNNINGHAM, E. J. CIOLKOSZ, G. W. PETERSON, and R. W. RANNEY.

TABLE 10.—*Physical*

[Dashes in columns indicate that the material was not

Soil series and sample number	Horizon	Depth from surface	Particle-size distribution									
			Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.10 mm)	Very fine sand (0.10 to 0.05 mm)	Silt (0.02 to 0.002 mm)	Silt (0.005 to 0.002 mm)	Total sand (2.0 to 0.05 mm)	Total silt (0.05 to 0.002 mm)	Total clay (Smaller than 0.002 mm)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Melvin:												
S68PA-3-3-1	Ap	0–9	0.2	0.8	1.7	6.0	7.6	34.7	11.9	16.3	51.8	31.9
S68PA-3-3-2	B21g	9–22	.1	.2	1.8	5.1	8.0	33.8	11.6	15.2	50.5	34.4
S68PA-3-3-3	B22g	22–35	.2	.6	2.2	7.2	8.5	32.7	11.3	18.8	49.3	32.0
S68PA-3-3-4	C1	35–44	.2	.7	1.8	9.4	15.4	23.8	8.6	27.4	41.3	31.3
S68PA-3-3-5	C2g	44–52	.1	.4	2.2	17.1	17.5	20.7	7.8	37.3	39.9	22.8
S68PA-3-3-6	IIC3	52–60	9.5	11.3	11.9	12.1	7.9	16.2	4.3	52.7	24.9	22.4
Rainsboro:												
S68PA-3-11-1	Ap	0–8	.8	1.1	1.9	2.1	5.3	40.8	8.5	11.2	70.3	18.5
S68PA-3-11-2	B21t	8–15	.3	1.1	1.3	1.8	3.9	43.0	9.7	8.4	72.4	19.2
S68PA-3-11-3	B22t	15–21	.1	.5	1.3	1.9	5.4	37.5	7.5	9.1	71.0	19.9
S68PA-3-11-4	B23t	21–28	-------	.7	1.6	2.1	6.8	35.2	7.1	11.2	67.5	21.3
S68PA-3-11-5	Bx1	28–40	.1	1.0	2.6	3.6	6.6	35.5	6.7	13.9	66.4	19.7
S68PA-3-11-6	IIBx2	40–50	.3	3.6	9.2	7.6	6.6	34.7	8.3	27.3	56.8	15.8
S68PA-3-11-7	IIBx3	50–60	.3	2.3	5.6	8.5	6.5	33.0	6.5	23.2	55.3	21.5
S68PA-3-11-8	IIC1	60–70	.3	1.2	4.9	13.0	10.4	20.5	3.7	29.8	37.8	32.4
S68PA-3-11-9	IIC2	70–76	.1	.8	4.0	34.3	11.5	8.3	1.4	50.7	21.5	27.8
Steff:												
S68PA-3-5-1	Ap1	0–7	-------	.5	3.2	25.2	21.8	26.1	9.2	34.2	44.7	21.1
S68PA-3-5-2	Ap2	7–14	1.7	1.1	1.9	8.5	13.0	30.2	10.2	26.2	49.7	24.0
S68PA-3-5-3	B21	14–20	.1	.6	1.7	4.8	10.2	33.1	10.6	17.4	55.1	27.6
S68PA-3-5-4	B22	20–25	.5	.6	3.1	4.2	10.0	33.3	9.6	18.4	55.5	26.1
S68PA-3-5-5	B23	25–33	-------	.3	1.9	6.2	13.9	29.7	8.3	22.2	50.8	27.0
S68PA-3-5-6	B24	33–45	-------	.6	2.3	5.3	17.0	27.6	7.1	25.2	52.7	22.1
S68PA-3-5-7	IIC1	45–50	.5	2.9	15.2	28.6	17.4	8.9	1.6	64.6	21.5	13.9
S68PA-3-5-8	IIIC2	50–55	3.8	8.9	34.0	19.0	6.8	9.4	4.9	72.5	16.8	10.7
S68PA-3-5-9	IVC3	55–60	1.7	7.6	32.9	20.7	6.9	12.1	4.5	69.8	20.7	9.5
S68PA-3-5-10	VC4	60–70	1.8	8.1	27.3	18.0	8.5	15.3	4.4	63.7	25.5	10.8
Vandergrift:												
S68PA-3-9-1	Ap1	0–9	2.0	1.8	1.6	2.5	3.6	46.3	13.2	11.4	58.6	30.0
S68PA-3-9-2	Ap2	9–14	3.2	1.5	1.3	2.6	2.3	47.6	15.4	10.9	58.9	30.2
S68PA-3-9-3	B21t	14–21	.3	.4	.3	.8	1.2	35.5	12.4	2.9	41.1	55.9
S68PA-3-9-4	B22t	21–34	-------	-------	.2	.6	1.0	35.3	15.1	1.8	40.6	57.6
S68PA-3-9-5	B23t	34–46	.1	.1	.6	.9	1.7	40.6	16.8	3.3	45.8	50.9
S68PA-3-9-6	B3t	46–56	.1	.3	.8	2.4	2.0	43.9	18.5	5.5	52.9	41.6
S68PA-3-9-7	C1	56–63	2.3	2.5	2.4	2.5	6.1	42.5	17.7	15.9	51.4	32.7
S68PA-3-9-8	C2	63–66	.8	2.2	1.9	2.1	5.1	50.4	20.7	12.2	60.2	27.6

clods weighing 100 to 300 grams that were taken from each horizon and coated with saran resin (*5*). The clods were soaked with water, then equilibrated at 1/3 atmosphere on a tension plate, and the percent moisture by weight was determined (*19*). The percent moisture by weight of the material smaller than 2 millimeters in diameter in the clod was also obtained. The percent moisture by weight of sieved material smaller than 2 millimeters in diameter was determined at 15 atmospheres in a pressure-plate apparatus (*19*). From these data the available moisture capacity was calculated on a weight basis. These calculations include all coarse fragments in the bulk sample.

Available moisture data is presented on a volume basis. The unit used for presentation of this data is inches of moisture per inch of soil. The calculation of this unit is given in the preceeding paragraph on bulk density.

Basic cations were extracted with neutral, normal NH_4OAc solution (*15*). Calcium, magnesium, and potassium determinations were made by flame emission spectrophotometry. A pH 8.1 $BaCl_2$-triethanolamine extract was titrated with 0.05 *N* HCl to determine extractable acidity (*14*). Aluminum was extracted with 1 *N* KCl and determined by the aluminon method (*10*). Organic carbon was determined by ignition in a Fisher carbon-induction apparatus (*21*). Nitrogen was determined by the Kjeldahl method (*4*).

properties of selected soils

present or that the determination was not made]

Textural class (based on laboratory data)	Coarse fragments (larger than 2.0 mm)		Bulk density at 1/3 bar moisture tension		Coefficient of linear extensibility (COLE)	Moisture held at—		Available moisture capacity (including coarse fragments)
	Percent by weight	Percent by volume	Material smaller than 2 mm in clods	Total soil mass including coarse fragments		Tension of 1/3 bar (material smaller than 2 mm in clods)	Tension of 15 bars (material smaller than 2 mm sieved)	
			Grams per cubic centimeter	*Grams per cubic centimeter*		*Percent*	*Percent*	*Inches per inch of soil*
Silty clay loam	2.3	1.2	1.33	1.33	0.051	38.8	18.8	0.24
Silty clay loam	—	—	1.55	1.55	.023	22.3	16.5	.09
Silty clay loam	.3	.2	1.54	1.54	.037	24.5	15.3	.14
Clay loam	8.9	5.3	1.55	1.55	.033	20.3	13.3	.10
Loam	.2	.1	1.47	1.47	.025	18.5	10.9	.11
Sandy clay loam	80.8	71.8	—	—	—	—	10.1	—
Silt loam	1.0	.5	1.35	1.36	.012	23.5	10.2	.18
Silt loam	1.0	.5	1.44	1.45	.014	22.5	9.2	.19
Silt loam	.5	.3	1.43	1.43	.011	23.0	10.5	.18
Silt loam	—	—	1.44	1.44	.017	22.6	10.3	.18
Silt loam	1.3	.7	1.44	1.45	.018	21.2	9.0	.17
Silt loam	8.1	6.1	1.70	1.73	.011	15.4	7.3	.13
Silt loam	4.1	2.7	1.60	1.63	.016	18.5	10.2	.13
Clay loam	13.3	8.5	1.43	1.55	.025	23.2	13.2	.14
Sandy clay loam	5.9	3.7	1.39	1.42	.014	20.6	11.3	.12
Loam	13.0	7.5	1.35	1.38	.021	24.7	13.3	.14
Loam	13.0	8.0	1.39	1.43	.020	24.2	13.5	.14
Silty clay loam	3.3	1.8	1.34	1.35	.028	28.2	18.2	.13
Silt loam	1.4	.7	1.33	1.33	.025	28.0	18.8	.12
Silt loam	.5	.3	1.43	1.43	.016	23.8	13.2	.15
Silt loam	.3	.2	1.41	1.41	.022	23.0	13.3	.14
Fine sandy loam	2.5	1.6	1.51	1.51	.013	12.5	7.2	.08
Sandy loam	44.6	34.4	1.65	1.76	.023	9.1	5.2	.04
Sandy loam	4.0	2.6	—	—	—	—	5.4	—
Sandy loam	53.0	40.5	—	—	—	—	6.6	—
Silty clay loam	6.0	3.8	1.56	1.56	.013	22.8	12.8	.15
Silty clay loam	3.2	2.0	1.43	1.43	.010	23.9	13.3	.15
Silty clay	6.0	3.3	1.40	1.40	.061	26.5	19.8	.09
Silty clay	—	—	1.51	1.51	.074	23.4	21.7	.02
Silty clay	—	—	1.49	1.49	.068	23.6	20.2	.05
Silty clay	2.0	1.2	1.61	1.61	.058	19.9	16.2	.06
Silty clay loam	3.5	2.6	1.63	1.65	.034	18.9	13.3	.07
Silty clay loam	3.5	2.2	1.80	1.82	.030	13.5	10.2	.06

Soil pH was measured on sieved, air-dried samples with a pH meter and a glass electrode. Measurements were made at soil-solution weight ratios of 1:1 with N KCl, 0.01M $CaCl_2$, and distilled water as suspending agents.

Clay minerals in selected horizons were identified by X-ray diffraction using copper radiation, Geiger counter, and chart recorder. Prior to X-ray analysis, the air-dried samples were treated with hydrogen peroxide to destroy organic matter. Iron oxides were removed by sodium dithionite-citrate-bicarbonate extraction (*13*), and iron was determined colorimetrically with orthophenanthroline.

Clay (particles smaller than 0.002 millimeters) was separated with a centrifuge; one portion was then saturated with potassium ions and one portion saturated with magnesium ions. The suspensions of clay were placed on glass slides, allowed to air dry, and used to obtain diffraction traces. The magnesium-saturated slide was vapor-solvated with ethylene glycol, and the potassium-saturated slide was heated to 300° C and 550° C successively. Diffraction traces were obtained from each treatment. The traces were interpreted on the basis of peak height and relationship to known soil-clay mixtures using a method developed by L. J. Johnson. Estimates were made to the nearest 5 to 10 percent.

TABLE 11.—*Chemical*

[Dashes in columns indicate that the material was not

Soil series and sample number	Horizon	Depth from surface	Organic carbon	Nitro-gen	Carbon-nitrogen ratio	Calci-um-mag-nesium ratio	Extractable cations (milliequivalents per 100 grams of soil)					
							Cal-cium	Magne-sium	Sodium	Potas-sium	Acidity	Alumi-num
		Inches	*Percent*	*Percent*								
Melvin:												
S68PA-3-3-1	Ap	0–9	2.12	0.23	9	51.0	20.4	0.4	0.14	0.19	6.6	0.1
S68PA-3-3-2	B21g	9–22	.64	.06	11	10.0	8.0	.8	.08	.12	10.5	2.9
S68PA-3-3-3	B22g	22–35	.37	.04	9	3.1	10.7	3.4	.13	.11	3.7	.5
S68PA-3-3-4	C1	35–44	.23	—	—	2.5	13.2	5.2	.12	.15	5.4	.5
S68PA-3-3-5	C2g	44–52	.22	—	—	2.8	11.6	4.1	.11	.15	4.6	.5
S68PA-3-3-6	IIC3	52–60	.24	—	—	3.0	8.4	2.8	.08	.13	6.6	.4
Rainsboro:												
S68PA-3-11-1	Ap	0–8	1.68	.16	10	35.3	10.6	.3	.07	.17	5.4	.1
S68PA-3-11-2	B21t	8–15	.23	—	—	—	7.9	—	.08	.15	7.8	.1
S68PA-3-11-3	B22t	15–21	.14	—	—	37.0	7.4	.2	.10	.18	6.8	.4
S68PA-3-11-4	B23t	21–28	.16	—	—	6.3	4.4	.7	.07	.18	9.0	2.0
S68PA-3-11-5	Bx1	28–40	.11	—	—	.7	2.0	3.0	.07	.17	9.7	3.1
S68PA-3-11-6	IIBx2	40–50	.14	—	—	.4	1.1	2.6	.06	.14	7.3	1.3
S68PA-3-11-7	IIBx3	50–60	.15	—	—	.4	1.4	3.3	.07	.15	8.9	2.6
S68PA-3-11-8	IIC1	60–70	.16	—	—	.3	1.4	4.0	.09	.17	13.1	3.5
S68PA-3-11-9	IIC2	70–76	.11	—	—	.7	1.7	2.6	.08	.18	11.5	3.4
Steff:												
S68PA-3-5-1	Ap1	0–7	3.07	.18	17	21.3	6.4	.3	.05	.20	12.1	.4
S68PA-3-5-2	Ap2	7–14	2.36	.16	15	18.3	5.5	.3	.04	.17	14.2	1.2
S68PA-3-5-3	B21	14–20	1.41	.15	9	13.5	5.4	.4	.03	.15	14.0	1.6
S68PA-3-5-4	B22	20–25	.73	.10	7	10.2	5.1	.5	.05	.15	11.6	2.0
S68PA-3-5-5	B23	25–33	.55	.08	7	6.3	4.4	.7	.05	.15	7.2	2.1
S68PA-3-5-6	B24	33–45	.51	.06	8	3.9	3.5	.9	.06	.14	6.4	1.2
S68PA-3-5-7	IIC1	45–50	.49	.04	12	3.6	1.8	.5	.06	.12	2.4	.4
S68PA-3-5-8	IIIC2	50–55	.32	.03	11	3.5	1.4	.4	.04	.10	1.6	.5
S68PA-3-5-9	IVC3	55–60	.50	.04	12	3.2	1.3	.4	.03	.09	.4	.3
S68PA-3-5-10	VC4	60–70	.27	.03	9	3.0	1.5	.5	.03	.11	3.9	.9
Vandergrift:												
S68PA-3-9-1	Ap1	0–9	1.88	.17	11	31.7	9.5	.3	.04	.16	12.9	.4
S68PA-3-9-2	Ap2	9–14	1.31	.12	11	10.3	3.1	.3	.03	.17	16.8	2.0
S68PA-3-9-3	B21t	14–21	.36	.08	4	4.0	2.8	.7	.04	.39	18.5	5.8
S68PA-3-9-4	B22t	21–34	.19	—	—	.9	2.3	2.6	.08	.51	21.3	9.1
S68PA-3-9-5	B23t	34–46	.16	—	—	.8	3.3	3.9	.07	.51	17.7	6.9
S68PA-3-9-6	B3t	46–56	.13	—	—	1.0	4.8	4.7	.09	.45	12.5	3.4
S68PA-3-9-7	C1	56–63	.03	—	—	1.3	6.7	5.0	.09	.20	11.1	2.2
S68PA-3-9-8	C2	63–66	.06	—	—	1.8	9.8	5.3	.09	.20	5.5	.6

Summary of Data

Coarse fragments are particles larger than 2 millimeters (0.08 inch) in diameter. The high content of coarse fragments below a depth of 50 inches in the Melvin and Steff soils is because of the gravelly stream bed material that underlies the finer alluvial sediment of the flood plains. The amount of coarse fragments in Vandergrift and Rainsboro soils is very low.

The Melvin and Steff soils formed in stratified alluvial sediment. The variations in texture with increasing depth are likely a reflection of the nature of accumulation. The Vandergrift soil, however, has a relatively high amount of clay and shows a change in clay content with increasing depth. The lesser amount of clay in the upper 14 inches as compared to the lower horizons is attributed to removal of clay from the A horizon and deposition in the B horizon. This soil development process is caused by water movement through the soil.

Soils that have a clay content as high as the Vandergrift soils have limitations for many uses because they tend to swell, become sticky, and lose their bearing strength when wet. They also tend to be hard when dry.

The particle-size distribution of the Rainsboro soil is similar to that of the Steff soil, another moderately well drained soil, except there is more total silt in the Rainsboro soil. Medium-textured soils that have a relatively high content of silt are generally suitable for many uses. But some of these soils, such as the Rainsboro soils, have a fragipan that may be a limitation for some uses.

Bulk density is an expression of the weight per unit volume of the naturally occurring soil mass. Mineral *properties of selected soils*

present or that the determination was not made]

Cation exchange capacity (sum)	Base saturation (sum)	Reaction (1:1 soil-solution ratio)			Free iron oxides (FE_2O_3)	Mineral composition of clay fraction (percent of material smaller than 0.002 mm)				
		Water	1*N* KCl	0.1*M* $CACl_2$		Kaolinite	Illite	Vermiculite	Montmorillonite	Interstratified
Meq/100 gms. soil	*Percent*	*pH*	*pH*	*pH*	*Percent*					
27.7	76	7.0	5.7	6.5	2.3	35	15	35	—	15
19.5	46	5.7	3.4	5.1	3.9	30	15	35	—	20
18.0	80	6.9	5.0	6.2	4.8	30	35	25	—	10
24.1	78	7.2	5.5	6.5	3.1	—	—	—	—	—
20.6	78	7.4	5.5	6.6	1.4	30	30	30	—	10
18.0	63	7.4	5.6	6.5	4.9	30	45	25	—	—
16.5	67	5.7	5.0	5.3	2.0	20	25	40	—	15
15.9	51	6.5	5.2	5.6	2.6	20	35	30	15	—
14.7	54	5.8	4.3	5.1	2.8	15	40	30	15	—
14.3	37	5.2	3.6	4.2	2.7	15	40	30	15	—
14.9	35	5.0	3.2	4.0	2.6	15	40	40	5	—
11.2	35	5.2	3.2	4.1	1.7	—	—	—	—	—
13.8	36	5.2	3.1	4.1	2.6	15	30	40	—	15
18.8	30	5.1	3.1	4.0	3.8	15	30	40	—	15
16.1	28	4.9	3.2	4.0	3.4	20	25	40	—	15
19.0	36	5.9	4.3	5.2	3.7	30	30	30	—	10
20.2	30	5.6	3.9	4.8	3.8	30	30	30	—	10
20.0	30	5.5	3.7	4.7	3.7	30	30	35	—	5
17.4	33	5.6	3.7	4.7	3.9	30	30	35	—	5
12.5	42	5.7	3.7	4.8	3.6	30	30	35	—	5
11.0	42	5.8	3.8	4.9	3.9	30	30	35	—	5
4.9	51	5.7	4.0	4.8	2.7	25	35	35	—	5
3.5	55	5.8	4.1	4.9	3.4	30	35	30	—	5
2.2	82	5.9	4.1	4.8	2.5	30	35	30	—	5
6.0	35	5.7	3.8	4.6	3.6	30	35	30	—	5
22.9	44	5.7	4.3	4.8	2.5	30	25	20	—	25
20.4	18	5.2	3.5	4.2	2.6	25	35	25	—	15
22.4	18	4.7	3.1	3.7	4.3	25	45	15	—	15
26.8	20	4.6	3.0	3.6	4.8	15	50	15	—	20
25.5	30	4.8	3.0	3.6	4.9	15	45	20	—	20
22.5	44	4.8	3.0	3.7	4.8	15	50	20	—	15
23.1	52	5.2	3.3	4.1	6.1	15	50	20	—	15
20.9	74	5.2	3.5	4.3	2.5	15	50	20	—	15

particles of soil have a density of about 2.5 grams per cubic centimeter, and thus a soil that is half pore space would have a bulk density of about 1.25 grams per cubic centimeter. Low bulk density values indicate a high degree of aeration (unless the soil is waterlogged) and easy workability. Two bulk density values are given for each soil horizon. The bulk density of the entire clod may not be representative of the whole soil mass because the clod can contain more or fewer coarse fragments than the whole soil. Weight and volume of fragments are deducted in calculation of the bulk density of the material less-than-2 millimeters in diameter in the clods. This bulk density value is indicative of the porosity or compactness of the soil material.

Bulk density usually increases with depth, reflecting less pore space. Fragipan horizons, such as the Bx2 and Bx3 horizons of the Rainsboro soil, commonly have higher bulk density than horizons above the fragipan. Such bulk density values reflect low pore space and the relative impermeability of the fragipan horizons.

The foregoing bulk density values represent the soil in a moist condition. Soil material shrinks on drying, causing a higher bulk density. COLE (coefficient of linear extensibility) (*7*) expresses the relative ability of soil materials to shrink and swell on drying and wetting.

The high COLE values of the B horizon of the Vandergrift soils help to explain the cracking of these horizons when they dry and the landslides and slips in areas where these soils are sloping. Further engineering problems might be expected when working with these soils because of their high shrinkage upon drying and swelling upon wetting.

Measurement of the percent moisture retained at two different tensions permits the estimation of the moisture storage capacity of the soil. The greater the difference between the 1/3- and 15-atmosphere tension values, the higher the moisture storage capacity of the soil. Because coarse fragments generally hold little or no available moisture, they must be considered in calculations. The available moisture capacity values given are for the soil mass as a whole, allowing for coarse fragments.

Although available moisture is adequate in the upper 14 inches of the Vandergrift soil, the subsoil has a low capacity for the storage of moisture. The high clay content is accompanied by a high 15 atmosphere moisture content, and consequently the differences between field capacity and wilting coefficient estimates are relatively small. The other soils sampled have relatively favorable available moisture capacity.

Mineral and organic particles in the soil absorb positively charged ions (cations) such as calcium, magnesium, sodium, and potassium, usually called bases, as well as acidic cations such as aluminum and hydrogen. All of these cations are held in the soil against leaching by water, but they can be displaced by other cations in solution. Each soil has a particular capacity to hold cations, and the total of the extractable cations (basic and acidic) equals the cation exchange capacity of a given soil sample. Extractable aluminum is not added since it is included in the extractable acidity value. Base saturation is the percentage of the cation exchange capacity satisfied by bases. This is an important index of fertility because the bases are plant nutrients while excess acidity generally is detrimental to plant growth.

A fertile soil has a cation exchange capacity high enough to store a reasonable amount of plant nutrients, 10 or more milliequivalents per 100 grams. Beyond this the relative amounts of each element are also important. For example, 5 milliequivalents per 100 grams is an adequate calcium level for a topsoil that has a cation exchange capacity of 10 milliequivalents per 100 grams, but it is low for one that has a cation exchange capacity of 20 milliequivalents per 100 grams. The magnesium level should be one-third to one-sixth of the calcium level for best growth of most crops, and the potassium level normally should be less than the magnesium level. Sodium occurs only in very small amounts in most soils in Pennsylvania.

Extractable magnesium is low in all the Ap horizons tested. In some places this may be because the soil has been limed with limestone materials that are low in magnesium. This practice would eventually displace magnesium in the soil. The low content of magnesium in the Ap horizon may not affect yields, however, because roots can obtain nutrients from below the plow layer if they are not restricted by waterlogging, a fragipan, clayey texture, or other conditions.

Carbon and nitrogen are present mainly in the organic matter. The ratio of these is indicative of the type and degree of organic decomposition that has taken place in the soil. A fertile agricultural topsoil typically has a ratio of about 10. To estimate the percent of organic matter in a soil horizon, multiply the percent of organic carbon by 2.

Organic carbon percentages greater than 0.2 at any depth much below the surface often identify soils that formed in recent alluvium, such as Melvin and Steff soils.

The mineralogical composition of the clay fraction is in many ways as important as the total amount of clay. Illite (soil mica), an important mineral in the parent material of many soils, contains potassium in a form not readily available to plants. If it is weathered, illite very slowly loses its potassium and is transformed to vermiculite, montmorillonite, or interstratified mixtures of these minerals with chlorite. Large percentages of kaolinite indicates that the soil is highly weathered.

Montmorillonite and vermiculite have high cation exchange capacities when compared to the other minerals and, therefore, enhance the ability of the soil to store some plant nutrients in an available form.

The clay minerals in Melvin and Steff soils are similar and occur in approximately equal mixtures of kaolinite, vermiculite, and illite. The Rainsboro soil has more illite and some montmorillonite and less kaolinite. The shrinking and swelling that occurs in Vandergrift soils is associated with the high amounts of clay rather than the type of clay, since it contains only moderate amounts of highly expanding minerals.

Environmental Factors Affecting Soil Use

This section provides information about some of the natural and cultural factors that affect use and management of the different kinds of soil shown on the soil map. It gives facts about climate, farming, industrial development, physiography, and geology. The statistics are mainly from recent records of the U.S. Department of Commerce, Bureau of the Census.

The area that is now Armstrong County was occupied by the Delaware Indians until 1730. The first farm in the county was started in 1784 in Plum Creek Township by Andrew Sharp.

Armstrong County was formed from parts of Westmoreland, Allegheny, and Lycoming Counties by an act of the state assembly on March 12, 1800. It was named in honor of General John Armstrong, an American officer during the French and Indian War.

Sawmills and gristmills were among the first industries in the county. The principal crops were corn, wheat, rye, oats, and vegetables; these were grown for home use.

By 1830, three iron furnaces were in operation. Next a steel mill was built at Bradys Bend. After the Pittsburgh, Kittanning, and Warren Railroad was completed in 1856, industrial development expanded rapidly. The mining of bituminous coal, the completion of the railroad, and the discovery of oil and natural gas contributed much to the growth and prosperity of the county.

Farming was influenced by industrial development in the county. After many farmers left their farms to seek jobs in industry, hay and oats for draft animals became the principal farm crops. The demand for hay decreased, however, as the size and number of small communities increased and modern technology brought electricity and gasoline engines. The demand then increased for dairy and poultry products, fruits, and vegetables. Dairy farms became the chief farming enterprise in the county, both in the number of farms and in the value of products produced.

Climate [7]

Armstrong County lies along the northern border of the Southwest Plateau climatic division. The climate is humid continental. Most weather systems that affect this area develop in the Central Plains or the Midwest and are steered eastward by the prevailing winds. The primary source of warm air and moisture is the Gulf of Mexico. Cold air comes from Canada.

Climatological data from records kept at Ford City are used in this section because of the central location of the town and the length of time accurate records have been kept at the weather station there. These data, however, are more representative of valley locations in Armstrong County than of the higher areas. Generalizations are made about the climate at the higher elevations.

The topography is rolling and hilly, and elevation ranges from 900 to 1,200 feet above mean sea level, except in the northeastern part of the county where elevation is commonly more than 1,500 feet above mean sea level. Because of the rugged topography, any generalization about temperature or precipitation may be inaccurate. For example, because of north-facing slopes and cold-air drainage, nighttime temperatures are lower in low-lying areas than in many areas on hillsides. Slightly more rainfall can be expected on west-facing places on higher elevations than on east-facing places at the same elevations.

The average temperature ranges from about 48° F. in the extreme northeast to a little above 50° along the southern border of the county. Annual precipitation ranges from about 40 inches in the southwest to about 44 inches in the northeast. The topography, mainly, accounts for these differences. The higher elevations in the northeast are cooler, and the orographic uplift of the prevailing westerly flow of air forces more moisture to fall in the northeast.

Summers are warm and pleasant. High temperatures in the daytime average in the low 80's and reach or exceed 90° on an average of 10 days each year. The record high temperature of 98° was set on September 3, 1953. Freezing temperatures generally do not occur from June through mid-September. Cloud cover is at a minimum in the summer; the area receives more than 60 percent of available sunshine, and nights are usually clear. The prevailing wind is from the southwest and averages 9 miles per hour. Summer rainfall is mostly thundershowers that occur on the average of 22 days from June through August.

During winter, high temperatures in the daytime average in the mid 30's, and low temperatures at night are in the mid and upper teens. Readings of 70° have been recorded in the middle of winter, but such occurances are rare and brief. On an average of 9 days each winter, the temperature dips to 0° or below. The record low temperature is −23°, which occurred on January 29, 1963. Cloudiness is prevalent in winter, especially during daylight hours, because of the increased frequency of cold fronts and low-pressure systems that result from wind being forced up slopes at higher elevations. Prevailing surface winds are from the west-southwest and average 10 to 15 miles per hour.

The first snowfall of any consequence usually occurs late in November or in December. In most storms the snowfall is less than 10 inches, but in a few it has exceeded 15 inches. The greatest daily snowfall was 19 inches, which fell on November 25, 1950. Snow continued to fall the following few days, and the snow depth of 24 inches on November 28, 1950 is still the greatest on record at Ford City. In the Ford City area and over much of Armstrong County, a snow cover of 1 inch or more is noted on about 50 days each winter. Snow cover is not too persistent in winter, because periods of thaw are frequent. On north-facing slopes at higher elevations, however, a snow cover generally stays on the ground throughout the winter.

After March, the probability of snow diminishes rapidly, although a few light snow flurries are possible even early in May.

Prevailing winds blow from the southwest in spring and from the south in fall. They average 10 miles per hour. By mid-May, maximum temperatures average near 70°. The average maximum of 70° or higher extends into October.

Fall is the driest time of the year, but prolonged periods of drought seldom occur. The longest dry spells last no more than 2 or 3 weeks.

More data on temperature and precipitation are given in table 12.

The growing season averages 150 days at Ford City but has ranged from 115 days in 1949 to 178 days in 1958. It ranges from about 130 days in the northeastern part of the county to nearly 160 days in the extreme southern part. At Ford City, May 11 is the average date of the last frost in spring, and October 7 is the average date of the first frost in fall. More data on the growing season are given in table 13.

Thunderstorms occur most frequently in summer, but they have occurred at one time or another in each month of the year. On the average, 40 thunderstorms occur during the year; 11 occur in spring, 22 in summer, 6 in fall, and 1 in winter. Damage caused by wind and hail that accompany severe thunderstorms is recorded in Armstrong County almost every year.

Since 1854, when records were first kept on tornadoes, only four such storms have been sighted in Armstrong County, and no deaths or injuries resulted from them.

Farming

In 1969, there were 953 farms in Armstrong County and the average size was approximately 146 acres. A definite trend is noticeable over the past 30 years in that the number of farms is decreasing, but the number of acres per farm is increasing. The number of acres devoted to farming is also decreasing. Much of this decrease can be attributed to the abandonment of marginal farm operations and the conversion of farms to suburban uses near the densely settled communities.

[7] By PAUL W. DAILEY, JR. NOAA Climatologist, University Park, Pennsylvania.

TABLE 12.—*Temperature and precipitation*

[All data from Ford City, elevation 950 feet above mean sea level, for the period 1944–1970]

Month	Temperature				Precipitation				Average number of days with snow cover of—	
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Average snowfall	1 inch or more	6 inches or more
	° F	*° F*	*° F*	*° F*	*Inches*	*Inches*	*Inches*	*Inches*		
January	36	16	59	−1	2.7	1.4	4.5	8.9	14	3
February	38	17	60	−3	2.5	.9	3.5	9.1	12	3
March	48	25	71	9	3.5	1.7	5.5	8.7	7	1
April	61	36	81	20	3.7	2.3	5.9	1.2	1	
May	71	44	86	30	4.0	2.4	6.5	.1	(1)	
June	80	53	91	39	3.7	1.8	6.6			
July	83	58	92	46	4.2	2.3	6.8			
August	82	56	91	44	3.8	1.8	6.7			
September	76	49	89	35	3.0	1.0	5.6			
October	65	38	82	25	2.9	1.3	4.5			
November	51	30	72	15	2.9	1.1	4.3	3.1	2	(1)
December	39	20	61	−1	2.7	1.2	4.3	9.0	13	3
Annual	61	37			39.6	33.8	47.8	40.1	49	10

[1] Less than one-half day.

TABLE 13.—*Probability of last freezing temperature in spring and first in fall*

[Based on records kept at Ford City]

Probability	Dates of given probability for temperature of—				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 3	April 9	April 20	May 8	May 25
2 years in 10 later than	March 31	April 5	April 18	May 7	May 18
5 years in 10 later than	March 21	March 30	April 11	April 24	May 8
Fall:					
1 year in 10 earlier than	November 12	October 25	October 20	October 5	September 24
2 years in 10 earlier than	November 15	November 5	October 23	October 7	September 28
5 years in 10 earlier than	November 27	November 13	November 5	October 20	October 7

A number of farms also have been sold for strip mining.

The average age of farm owner-operators is increasing. In 1969, according to the census, it was 52 years. This indicates that younger farmers are seeking employment off the farm. Many farms in Armstrong County are operated parttime. Because the county is close to Pittsburgh, a number of marginal farms have been purchased as second homes or vacation homes.

The number of acres used for harvested crops is decreasing. According to the U.S. Census of Agriculture, the total number of acres of harvested crops was 60,746 in 1964 and 53,022 in 1969. Hay, small grains, and corn and sorghum are the principal crops grown in the county. In 1964, 30,536 acres of hay, 17,167 acres of small grains, and 12,405 acres of corn and sorghum were harvested. In 1969 the totals had decreased to 27,100 acres of hay, 12,783 acres of small grains, and 11,133 acres of corn and sorghum. In 1964 there were 200 acres of vegetables and 438 acres of orchards. In 1969 there were 300 acres of vegetables and 327 acres of orchards. The acreage of other crops was not reported in 1964, but in 1969 there were 1,379 acres of other crops grown in the county.

Industry

Industry in the county started in the towns of Freeport, Apollo, Ford City, Kittanning, and Parker. These towns were concentrated on the flood plains along the main rivers, close to water transportation. The early railroads also followed the waterways. The flood plains were narrow, and after World War II industry expanded onto the high terraces adjacent to the towns on the flood plains. Most of the development in recent years has been along major highways.

The first heavy industries were iron furnaces along the Allegheny River at Bradys Bend, which were started in the 1800's. The discovery of oil, gas, glacial sand and gravel, limestone, clay, and sand for grinding glass brought other industries.

In recent years, other industries have moved into the county. Among these are firms that manufacture wearing apparel, lumber products, electrical fixtures, ceramics, and glass products and that process food.

Physiography

Armstrong County lies on the Allegheny Plateau. After thousands of years of stream cutting and other geological erosion, however, the county does not resemble a plateau. It is characterized by narrow, gently sloping valleys, very steep adjacent hillsides, and narrow, gently sloping and moderately sloping ridgetops. The lowest elevation is 750 feet above sea level at Freeport Borough along the Allegheny River. The highest point is 1,720 feet near the village of Muff in Wayne Township.

The Allegheny River cuts through the western part of the county. Mahoning Creek and Redbank Creek parallel each other and flow westward through the northern part of the county, finally emptying into the Allegheny River.

Although the rugged terrain has hindered development, it has advantages. The hillsides that remain undeveloped in and around the urban centers provide valuable open space and a pleasing view. The broken pattern of development, which is the result of the steep terrain, provides visual relief and is a contrast to the monotonous sprawl of concrete in other urban areas.

Geology

Minerals, gas, oil, and water are extracted from rock formations in Armstrong County. The rock formations affect the type and location of large structures, such as buildings, dams, and highways.

Rocks underlying the county originated millions of years ago as layers of sand, gravel, silt, and animal remains were being deposited. Subjected to pressure for long periods, these layers evolved into sedimentary rocks such as shale, sandstone, conglomerate, and limestone. Faulting, tilting, folding, and uplift followed by erosion exposed the rocks and shaped the landscape of the county.

Exposed rocks in the county were formed during two different geological periods, the Mississippian, the older period, and the Pennsylvanian. The Pocono group of the Mississippian period is exposed along the Allegheny River and Redbank Creek in the northern and northwestern parts of the county. This group consists predominantly of gray, hard, massive, crossbedded conglomerate and sandstone and some shale.

Three formations of the Pennsylvanian period, the Pottsville, Allegheny, and Conemaugh, are exposed throughout the remaining parts of the county. The Pottsville formation consists of massive sandstone interbedded with thin layers of shale and coal. These rocks are exposed in the valleys. The Allegheny formation consists of interbedded siltstone, shale, sandstone, and limestone and some productive veins of coal. It overlies the Pottsville formation and is most extensively exposed in the northern third of the county. The Conemaugh formation consists of gray and red shale interbedded with siltstone, fine-grained sandstone, and thin beds of limestone. This formation also contains beds of coal. It is exposed over most of the southern two-thirds of the county, except in some of the valley areas along the river and main streams. It is also exposed on higher uplands in the northern part of the county.

The mineral resources of Armstrong County are coal, clay, limestone, oil, gas, sand, and gravel. Coal is the most important mineral resource, followed by oil and gas. Estimates indicate that there are probably 2.5 billion tons of recoverable coal remaining in the county. Most of the remaining coal is in the Lower Kittanning and the Upper and Lower Freeport beds.

Clay and clay products come after the coal, oil, and gas in value. The Clarion and Lower Kittanning clays are the most extensive within the county, and most of the mining is near Kittanning, Freeport, Worthington, and Templeton. This clay is used in making bricks, tile, and other pottery products.

Sandstone has been quarried extensively near Freeport for dimension stone. Some of the Mahoning sandstone and the Freeport and Homewood sandstones are crushed to sand for grinding glass at Ford City.

The Vanport and Upper Freeport limestones occur throughout the county and have been used for cement, flux, and lime. Currently, most of the limestone is being quarried near Worthington, Girty, Garrets Run, Kaylor, and McWilliams.

Sand and gravel for a variety of uses are found along the Allegheny River on high river terraces.

Information about the geological formations of the county can help determine the extent and location of ground-water supplies. Generally, the sandstones and conglomerates yield the best water, both in quality and quantity, and the shales generally yield fair water. Although many limestone wells produce large quantities of water, the water is hard and is subject to contamination from sewage because of the excessively permeable soil material over cavernous limestone.

Literature Cited

(1) Allan, Phillip F., Garland, Lloyd E., and Dugan, R. Franklin. 1963. Rating Northeastern Soils for Their Suitability for Wildlife Habitat. 28th North Am. Wildl. and Nat. Resour. Conf. Wildl. Manage. Inst., pp. 247–261, illus.

(2) American Association of State Highway [and Transportation] Officials. 1970. Standard Specifications for Highway Materials and Methods of Sampling and Testing. Ed. 10, 2 vol., illus.

(3) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(4) Association of Official Agricultural Chemists. 1955. Official Methods of Analysis. Ed. 8, pp. 805–806, illus.

(5) Brasher, B. R., Franzmeier, D. P., Valassis, V. T., and Davidson, S. E. 1966. Use of saran resin to coat natural soil clods for bulk-density and water-retention measurements. Soil Sci. 101: 108.

(6) Ferguson, Roland H. 1968. Timber Resources of Pennsylvania. USDA Forest Serv. Bull. N.E.–8., 147 pp., illus.

(7) Franzmeier, D. P., and Ross, S. J., Jr. 1968. Soil swelling: laboratory measurement and relation to other soil properties. Soil Sci. Soc. Am. Proc. 32: 573–577.

(8) Grossman, R. B., Brasher, B. R., Franzmeier, D. P., and Walker, J. L. 1968. Linear extensibility as calculated from natural-clod bulk density measurements. Soil Sci. Soc. Am. Proc. 32: 570–573.

(9) Holmgren, G. G. S. 1968. Nomographic calculation of linear extensibility in soils containing coarse fragments. Soil Sci. Soc. Am. Proc. 32: 568–570.

(10) Hsu, Pa Ho. 1963. Effect of initial pH, phosphate, and silicate on the determination of aluminum with aluminon. Soil Sci. 96: 230–238, illus.

(11) Kilmer, Victor J. and Alexander, L. T. 1949. Methods of Making Mechanical Analysis of Soils. Soil Sci. Soc. Am. Proc. 68: 15–24.

(12) McCarthy, Edward Florince. 1933. Yellow Poplar Characteristics, Growth and Management. U. S. Dep. Agric. Tech. Bull. 356, 58 pp., illus.

(13) Mehra, O. P., and Jackson, M. L. 1960. Iron Oxide removal from soils and clays by a dithionite-citrate system buffered with sodium bicarbonate. Proc. 7th Nat. Conf. on Clays and Clay Miner. pp. 317–327.

(14) Melich, A. 1948. Determination of cation and anion exchange properties of soils. Soil Sci. 66: 429–445.

(15) Peech, Michael, Alexander, L. T., Dean, L. A., and Reed, J. F. 1947. Methods of Soil Analysis for Soil-Fertility Investigations. U.S. Dep. Agric. Circ. 757, 25 pp., illus.

(16) Research Committee on Coal Mine Spoil Revegetation in Pennsylvania. 1965. A guide for revegation of bituminous strip mine spoils in Pennsylvania. 46 pp., illus. [Revised in 1971]

(17) Schnur, G. Luther. 1937. Yield, Stand, and Volume Tables for Even-Aged Upland Oak Forest. U. S. Dep. Agric., Tech. Bull. 560, 88 pp. illus. [Reprinted in 1961]

(18) United States Department of Agriculture. 1951. Soil Survey Manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement replacing pp. 173–188 issued in May 1962]

(19) ——— 1954. Diagnosis and improvement of saline and alkali soils. U.S. Dep. Agric. Handb. 60, 160 pp., illus.

(20) ——— 1960. Soil Classification, A Comprehensive System, 7th Approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued in March 1967, September 1968, and April 1969]

(21) Young, J. L. and Lindbeck, M. R. 1964. Carbon determination in soils and organic material with a high-frequency induction furnace. Soil Sci. Soc. Am. Proc. 28: 377–381, illus.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

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

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

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.

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

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 and brittle; little affected by moistening.

Depth, soil. The distance from the surface of the soil to bedrock. The classes of soil depth used in this soil survey are:

Deep	40 inches or more to bedrock
Moderately deep	20 to 40 inches to bedrock
Shallow	less than 20 inches to bedrock

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by melt-water as it flowed from glacial ice.

Graded stripcropping. Growing of crops in strips that are graded toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered by grass for protection against erosion; used to conduct surface water away from cropland.

Gravel. Rounded and subrounded rock fragments as large as 3 inches in diameter.

High water table. A zone of saturation in the soil that is within 6 inches of the surface in most seasons. May be caused by a normal ground water table or a perched water table. A high water table is indicated by mottling. Generally associated with poorly drained and very poorly drained soils.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizons.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Loam. Soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

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

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Seasonal high water table. A zone of saturation that is within 8 to 36 inches of the surface at least part of the year. Generally caused by a perched water table. This term is associated with somewhat poorly drained and moderately well drained soils.

Sedimentary rock. A rock composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

Shale. A sedimentary rock formed by the hardening of clay deposits.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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."

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Estimated yields, table 1, page 12.
Woodland, table 2, page 16.
Suitability for wildlife habitat, table 3, page 20.
Engineering uses of the soils, tables 4, 5, 6, and 7, pages 22 through 45.
Acreage and extent, table 8, page 46.

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page
AlB	Allegheny silt loam, 3 to 8 percent slopes	44	IIe-1	8
AlC	Allegheny silt loam, 8 to 15 percent slopes	44	IIIe-1	9
CaB	Cavode silt loam, 3 to 8 percent slopes	46	IIIw-2	10
CaC	Cavode silt loam, 8 to 15 percent slopes	47	IIIe-4	10
CaD	Cavode silt loam, 15 to 25 percent slopes	47	IVe-3	10
EnA	Ernest silt loam, 0 to 3 percent slopes	47	IIw-2	9
EnB	Ernest silt loam, 3 to 8 percent slopes	48	IIe-3	8
EnC	Ernest silt loam, 8 to 15 percent slopes	48	IIIe-4	10
EnD	Ernest silt loam, 15 to 25 percent slopes	48	IVe-3	10
ErB	Ernest very stony silt loam, 0 to 8 percent slopes	49	VIs-1	11
ErD	Ernest very stony silt loam, 8 to 25 percent slopes	49	VIs-1	11
GwB	Gilpin-Weikert complex, 3 to 8 percent slopes	49	IIe-2	8
GwC	Gilpin-Weikert complex, 8 to 15 percent slopes	50	IIIe-2	9
GwD	Gilpin-Weikert complex, 15 to 25 percent slopes	50	IVe-2	10
HaB	Hazleton channery loam, 3 to 8 percent slopes	51	IIe-1	8
HaC	Hazleton channery loam, 8 to 15 percent slopes	51	IIIe-1	9
HaD	Hazleton channery loam, 15 to 25 percent slopes	51	IVe-1	10
HlD	Hazleton very stony loam, 8 to 25 percent slopes	51	VIs-1	11
Me	Melvin silty clay loam	52	IIIw-1	10
Ms	Mine dumps	52	------	--
Pm	Pope fine sandy loam	52	I-1	8
Po	Pope loam	53	I-1	8
RaA	Rainsboro silt loam, 0 to 3 percent slopes	53	IIw-2	9
RaB	Rainsboro silt loam, 3 to 8 percent slopes	54	IIe-3	8
RaC	Rainsboro silt loam, 8 to 15 percent slopes	54	IIIe-4	10
RnB	Rayne silt loam, 3 to 8 percent slopes	54	IIe-1	8
RnC	Rayne silt loam, 8 to 15 percent slopes	54	IIIe-1	9
RpD	Rayne-Gilpin very stony silt loams, 8 to 25 percent slopes	54	VIs-1	11
Se	Steff loam	55	IIw-1	8
Sf	Steff loam, high bottom	55	IIw-1	8
Sm	Strip mines	56	------	--
UgB	Upshur-Gilpin silt loams, 3 to 8 percent slopes	56	IIIe-3	10
UgC	Upshur-Gilpin silt loams, 8 to 15 percent slopes	56	IVe-4	10
UgD	Upshur-Gilpin silt loams, 15 to 25 percent slopes	56	VIe-1	10
UgE	Upshur-Gilpin silt loams, 25 to 35 percent slopes	57	VIIe-1	11
Ur	Urban land	57	------	--
WeB	Weikert shaly silt loam, 3 to 8 percent slopes	59	IIIe-2	9
WeC	Weikert shaly silt loam, 8 to 15 percent slopes	59	IVe-2	10
WkF	Weikert and Gilpin soils, 25 to 70 percent slopes	59	VIIe-1	11
WrB	Wharton silt loam, 3 to 8 percent slopes	60	IIe-3	8
WrC	Wharton silt loam, 8 to 15 percent slopes	60	IIIe-4	10
WtB	Wharton-Gilpin silt loams, 3 to 8 percent slopes	60	IIe-3	8
WtC	Wharton-Gilpin silt loams, 8 to 15 percent slopes	60	IIIe-4	10
WtD	Wharton-Gilpin silt loams, 15 to 25 percent slopes	60	IVe-3	10
WvB	Wharton-Vandergrift complex, 3 to 8 percent slopes	60	IIe-3	8
WvC	Wharton-Vandergrift complex, 8 to 15 percent slopes	61	IIIe-4	10
WvD	Wharton-Vandergrift complex, 15 to 25 percent slopes	61	IVe-3	10

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