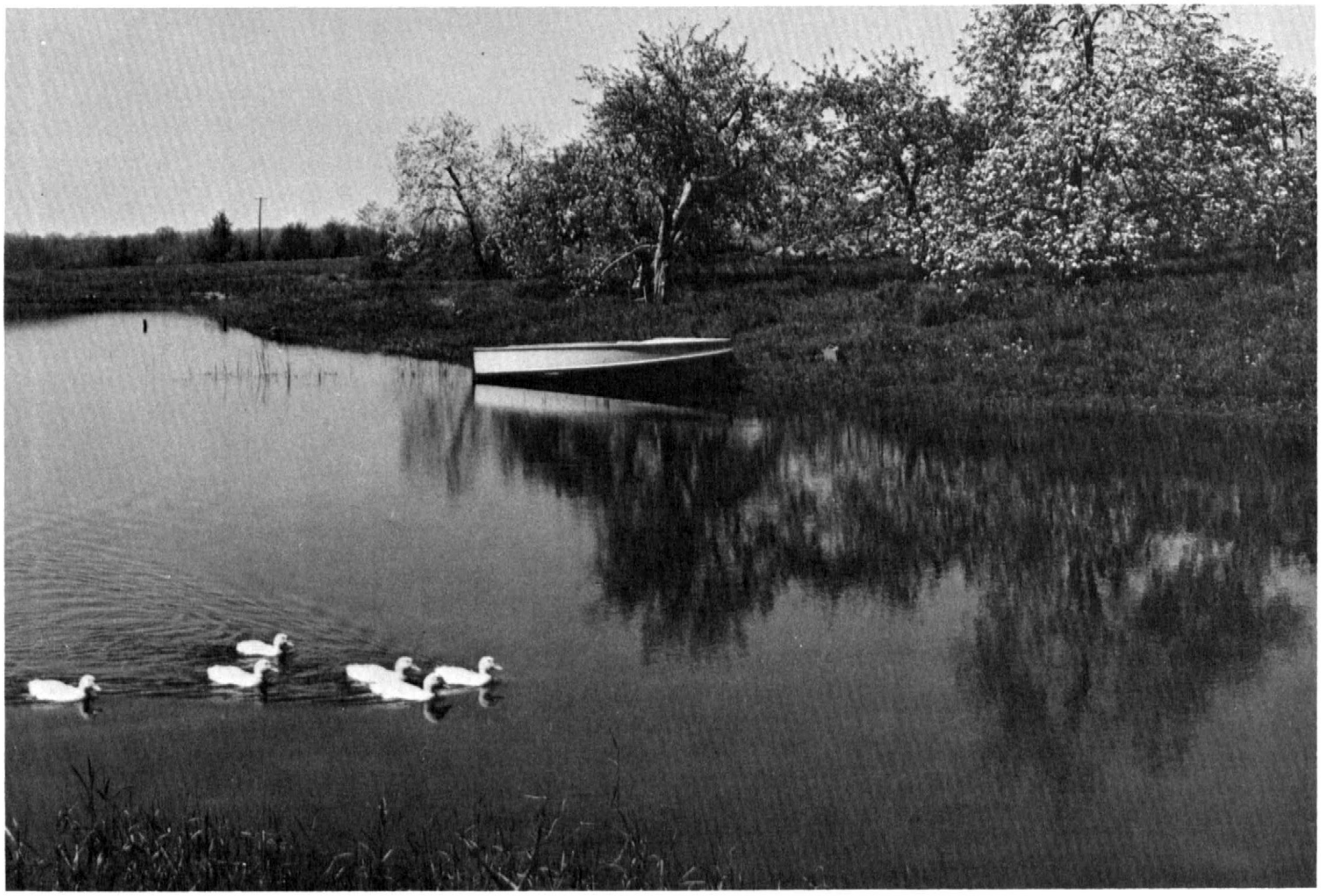
SOIL SURVEY OF

Venango 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

Major fieldwork for this soil survey was done in the period 1964–70. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service; 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 Venango County Soil and Water Conservation District. Financial assistance for part of the Soil Survey was provided by the Venango County Commissioners and by the Department of Housing and Urban Development under the provisions of Section 701 of the Housing Act of 1954, amended.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All the soils of Venango 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.

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 and the section on woodland.

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

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of Soils as Wildlife Habitat."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Use of Soils in Town and Country Planning" and "Use of Soils for Recreational Facilities."

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 how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of the Soils."

Newcomers in Venango County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

***Cover:* Farm pond in Alvira silt loam, 0 to 3 percent slopes, a soil that is generally favorable for water impoundments.**

Contents

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SOIL SURVEY OF VENANGO COUNTY, PENNSYLVANIA

SOIL SURVEY OF VENANGO COUNTY, PENNSYLVANIA
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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

VENANGO COUNTY is on the Allegheny Plateau in northwestern Pennsylvania (fig. 1). Franklin, the county seat, is slightly west of the geographical center of the county. The county has a land area of 432,000 acres

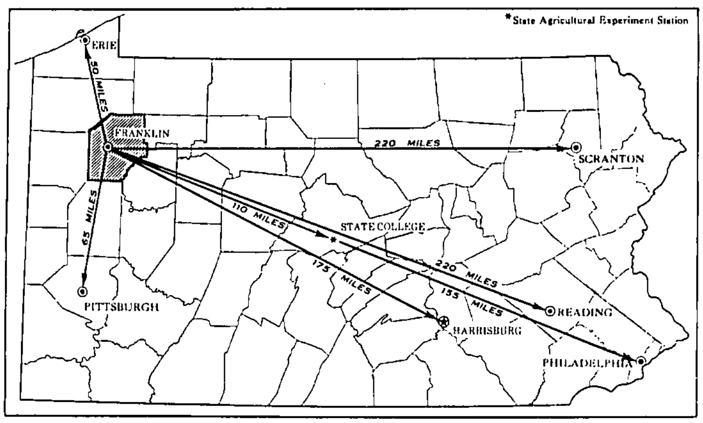

Figure 1.—**Location of Venango County in Pennsylvania.**

and is approximately 25 miles wide by 29 miles long. Interstate Highway No. 80 crosses the southern part of the county from east to west. United States Highway No. 322 crosses the county from northwest to southeast, and State Route 8 crosses it from southwest to northeast. Two railroads and one airline also serve the county. Elevations range from 1,755 feet on a hill near Powell Corners in Pinegrove Township to 860 feet where the Allegheny River, the major waterway in the county, flows out of the county at Emlenton.

The main industries in the county are manufacturing metal products and refining oil. Farming has been a leading occupation in Venango County in the past, but it has decreased in importance at the present. Most farms are dairy farms.

Most soils in the county are deep, nearly level to sloping, loamy, and acid. Wetness is the chief limitation. Crops respond well to applications of lime and fertilizer.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Venango County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would 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 (*20*).[1] 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. Frenchtown and Canfield, for example, are the names of two soil series. All the soils in the United States that have 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, Allegheny silt loam, 3 to 8 percent slopes, is one of several phases within the Allegheny series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of

[1] Italic numerals in parenthesis refer to Literature Cited, p. 84.

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 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 mapping units shown on the soil map of Venango County are the soil complex and the undifferentiated group.

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 or more 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. Urban land-Monongahela complex 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." Hazleton and Gilpin very stony soils, 8 to 25 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. Strip mines is an example.

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 soils, and they relate this to the slow permeability of the soil or to 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 groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups 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 Venango County. A soil association is a landscape that has a distinctive 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 soils in a county, who want to compare different parts of a 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, recreational 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 similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The term for texture used in the title for soil association 1 applies to the texture of the surface layer. This term is "dominantly gravelly."

Some of the names and boundaries of the Venango County General Soil Map do not match those in earlier surveys, for example, the Clarion and Mercer County Soil Surveys. This is the result of changes in the concept of some series, differing soil patterns observed between adjacent areas, and correlations that have combined some soils into other associations. In addition, more precise and detailed maps are needed because uses of the general soil map have expanded in recent years. The more modern maps meet this need. Still another difference is caused by the range in slope that is permitted within associations in different surveys.

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

1. *Canfield-Ravenna association*

Gently sloping and sloping, deep, dominantly gravelly, moderately well drained and somewhat poorly drained soils underlain by glacial till; on uplands

This association (fig. 2) borders Crawford County on the north, Mercer County on the west, and Butler County on the south. The landscape ranges from smooth slopes to the hummocky topography of a glacial end moraine. Most of this association was originally stony and gravelly. In many areas the stones were removed to piles or fence rows, and the soils were cultivated. The steeper soils have been

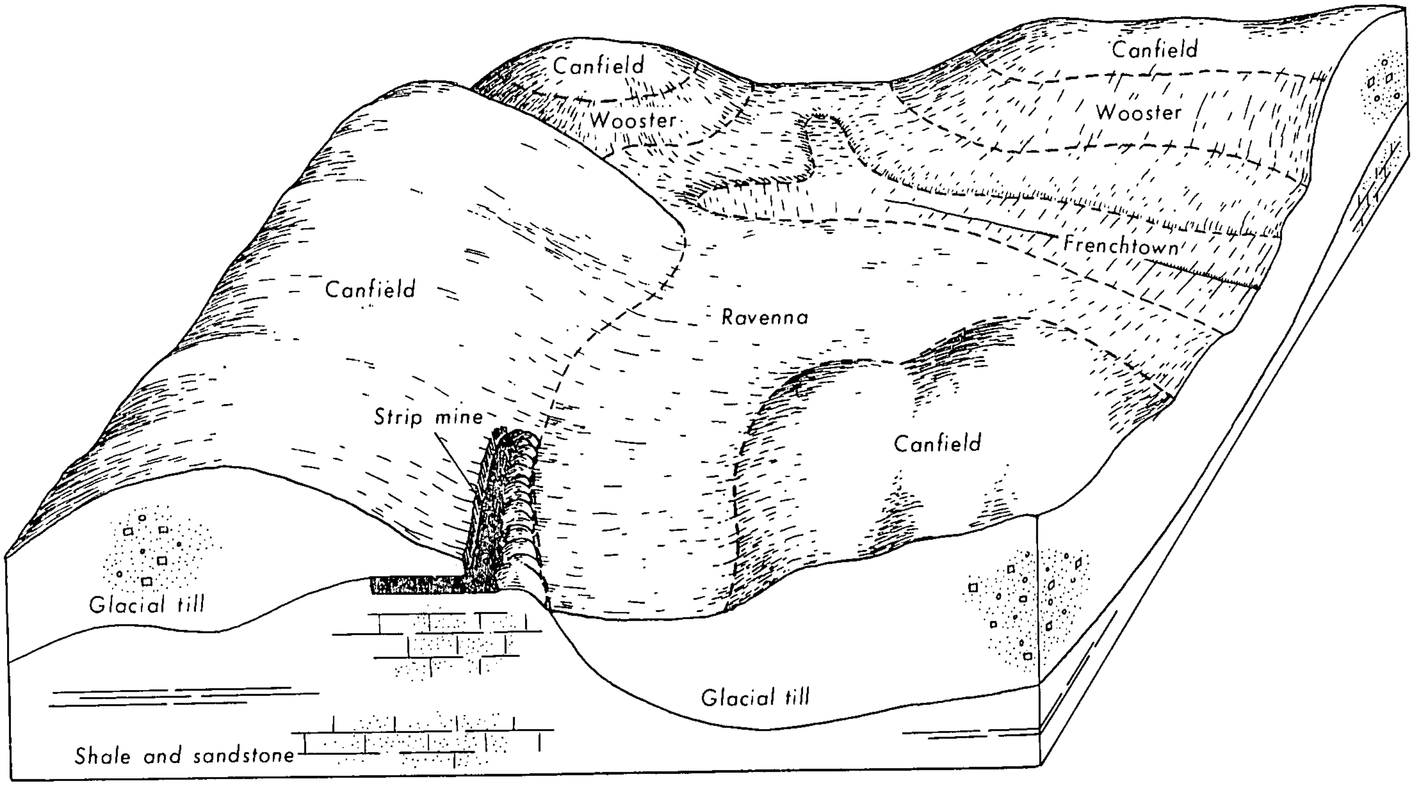

***Figure 2.*—Pattern of soils and underlying material in Canfield-Ravenna association.**

cleared for pasture or left as woodland. Many areas that were cultivated have reverted to woodland or are idle. Most of the association has impeded drainage; excess water is a limitation.

About 63 percent of this association is Canfield soils, about 17 percent is Ravenna soils, and about 20 percent is minor soils and land types. Altogether, this association makes up about 10 percent of the county.

Canfield soils are moderately well drained and have convex slopes. Ravenna soils are somewhat poorly drained and are in depressions.

Wooster and Frenchtown are the most extensive minor soils in this association. Pope, Philo, and Atkins soils and Strip mines are of lesser extent.

Dairying is the most common type of farming. The number of family-owned farms is declining, and the number of farms having absentee owners is increasing. Idle land is becoming increasingly prominent. Restricted permeability and a seasonal high water table limit use of the soils of this association.

2. *Alton-Monongahela-Philo association*

Nearly level and gently sloping, deep, well drained and moderately well drained soils underlain by alluvium; on terraces and flood plains

This association (fig. 3) is in wide valleys in the northwestern part of the county that formerly contained glacial melt water. The largest area is in Sugar Creek Valley. The landscape ranges from elevated terraces to flood plains in low places next to streams. Most of the association has been cleared and farmed. It includes the most productive farmland in Venango County.

About 26 percent of this association is Alton soils, about 14 percent is Monongahela soils, about 13 percent is Philo soils, and about 47 percent is minor soils and land types. Altogether, this association makes up about 4 percent of the county.

Alton soils are well drained and are on terraces. Monongahela soils are moderately well drained and are on terraces. Philo soils are moderately well drained and are on flood plains.

Allegheny, Rexford, and Tyler soils on stream terraces and Atkins and Pope soils on flood plains are the most extensive minor soils in this association. Urban land is of small extent.

Dairying is the most common type of farming. Large-scale family-owned farms are common. A hazard of flooding limits use of the soils on flood plains. The soils on terraces have varying limitations for most uses.

3. *Hanover-Alvira association*

Gently sloping and sloping, deep, well-drained to somewhat poorly drained soils underlain by glacial till; on uplands

This association (fig. 4) borders Crawford and Warren Counties on the north, and one area south of French Creek and west of the Allegheny River borders Butler County on the south. The landscape ranges from smooth slopes on uplands to a few, very steep valley sides. Almost half of this association was originally stony. In many areas the stones were removed to fence rows, and the soils were cultivated. Many areas that were cultivated have reverted to woodland or are idle. Most of the association has impeded drainage; excess water is a limitation.

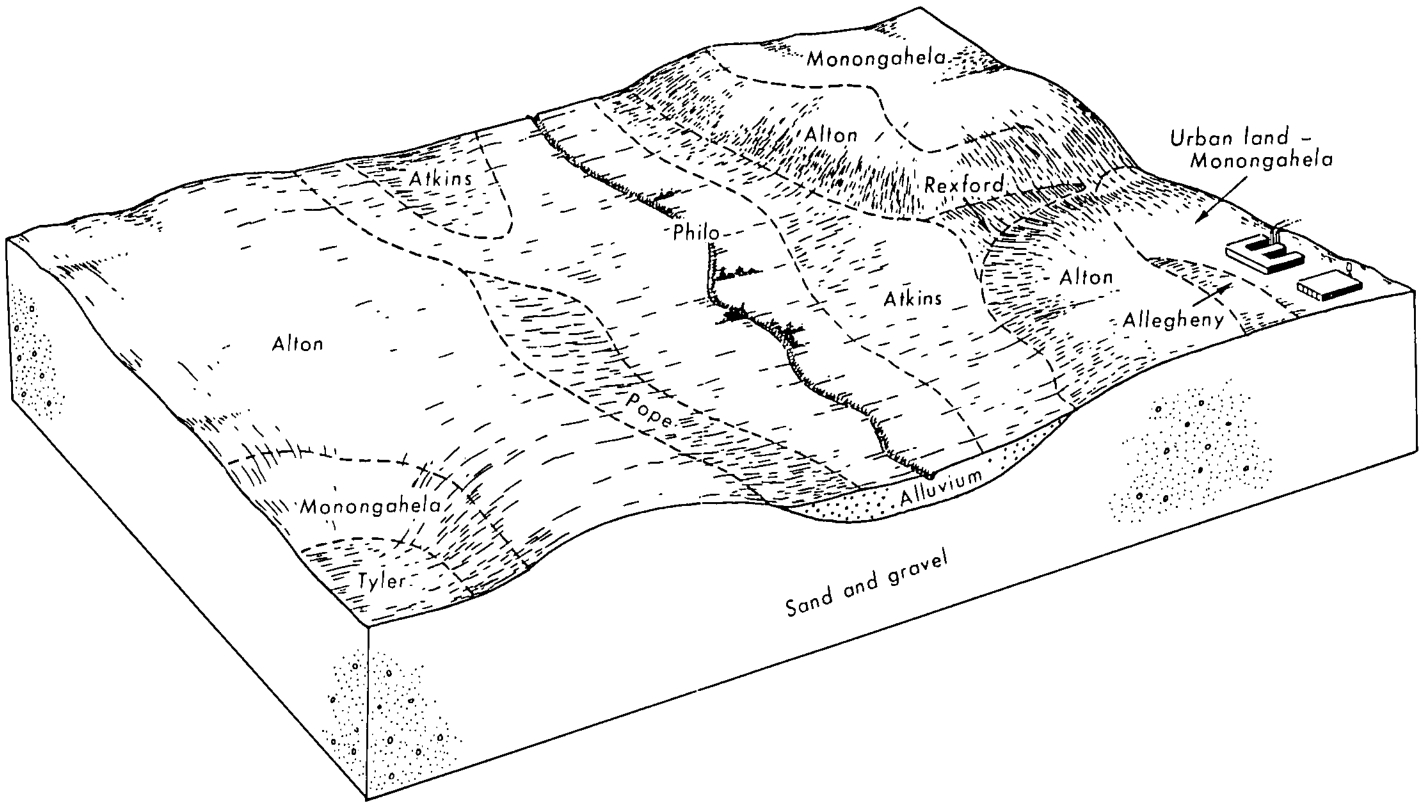

Figure 3.—Pattern of soils and underlying material in Alton-Monongahela-Philo association.

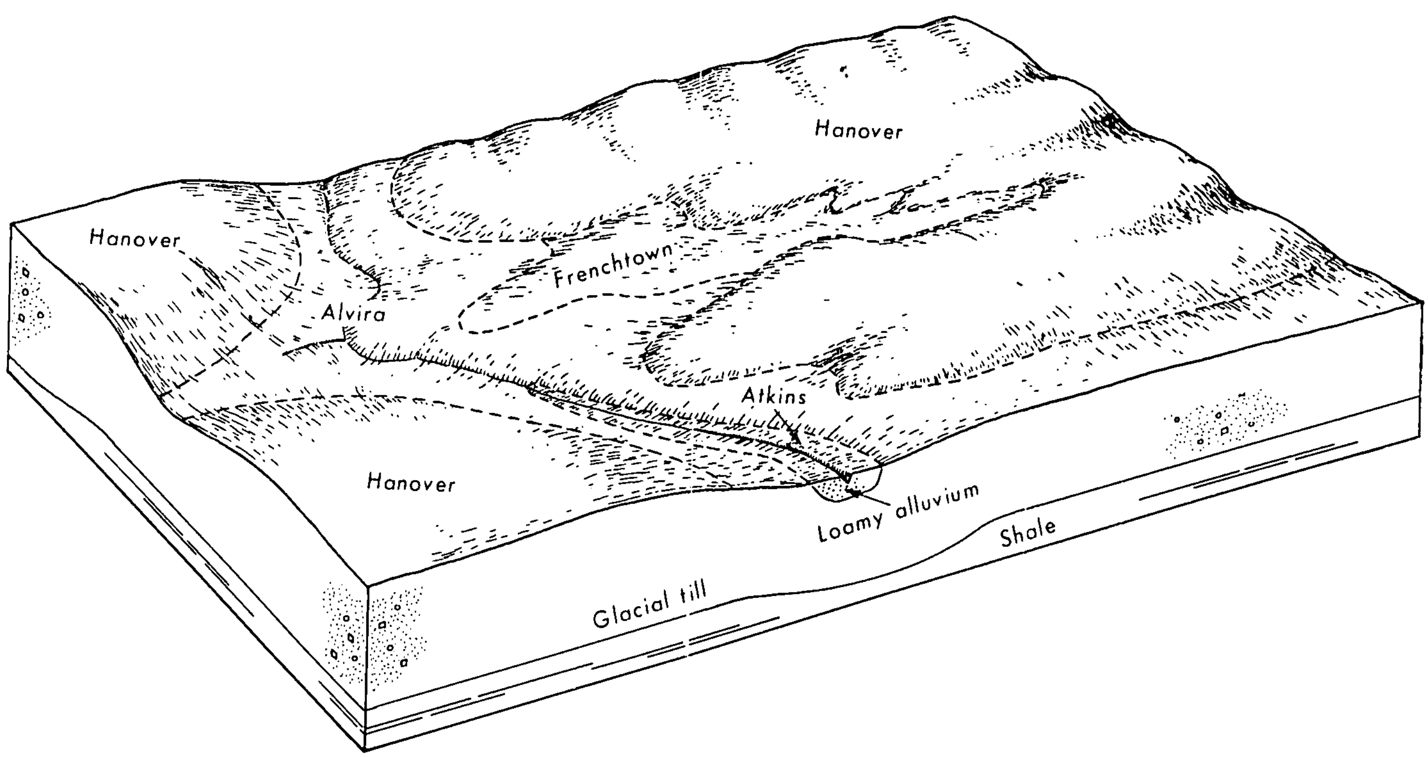

Figure 4.—Pattern of soils and underlying material in Hanover-Alvira association.

About 65 percent of this association is Hanover soils, about 27 percent is Alvira soils, and about 8 percent is minor soils. Altogether, this association makes up about 33 percent of the county.

Hanover soils are moderately well drained to well drained and have convex slopes. Alvira soils are somewhat poorly drained and are in depressions.

Atkins soils on flood plains and Frenchtown soils in upland depressions are the most extensive minor soils in this association.

Much of this association is abandoned farmland. Dairying is the most common type of farming. The number of family-owned farms is declining, and the number of farms having absentee owners is increasing. Idle land and former farm houses used as summer homes are becoming increasingly prominent. Restricted permeability and a seasonal high water table limit use of the soils of this association.

4. Hazleton-Gilpin association

Steep and very steep, deep and moderately deep, stony, well-drained soils underlain by shale, siltstone, and sandstone; on valley sides

This association is along most major streams in the county. Most of it is along the Allegheny River. The dominant feature of the landscape is the steepness of the soils. Almost all the association is wooded.

About 68 percent of this association is Hazleton soils, about 22 percent is Gilpin soils, and about 10 percent is minor soils. Altogether, this association makes up about 13 percent of the county.

Hazleton soils are deep and well drained. Gilpin soils are well drained and moderately deep.

Ernest and Brinkerton soils on uplands and Atkins soils on flood plains are the most extensive minor soils in this association.

Steepness of slopes and stoniness limit most uses of the soils of this association. The rugged, steep slopes add scenic beauty to the river valleys.

5. Cookport-Hazleton-Gilpin association

Gently sloping to moderately steep, deep and moderately deep, moderately well drained and well drained soils underlain by sandstone, siltstone, and shale; on uplands

This association (fig. 5) is mainly in the eastern and southeastern parts of the county. Only one area is in the south-central part. The landscape ranges from gently sloping hilltops to moderately steep valley sides and hillsides. Some of this association is stony. In some areas the stones were removed to piles or fence rows, and the soils were cultivated. The steeper soils were cleared for pasture or left as woodland. Many areas that were cultivated have reverted to woodland or are idle. Most of the association has excess water and needs to be drained.

About 74 percent of this association is Cookport soils, about 11 percent is Hazleton soils, about 4 percent is Gilpin soils, and about 11 percent is minor soils. Altogether, this association makes up about 28 percent of the county.

Cookport soils are deep and moderately well drained. Hazleton soils are deep and well drained. Gilpin soils are moderately deep and well drained.

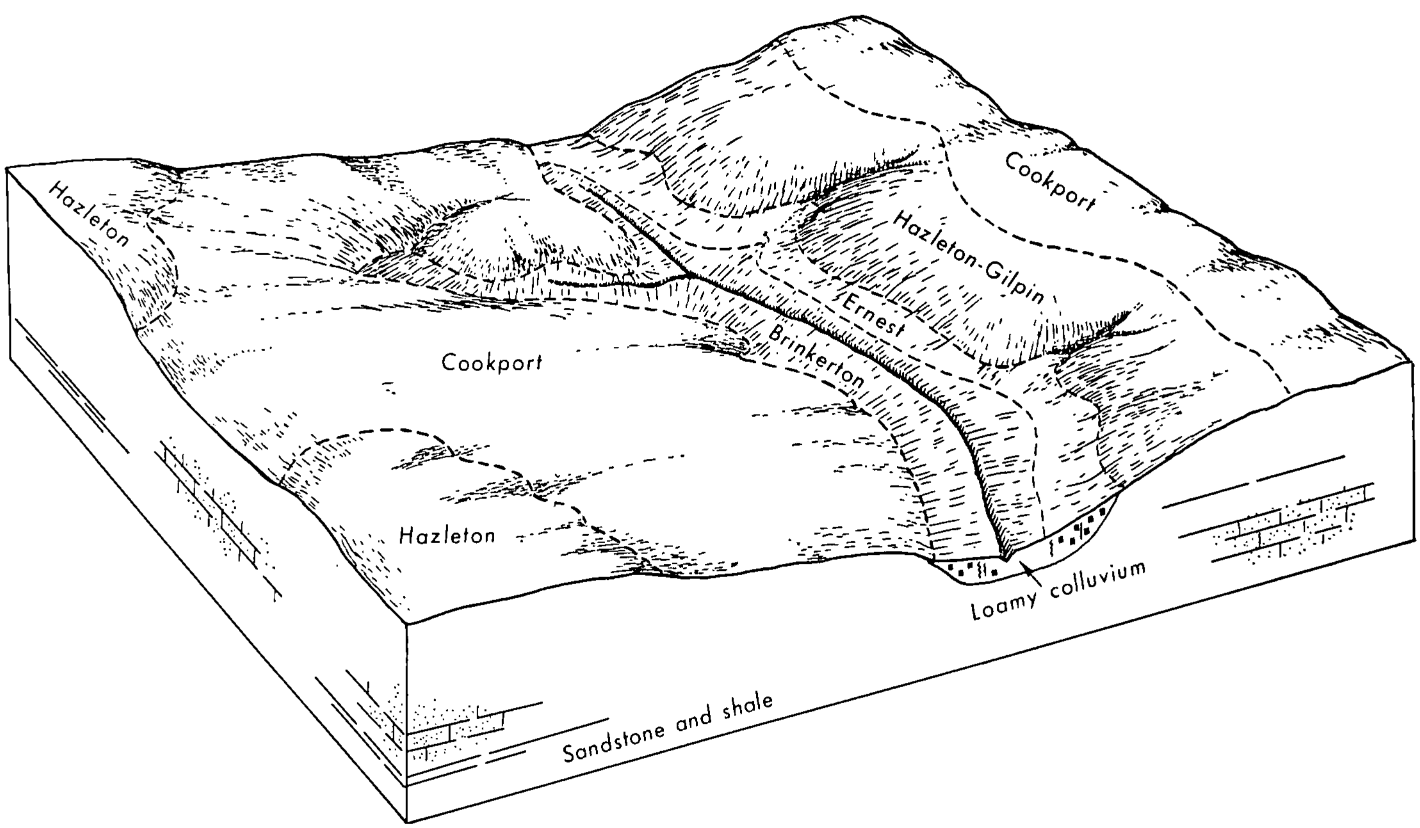

Figure 5.—Pattern of soils and underlying material in Cookport-Hazleton-Gilpin association

Brinkerton and Ernest soils are the most extensive minor soils in this association.

Most of this association is woodland. Dairying is the most common type of farming. The number of family-owned farms is declining, and the number of farms having absentee owners is increasing. Idle land makes up most of the association. Restricted permeability and a seasonal high water table limit use of the Cookport and Gilpin soils. Stoniness limits use of most Hazleton soils.

6. *Cavode-Wharton association*

Nearly level and gently sloping, deep, somewhat poorly drained and moderately well drained soils underlain by shale and siltstone; on uplands

This association (fig. 6) is at the higher elevations, mainly in the southern and eastern parts of the county. The landscape is dominantly gently sloping. Most of the association has impeded drainage; excess water is a limitation.

About 49 percent of this association is Cavode soils, about 22 percent is Wharton soils, and about 29 percent is minor soils and land types. Altogether, this association makes up about 12 percent of the county.

Cavode soils are somewhat poorly drained. Wharton soils are moderately well drained.

Atkins soils on flood plains and Brinkerton, Ernest, and Gilpin soils on uplands are the more extensive minor soils in this association. Strip mines are of small extent.

Dairying is the most common type of farming. The number of family-owned farms is declining, and the number of farms having absentee owners is increasing. Idle land is becoming increasingly prominent. Restricted permeability and a seasonal high water table limit use of the soils of this association.

Use and Management of the Soils

This section of the survey deals with the soils of the county in relation to various uses and methods of management.

First, the system of capability classification used by the Soil Conservation Service is explained. Then the capability units, or groups of soils that have similar management, and suitable crops or other uses and the main needs in management are described. Also given are estimates of the yields of the soils for various crops under two levels of management. Next, the productivity and limitations of the soils for forest products and the suitability of the soils for game and wildlife habitat are described. Tabular data are provided on engineering tests, estimated engineering properties of the soils, and interpretations of soil properties that influence engineering work. The last part of this section deals with uses of the soils for town and country planning and for recreation.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of farming. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are farmed, and the way they respond to treatment. The grouping does not

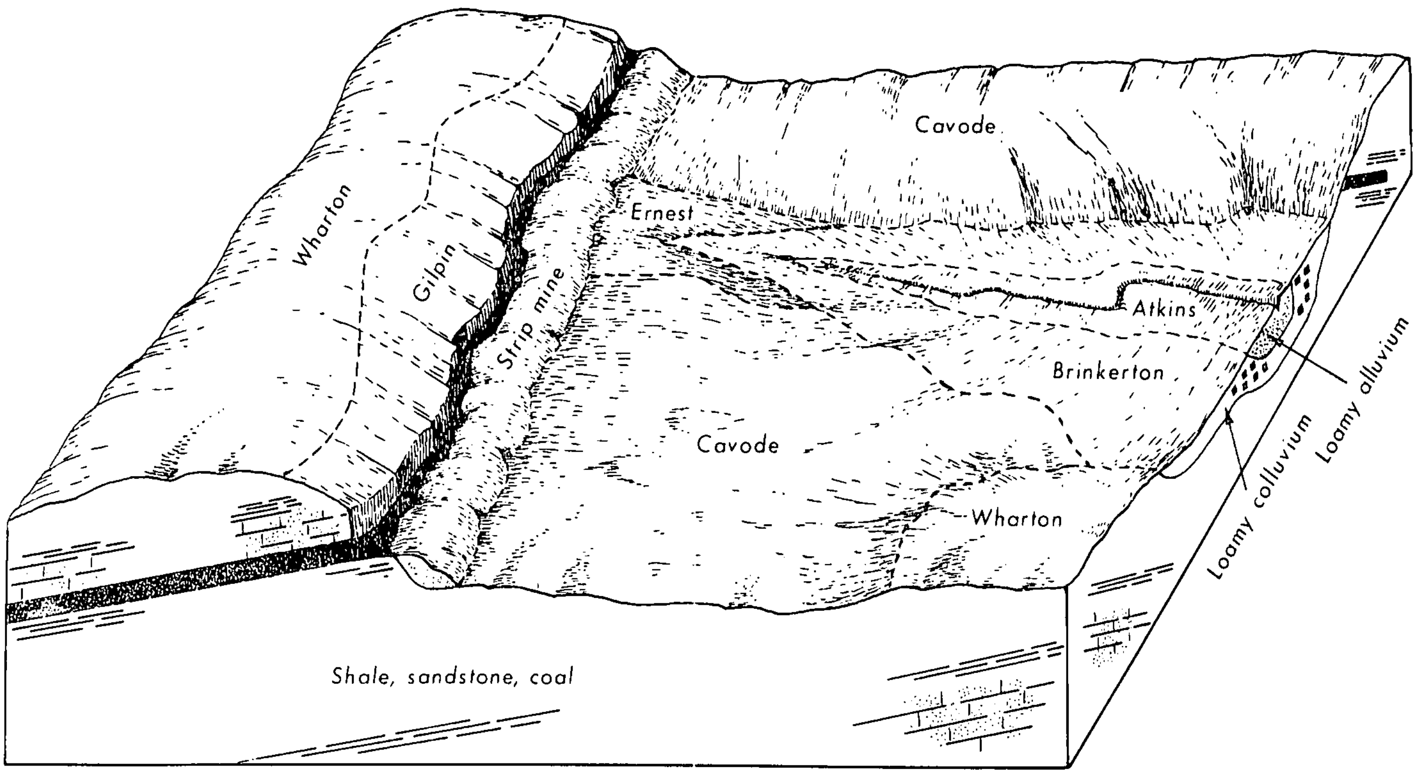

Figure 6.—Pattern of soils and underlying material in Cavode-Wharton association.

take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are defined in the following paragraphs. The capability classification of any soil in the county can be learned by referring to the "Guide to Mapping Units."

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, defined as follows:

Class I soils have few limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce 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, range, woodland, or wildlife habitat. There are no class V soils in Venango County.

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

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, 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, water supply, or esthetic purposes. There are no class VIII soils in Venango County.

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

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

CAPABILITY UNITS are soil groups within the subclasses. 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-2 or IIIw-3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Venango County are described and suggestions for the use and management of the soils are given.

Management by capability units [2]

Described on the following pages are the capability units in Venango County. The soils in any one unit are similar in the kind of management they require and in their response to that management.

Certain practices basic to good soil management can be mentioned before describing the individual capability units. Fundamental are the selection of a suitable cropping system and application of conservation practices that supplement this system in maintaining productivity of the soil and controlling wetness or erosion. The practices to be applied depend on the nature of the soil and the cropping system used.

Conservation practices that can be applied on sloping soils are contour stripcropping, terraces, and sod waterways. On sloping, wet soils, surface water can be removed and erosion controlled by use of graded strips, terraces, and grassed waterways. If suitable outlets are available, subsurface water generally can be removed by use of random tile lines or open ditches.

Practices to maintain and improve organic-matter content and soil structure and to reduce erosion include winter cover crops, stubble mulching, minimum tillage, and green-manure crops. Such practices are needed most if the cropping system is intensive or cultivation is continuous.

Lime and fertilizer should be applied according to soil tests and needs of crops.

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

The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in the unit. To find the names of all the soils and the capability unit in which each one has been placed, refer to the "Guide to Mapping Units" at the back of this survey.

[2] Written in cooperation with ROBERT L. BOND, conservation agronomist, Soil Conservation Service.

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CAPABILITY UNIT I-1

Pope loam is the only soil in this unit. This is a deep, well-drained, nearly level soil on flood plains. It is easy to till. It has high available moisture capacity and moderate permeability. Flooding is of short duration and generally does not occur during the growing season. The hazard of erosion is slight.

This soil is well suited to all crops commonly grown in the county. Crops respond well to applications of fertilizer and to other good management practices. Growing cover crops, utilizing crop residue, and including hay in cropping systems are ways to maintain organic-matter content and preserve tilth.

CAPABILITY UNIT I-2

Allegheny silt loam, 0 to 3 percent slopes, is the only soil in this unit. This is a deep, well-drained, nearly level soil on terraces. It is easy to till. It has high available moisture capacity and moderate permeability. The hazard of erosion is slight.

This soil is well suited to all crops commonly grown in the county. Crops respond well to applications of fertilizer and to other good management practices. Growing cover crops, utilizing crop residue, and including hay in cropping systems are ways to maintain organic-matter content and preserve tilth.

CAPABILITY UNIT IIe-1

This unit consists of deep, moderately well drained and well drained, gently sloping Canfield, Cookport, Ernest, Hanover, Monongahela, and Wharton soils on uplands and terraces. These soils have moderate available moisture capacity and moderately slow or slow permeability. The hazard of erosion is moderate.

If protected from erosion, these soils are suited to all general farm crops and pasture grasses commonly grown in the county. Graded strips, diversions, and sod waterways help to control erosion. These soils are somewhat wet, and stands of alfalfa are likely to be winterkilled. Winter grain is likely to be affected by frost heaving. Tile is helpful in draining wet weather seeps and permitting earlier cultivation in spring.

CAPABILITY UNIT IIe-2

This unit consists of deep and moderately deep, well-drained, gently sloping Allegheny soils on terraces and Gilpin, Hazleton, and Wooster soils in upland areas. Available moisture capacity is low in Gilpin soils and moderate to high in the rest. Permeability is moderately rapid to moderately slow in all. The surface layer is easy to work, and tillage is possible early in spring. The erosion hazard is moderate in cultivated areas. Surface runoff is medium to slow.

These soils are suited to alfalfa and all other general farm crops grown in the county. Stripcropping, contour cultivation, sod waterways, and diversions help to control erosion.

CAPABILITY UNIT IIw-1

This unit consists of deep, moderately well drained and well drained, nearly level Cookport, Hanover, and Monongahela soils on uplands and terraces. These soils have moderate available moisture capacity and slow or moderately slow permeability. They warm up slowly in spring. Areas in depressions are covered with shallow water during heavy rain. Depth of the root zone is limited by a firm, brittle layer in the lower part of the subsoil.

If drained, these soils are suited to all general farm crops grown in the county. Legumes and winter grain are likely to be affected by frost heaving. Keeping natural drainageways open and providing outlets for water ponded in depressions are the principal management needs.

CAPABILITY UNIT IIw-2

Philo silt loam is the only soil in this unit. It is a deep, moderately well drained, nearly level soil on flood plains. It has a seasonal high water table late in winter and early in spring. Available moisture capacity is high, and permeability is moderately slow. Flooding is of short duration and generally does not occur during the growing season.

If wet areas are drained, this soil is suited to continuous cropping. Surface drainage can be furnished by keeping natural drainageways open and providing outlets for water ponded in depressions. Wherever practical, digging ditches to lower the water level of streams that drain this soil helps in locating and installing outlets for tile drains. Cover crops and sod waterways help to control eroison and scouring.

CAPABILITY UNIT IIIe-1

This unit consists of deep, somewhat poorly drained, sloping Alvira, Cavode, and Ravenna soils on uplands. These soils have moderate to high available moisture capacity and slow permability. Depth of the root zone is limited by a seasonal high water table. Excess water causes the soils to warm up slowly in spring. The hazard of erosion is high in areas where these soils are cultivated and not protected.

If drained, these soils are suited to most general farm crops of the county. Legumes and winter grain are likely to be winterkilled or heaved out by freezing. Contour stripcropping, diversion terraces, and sod waterways help control erosion. Growing cover crops and leaving crop residue on the soil surface are ways of supplying organic matter and conserving moisture.

CAPABILITY UNIT IIIe-2

This unit consists of deep, moderately well drained and well drained, sloping Canfield, Cookport, Hanover, and Wharton soils on uplands. These soils have moderate available moisture capacity and slow or moderately slow permeability. The hazard of erosion is high in areas where the soils are cultivated and not protected.

The soils in this unit are suited to most general farm crops of the county. Legumes and winter grain are likely to be heaved out by freezing. Contour stripcropping (fig. 7), diversion terraces, and sod waterways help control erosion. Growing cover crops and leaving crop residue on the soil surface are ways of supplying organic matter.

CAPABILITY UNIT IIIe-3

This unit consists of moderately deep and deep, well-drained, sloping Gilpin, Hazleton, and Wooster soils on uplands. These soils have moderate to low available moisture capacity and moderately slow to moderately rapid permeability. They are easy to till. The hazard of erosion is high in cultivated areas.

If protected against erosion, these soils are suited to all general farm crops of the county. Strips and diversions lessen the hazard of erosion. Growing cover crops and

Figure 7.—Contour stripcropping is used for erosion control in many places on soils in capability unit IIIe-2. The soil is Cookport loam, 8 to 15 percent slopes.

leaving crop residue on the soil surface increase the organic-matter content and protect the soil surface.

CAPABILITY UNIT IIIw-1

This unit consists of deep, poorly drained and somewhat poorly drained, nearly level and gently sloping Alvira, Cavode, Ravenna, Rexford, and Tyler soils on uplands and terraces. These soils have moderate to high available moisture capacity and slow permeability. Depth of the root zone is limited by a seasonal high water table. Excess water causes the soils to warm up slowly in spring.

If drained, these soils are suited to most general farm crops of the county. Legumes and winter grain are likely to be winterkilled or heaved out by freezing. Excess water can be drained from the surface by keeping natural drainageways open. Tile drains generally are not satisfactory because the subsoil is firm and brittle. Graded strips, sod waterways, and diversion terraces help to control runoff and erosion on the gently sloping soils.

CAPABILITY UNIT IIIw-2

This unit consists only of a deep, poorly drained, nearly level Atkins silt loam on flood plains. Flooding and a high water table are the main limitations. Overflow generally occurs in winter or spring, but summer flooding does occur in some areas.

If protected from flooding and adequately drained, this soil is suited to most general farm crops of the county. Where necessary, surface drainage can be improved by landforming and, if outlets are available, by open ditches. Leaving crop residue on the soil surface provides the organic-matter content needed to maintain tilth.

CAPABILITY UNIT IIIw-3

This unit consists of deep, poorly drained, nearly level and gently sloping Frenchtown soils on uplands. These soils have moderate available moisture capacity and slow permeability. Depth of the root zone is limited by a high water table. Excess water causes the soils to warm up slowly in spring.

If drained, these soils are suited to most general farm crops of the county. Legumes and winter grain are likely to be winterkilled or heaved out by freezing. Excess water can be drained from the surface by keeping natural drainageways open. Tile drains generally are not satisfactory because the subsoil is firm and brittle. Graded strips, sod waterways, and diversion terraces help to control runoff and erosion on the gently sloping soils of this unit.

CAPABILITY UNIT IIIs-1

This unit consists of deep, well-drained, nearly level and gently sloping Alton soils on terraces. These soils have low available moisture capacity and rapid permeability.

These soils are suited to most general farm crops of the county. The low available moisture significantly affects crops in most years. Contour tillage, cover crops, and crop residue increase the organic-matter content, improve tilth, and conserve moisture.

CAPABILITY UNIT IVe-1

This unit consists of moderately deep and deep, well drained and moderately well drained, sloping and moderately steep Alton, Gilpin, Hanover, Hazleton, and Wooster soils on uplands and terraces. These soils have low to moderate available moisture capacity and slow to rapid permeability. The hazard of erosion is very high in cultivated areas.

These soils are suited to cultivated crops, but they are better suited to long-term hay or pasture. Contour strips, diversion terraces, and sod waterways help to control runoff and erosion in cultivated areas.

CAPABILITY UNIT IVw-1

This unit consists of deep, poorly drained, nearly level and gently sloping Armagh and Brinkerton soils on uplands. These soils have moderate available moisture capacity and slow permeability. Depth of the root zone is limited by a high water table. Excess water causes the soils to warm up very slowly in spring and severely limits them for cultivation. The Brinkerton soils are adversely affected by runoff and seepage from adjacent slopes.

The soils in this unit are better suited to long-term hay or pasture than to cultivated crops. Grasses and legumes tolerant of wet soil conditions are best adapted. Excess water can be removed from the surface by keeping natural drainageways open and providing outlets to drain depressions. Surface water that flows down from higher elevations should be diverted. Tile drains can be installed to drain seep spots.

CAPABILITY UNIT VIs-1

This unit consists of deep, well drained and moderately well drained, nearly level to moderately steep Canfield, Cookport, Ernest, and Hanover soils on uplands. These soils are very stony and occur as scattered areas throughout the county. They have moderate available moisture capacity and moderately slow to slow permeability.

These soils are too stony for cultivated crops. In areas where the use of light farm equipment is feasible, bluegrass and white clover can be planted for pasture.

CAPABILITY UNIT VIs-2

This unit consists of deep and moderately deep, well-drained, nearly level to moderately steep, very stony Hazleton, Gilpin, and Wooster soils on uplands. These soils have moderate to low available moisture capacity and moderately rapid to moderately slow permeability.

These soils are too stony for cultivated crops. In areas where the use of light farm equipment is feasible, bluegrass and white clover can be planted for pastures.

CAPABILITY UNIT VIIe-1

Alton gravelly loam, 25 to 80 percent slopes, is the only soil in this unit. It is a deep, well-drained, steep to very steep, gravelly soil on terraces. It has low available moisture capacity and rapid permeability. Slope and a hazard of erosion severely limit use of this soil. The soil is poorly suited to woodland and wildlife development and is too steep for crops, hay, or pasture. It is a good source of gravel.

CAPABILITY UNIT VIIs-1

This unit consists of deep, somewhat poorly drained and poorly drained, nearly level to gently sloping, very stony Alvira, Brinkerton, Frenchtown, and Ravenna soils on uplands. These soils have moderate available moisture capacity and slow permeability.

These soils are fairly well suited to unimproved pasture (fig. 8) and to water-tolerant trees. They are wet in spring and moving equipment over them is difficult.

CAPABILITY UNIT VIIs-2

This unit consists of deep and moderately deep, moderately well drained and well drained, steep and very steep, very stony Gilpin, Hanover, Hazleton, and Wooster soils on uplands. These soils have moderate to low available moisture capacity and slow to moderately rapid permeability.

Because these soils are stony and steep, they are better suited to woodland than to cultivated crops or pasture. In most places, however, logging is difficult or hazardous and replanting must be done by hand. Some areas can be developed for wildlife and watershed uses.

Estimated Crop Yields

Table 1 shows the estimated yields for representative field and specialty crops and pasture plants grown in the county. These predictions are averages for a period of 10 years or more, not just for one season.

Yields are shown under two levels of management. In columns A are yields to be expected under the normal or prevailing management used by the average farmer in the county. In columns B are yields that may be obtained in average growing seasons under improved management. The improved management indicated in columns B is based on the assumption that 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 effective. Such soil and water conservation practices as minimum tillage, contour tillage, stripcropping, crop residue management, and use of diversions, drainage, waterways, or other practices recommended by the Agricultural Extension Service and the Soil Conservation Service are followed. Irrigation is not considered.

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

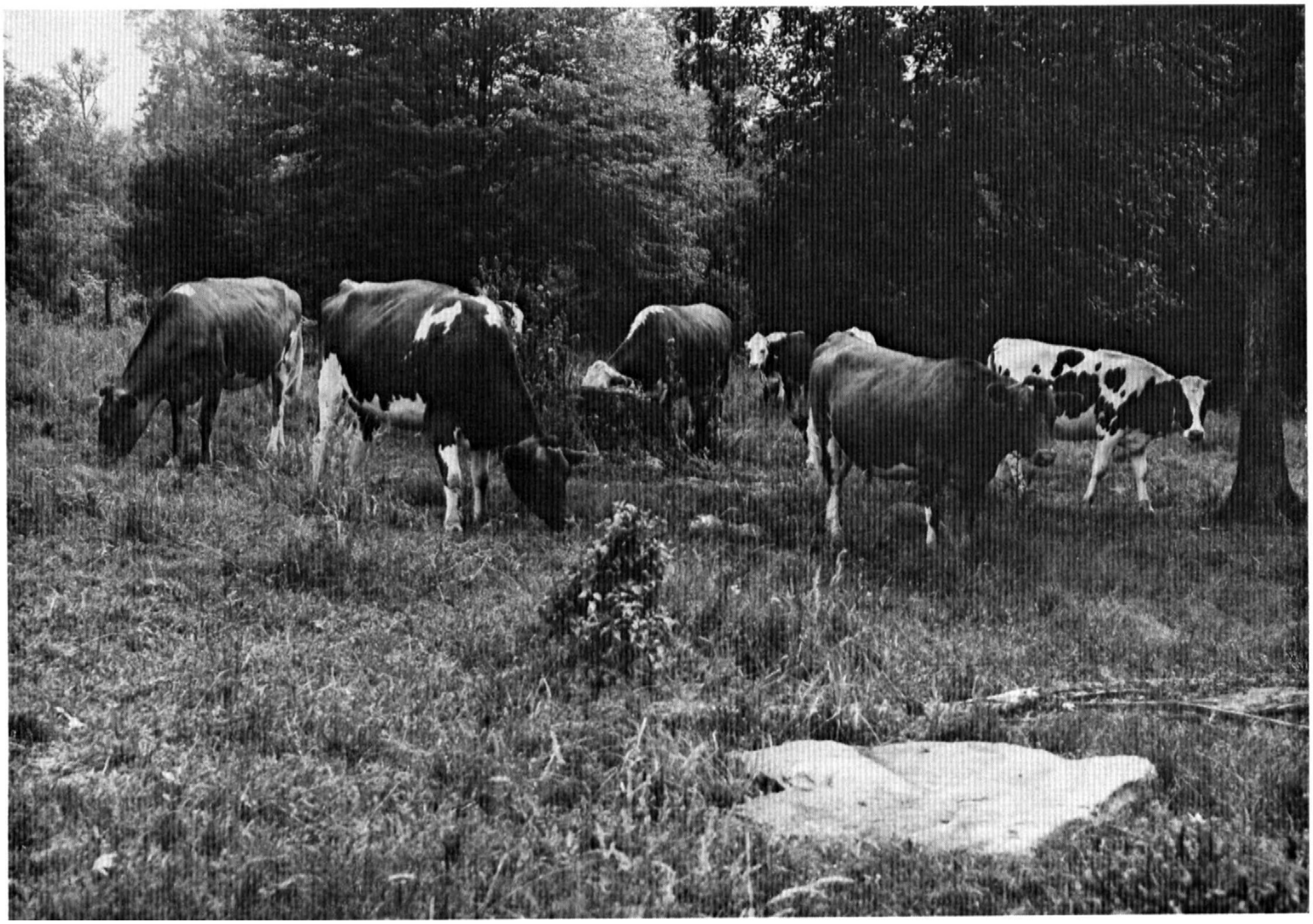

Figure 8.—Cows grazing on Alvira and Ravenna very stony silt loams, 0 to 8 percent slopes. Soils in capability unit VIIs-1 are used mostly as pasture or woodland.

The following mapping units generally are not used for crops, hay, or pasture and are not listed in table 1: Alton gravelly loam, 25 to 80 percent slopes; Alvira and Ravenna very stony silt loams, 0 to 8 percent slopes; Brinkerton and Frenchtown very stony silt loams; Hanover very stony silt loam, 25 to 45 percent slopes; Hazleton and Gilpin very stony soils, 25 to 70 percent slopes; Strip mines; and Urban land-Monongahela complex.

Use of Soils as Woodland[3]

Venango County once had a dense cover of trees, but cutting timber for commercial purposes and clearing land for farms have eliminated nearly all the virgin stands. At present the commercial woodland, which occupies 84 percent of the county, consists of second- and third-growth stands. Approximately 40 percent of the acreage in commercial forests is sawtimber, 36 percent is poletimber, and the rest is seedlings and saplings (*5*).

The principal forest types that make up the present commercial woodland and the proportionate extent of each as given by the Forest Service (*5*) follow:

	Percent
White pine	9
Fifty percent or more of the stand is eastern white pine.	
Virginia-pitch pine	2
Fifty percent or more of the stand is Virginia pine, pitch pine, or other yellow pines, singly or in combination.	
Oak-hickory	56
Fifty percent or more of the stand is upland oaks or hickory, singly or in combination. The stand also includes the yellow-poplar-oak forest type.	
Elm-ash-red maple	10
Fifty percent or more of the stand is American elm, black ash, or red maple, singly or in combination. Red maple stands make up most of the acreage on upland sites.	
Maple-beech-birch	10
Fifty percent or more of the stand is sugar maple, beech, or yellow birch, singly or in combination. The stand also includes the black cherry forest type.	
Aspen-birch	12
Fifty percent or more of the stand is aspen, paper birch, gray birch, or pin cherry, singly or in combination.	
Other oak types	1

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

TABLE 1.—*Estimated yields of field and forage crops*

[In columns A are productivity ratings for normal management, and in columns B are ratings for improved management. Absence of data indicates that the soil is not suited to the specified crop at the specified level of management]

Soils	Corn				Oats		Wheat		Potatoes		Hay				Pasture			
	Grain		Silage								Alfalfa-grass mixture		Grass-legume mixture		Bluegrass		Tall grass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu./acre	*Bu./acre*	*Tons/acre*	*Tons/acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Tons/acre*	*Tons/acre*	*Tons/acre*	*Tons/acre*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Allegheny silt loam, 0 to 3 percent slopes	70	120	14	24	65	75	40	45	450	550	2.7	4.5	2.1	3.5	85	160	135	255
Allegheny silt loam, 3 to 8 percent slopes	70	120	14	24	65	75	40	45	450	550	2.6	4.5	2.0	3.5	80	160	130	255
Alton gravelly loam, 0 to 3 percent slopes	50	95	10	19	55	75	35	45	400	450	2.0	4.0	1.1	3.0	45	135	100	230
Alton gravelly loam, 3 to 8 percent slopes	50	90	10	18	55	75	35	45	400	450	2.0	4.0	1.1	3.0	45	135	100	230
Alton gravelly loam, 8 to 15 percent slopes	45	75	9	15	50	70	30	40	----	----	1.9	3.5	1.0	2.5	40	115	95	200
Alton gravelly loam, 15 to 25 percent slopes	----	----	----	----	40	50	25	30	----	----	1.9	3.0	1.0	2.0	40	90	95	170
Alvira silt loam, 0 to 3 percent slopes	50	90	10	18	50	70	----	35	----	400	----	3.0	1.5	2.5	60	115	75	170
Alvira silt loam, 3 to 8 percent slopes	50	90	10	18	50	70	----	35	----	400	----	3.0	1.5	2.5	60	115	75	170
Alvira silt loam, 8 to 15 percent slopes	45	85	9	17	45	65	----	30	----	----	----	3.0	1.5	2.5	60	115	75	170
Armagh silt loam	40	80	8	16	40	60	----	----	----	----	----	----	1.4	2.5	55	115	70	145
Atkins silt loam	70	100	14	20	55	60	----	----	----	----	----	----	2.4	3.0	95	135	120	170
Brinkerton silt loam, 0 to 3 percent slopes	40	90	8	18	40	60	----	----	----	----	----	----	1.4	2.5	55	115	70	145
Brinkerton silt loam, 3 to 8 percent slopes	45	90	9	18	45	60	----	----	----	----	----	----	1.6	2.5	65	115	80	145
Canfield gravelly silt loam, 3 to 8 percent slopes	55	100	11	20	55	70	30	45	360	495	2.1	4.0	1.8	3.0	70	145	105	220
Canfield gravelly silt loam, 8 to 15 percent slopes	50	90	10	18	50	65	30	40	----	----	2.0	3.5	1.7	3.0	70	145	100	205
Canfield very stony silt loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	40	115	----	----
Canfield very stony silt loam, 8 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	40	110	----	----
Cavode silt loam, 0 to 3 percent slopes	50	85	10	17	50	65	----	35	----	400	----	----	1.5	3.0	60	135	75	170
Cavode silt loam, 3 to 8 percent slopes	50	85	10	17	50	65	----	35	----	400	----	----	1.5	3.0	60	135	75	170
Cavode silt loam, 8 to 15 percent slopes	45	80	9	16	45	60	----	30	----	----	----	----	1.5	3.0	60	135	75	170
Cookport loam, 0 to 3 percent slopes	55	100	11	20	55	70	30	45	360	495	2.0	4.0	1.8	3.0	70	145	100	220
Cookport loam, 3 to 8 percent slopes	55	100	11	20	55	70	30	45	360	495	2.1	4.0	1.7	3.0	70	145	105	220
Cookport loam, 8 to 15 percent slopes	50	90	10	18	50	65	30	40	----	----	2.0	3.5	1.7	3.0	70	145	100	205
Cookport very stony loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	115	----	----
Cookport very stony loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	110	----	----
Ernest silt loam, 3 to 8 percent slopes	55	100	11	20	55	70	30	45	360	495	2.1	4.0	1.7	3.0	70	145	105	200
Ernest very stony silt loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	115	----	----
Ernest very stony silt loam, 8 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	110	----	----
Frenchtown silt loam, 0 to 3 percent slopes	40	80	8	16	45	65	----	----	----	----	----	----	1.4	2.5	55	115	70	145
Frenchtown silt loam, 3 to 8 percent slopes	45	80	9	16	45	65	----	----	----	----	----	----	1.5	2.5	60	115	75	145

See footnotes at end of table.

TABLE 1.—*Estimated yields of field and forage crops*—Continued

Soils	Corn				Oats		Wheat		Potatoes		Hay				Pasture			
	Grain		Silage								Alfalfa-grass mixture		Grass-legume mixture		Bluegrass		Tall grass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu./acre	*Bu./acre*	*Tons/acre*	*Tons/acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Bu./acre*	*Tons/acre*	*Tons/acre*	*Tons/acre*	*Tons/acre*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Gilpin silt loam, 3 to 8 percent slopes	50	90	10	18	55	65	35	40	335	435	2. 1	3. 5	1. 6	3. 0	65	135	105	200
Gilpin silt loam, 8 to 15 percent slopes	50	85	10	17	55	60	30	35	----	----	2. 0	3. 5	1. 5	3. 0	60	135	100	200
Gilpin silt loam, 15 to 25 percent slopes	45	80	9	16	50	55	25	30	----	----	1. 9	3. 0	1. 4	2. 5	55	115	95	170
Hanover silt loam, 0 to 3 percent slopes	55	100	11	20	55	70	30	45	360	495	2. 0	4. 0	1. 8	3. 0	70	145	100	230
Hanover silt loam, 3 to 8 percent slopes	55	100	11	20	55	70	30	45	360	495	2. 1	4. 0	1. 7	3. 0	70	145	105	230
Hanover silt loam, 8 to 15 percent slopes	50	90	10	18	50	65	30	40	----	----	2. 0	3. 5	1. 7	3. 0	70	145	100	205
Hanover silt loam, 15 to 25 percent slopes	50	85	10	17	50	60	30	35	----	----	2. 0	3. 5	1. 6	3. 0	65	135	100	205
Hanover very stony silt loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	115	----	----
Hanover very stony silt loam, 8 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	110	----	----
Hazleton channery loam, 3 to 8 percent slopes	70	120	14	24	65	75	40	45	400	500	2. 6	4. 5	2. 0	3. 5	80	160	130	255
Hazleton channery loam, 8 to 15 percent slopes	65	110	13	22	60	70	35	40	----	----	2. 5	4. 0	2. 0	3. 0	80	135	125	230
Hazleton channery loam, 15 to 25 percent slopes	50	95	10	19	50	60	30	35	----	----	2. 4	4. 0	1. 9	3. 0	75	135	120	230
Hazleton very stony loam, 0 to 8 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	110	----	----
Hazleton and Gilpin very stony soils, 8 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	50	90	----	----
Monongahela silt loam, 0 to 3 percent slopes	55	100	11	20	55	70	30	45	360	495	2. 0	4. 0	1. 8	3. 0	70	145	100	220
Monongahela silt loam, 3 to 8 percent slopes	55	100	11	20	55	70	30	45	360	495	2. 1	4. 0	1. 7	3. 0	70	145	105	220
Philo silt loam	95	130	19	26	70	80	40	45	500	600	3. 0	4. 5	2. 6	3. 5	105	160	150	255
Pope loam	105	135	21	27	75	80	45	50	550	650	3. 4	5. 0	2. 7	3. 5	110	160	170	285
Ravenna silt loam, 0 to 3 percent slopes	50	90	10	18	50	70	----	35	----	400	----	3. 0	1. 5	2. 5	60	115	75	170
Ravenna silt loam, 3 to 8 percent slopes	50	90	10	18	50	70	----	35	----	400	----	3. 0	1. 5	2. 5	60	115	75	170
Ravenna silt loam, 8 to 15 percent slopes	45	85	9	17	45	65	----	30	----	----	----	3. 0	1. 5	2. 5	60	115	75	170
Rexford silt loam	50	90	10	18	45	70	----	35	----	----	----	3. 0	1. 5	2. 5	60	115	75	170
Tyler silt loam	50	90	10	18	50	60	----	35	----	----	----	3. 0	1. 5	3. 0	60	135	75	170
Wharton silt loam, 3 to 8 percent slopes	55	90	11	20	55	65	30	40	360	495	2. 1	3. 5	1. 7	3. 0	70	140	105	220
Wharton silt loam, 8 to 15 percent slopes	50	80	10	18	50	60	25	35	360	475	2. 0	3. 5	1. 7	3. 0	70	140	100	205
Wooster gravelly silt loam, 3 to 8 percent slopes	70	100	14	20	65	75	40	45	400	500	2. 6	4. 0	2. 0	3. 5	80	160	130	230
Wooster gravelly silt loam, 8 to to 15 percent slopes	65	95	13	19	60	75	35	45	----	----	2. 5	4. 0	2. 0	3. 5	80	160	125	230
Wooster gravelly silt loam, 15 to 25 percent slopes	60	90	12	18	60	70	35	40	----	----	2. 4	3. 5	1. 9	3. 0	75	135	120	200
Wooster very stony silt loam, 8 to 25 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	60	130	----	----
Wooster very stony silt loam, 25 to 45 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	55	110	----	----

[1] Cow-acre-days is a term used to express the carrying capacity of a pasture. It is the number of animal units carried per acre 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 provides 30 days of grazing for 2 cows has a carrying capacity of 60 cow-acre-days.

In general, the soils of this county are capable of supporting a good growth of sugar maple, black cherry, ash, yellow-poplar, and red oak. Trees grow slowly on the shallow soils and on the very poorly drained soils.

Sixty-six percent of the existing woodland in the county is made up of soils that are excellent, very good, and good woodland sites; 28 percent of soils that are fair sites; and 6 percent of soils that are poor sites.

A landowner can favor the more desirable trees in his woodland by good woodland management. The soils and the climate are favorable; help in planning a program of woodland improvement can be obtained from local technicians. How much effort the landowner is willing to make toward improving his woodland probably depends on general economic conditions.

Returns from excellent, very good, and good sites generally justify the additional expense of improved management, but the potential yield, quality of the particular species growing on the site, and the market potential should be considered. Converting woodland of low-value species and a high proportion of poor-quality stems to its potential capacity may not be economically justifiable.

Soils that are fair sites are the most difficult to appraise for management. A thorough appraisal of the woodland as to species and quality is essential, and the market potential should be investigated. A proper analysis of all these interrelated factors is essential in determining the intensity of management.

Returns from poor sites generally do not justify management for the production of wood products. Nevertheless, woodland is in most cases the most practical use for these soils. Generally such soils cannot be used for cropland or grassland.

Table 2 rates the soils of the county according to limitations and hazards to be considered in management, to species suitability, and site quality for production of timber.

The erosion hazard indicates the amount or intensity of practices needed to reduce or control erosion. A rating of *slight* indicates little or no risk of erosion when wood products are harvested; few, if any, practices are needed for erosion control. A rating of *moderate* indicates that erosion control measures are needed on skid 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. Erosion control measures are needed on logging roads and skid trails immediately after logging.

Equipment limitations are based on characteristics of the soils and topographic features that restrict or prohibit the use of equipment for harvesting trees and planting seedlings. Steepness of slope, stoniness, and wetness are principal limitations. A rating of *slight* indicates very few limitations. A rating of *moderate* indicates moderate limitations to equipment by some stones and boulders, moderately steep slopes, or wetness for part of the year. A rating of *severe* means that steep slopes, stoniness, or prolonged wetness makes tract-type equipment best for general use and that winches or similar special equipment are needed for some kinds of work.

Seedling mortality refers to the loss of seedlings, either naturally occurring or planted, as a result of unfavorable soil characteristics. A rating of *slight* means that no more than 25 percent of the seedlings is likely to die and satisfactory restocking from the initial planting can be expected. Adequate restocking ordinarily results from natural regeneration. A rating of *moderate* means that the loss will be between 25 and 50 percent 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 seedlings is likely to die and that special seedbed preparation, superior planting techniques, and considerable replanting are needed for adequate and immediate restocking. Restocking cannot be expected to result from natural regeneration if the rating for seedling mortality is *severe*.

Plant competition refers to the rate at which brush, grass, and undesirable trees are likely to invade woodland stands. A rating of *slight* means that unwanted plants do not prevent adequate natural regeneration and early growth or interfere with adequate development of planted seedlings. A rating of *moderate* means that competition delays natural or artificial regeneration, both establishment and growth, but does 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, including weeding.

The ratings for windthrow hazard represent an evaluation of factors that control the development of tree roots and, consequently, the possibility that trees will be uprooted by wind. A rating of *slight* means that normally no trees are blown down by wind. A rating of *moderate* means that some trees can be expected to be blown down during periods of excessive soil wetness and strong wind. A rating of *severe* means that trees will not stand alone in strong wind.

The trees listed in the column headed "Species to be favored" are fast growing and have high economic value. In planning the development of an existing woodland, the landowner can determine, according to his objectives, the species to be favored when plantations are to be started. The trees listed in the column "For planting or seeding" are those best suited to the particular soil.

Site quality indicates the ability of a soil to produce timber. The ratings are based on sample plots 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. Yield information on oak is based on data by G. L. Schnur (*16*). The ratings are based on site index, which is defined as the average height of the dominant and codominant trees in a stand at the age of 50 years. Foresters using this rating can determine the volume of timber that normal stands will produce at different ages. A site index of 85 or better is rated *excellent*, and the expected yield at age 50 is 13,750 or more board feet per acre (published data for oak do not go beyond site index 80) (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*,

TABLE 2.—*Wood crops and factors in management*

Series and map symbols	Site quality	Hazards					Species to be favored—	
		Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	Windthrow	In existing stands	For planting or seeding
Allegheny: Aga, AgB.	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, red oak, ash, sugar maple, black walnut, black cherry.	Yellow-poplar, black cherry, red pine, black walnut, larch, Norway spruce.
Alton:								
AhA, AhB, AhC	Fair	Slight	Slight	Severe	Slight for conifers and hardwoods.	Slight	Red oak, black oak, red maple.	Red pine, larch, white pine.
AhD	Fair	Slight	Moderate	Severe	Slight for conifers and hardwoods.	Slight	Red oak, black oak, red maple.	Red pine, larch, white pine.
AhF	Fair	Moderate	Severe	Severe	Slight for conifers and hardwoods.	Slight	Red oak, black oak, red maple.	Red pine, larch, white pine.
Alvira: AlA, AlB, AlC, ArB.	Good	Slight	Moderate	Moderate	Severe for conifers; moderate for hardwoods.	Moderate	Yellow-poplar, red oak, ash, sugar maple, red maple.	Yellow-poplar, larch, Norway spruce, white spruce, white pine.
Armagh: As	Very good	Slight	Severe	Severe	Moderate for conifers and hardwoods.	Severe	Red oak, ash, sugar maple, red maple.	White pine, larch, Norway spruce.
Atkins: At	Fair	Slight	Severe	Severe	Severe for conifers and hardwoods.	Moderate	Pin oak, red maple, sycamore.	White pine, white spruce.
Brinkerton: BrA, BrB, Bt.	Good	Slight	Severe	Severe	Moderate for conifers and hardwoods.	Severe	Yellow-poplar, red oak, ash, sugar maple, red maple.	Yellow-poplar, larch, Norway spruce, white spruce, white pine.
Canfield:								
CdB, CdC, CeB	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
CeD	Very good	Moderate	Moderate	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
Cavode:								
ClA, ClB	Very good	Slight	Moderate	Moderate	Severe for conifers and hardwoods.	Moderate	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.
ClC	Very good	Moderate	Moderate	Moderate	Severe for conifers and hardwoods.	Moderate	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.

See footnote at end of table.

TABLE 2.—*Wood crops and factors in management*—Continued

Series and map symbols	Site quality	Hazards					Species to be favored—	
		Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	Windthrow	In existing stands	For planting or seeding
Cookport: CoA, CoB, CoC, CpB, CpC.	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
Ernest:								
ErB, EsB	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
EsC	Very good	Moderate	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
Frenchtown: FeA, FeB.	Excellent	Slight	Severe	Severe	Moderate for conifers and hardwoods.	Severe	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.
Gilpin:								
GlB, GlC	Very good	Slight	Slight	Moderate	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.
GlD	Very good	Moderate	Moderate	Moderate	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.
Hanover:								
HaA, HaB, HaC, HdB.	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
HaD, HdD	Very good	Moderate	Moderate	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
HdE	Very good	Severe	Severe	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
Hazleton:								
HeB, HeC, HlB	Good	Slight	Slight	Slight	Moderate for conifers; slight for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.

HeD	Good	Slight	Moderate	Slight	Moderate for conifers; slight for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.
HnD	Good	Moderate	Moderate	Moderate	Moderate for conifers; slight for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.
HnF	Good	Severe	Severe	Moderate	Moderate for conifers; slight for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.
Monongahela: MoA, MoB.	Good	Slight	Slight	Slight	Moderate for conifers; slight for hardwoods.	Slight	Yellow-poplar, black cherry, ash, red oak, sugar maple.	Yellow-poplar, larch, white pine, Norway spruce, black cherry.
Philo: Ph	Excellent	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, ash, black walnut, red oak, sugar maple.	Yellow-poplar, larch Norway spruce, white pine, black walnut, black cherry.
Pope: Po	Excellent	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, ash, black walnut, red oak, sugar maple.	Yellow-poplar, larch, Norway spruce, white pine, black walnut, black cherry.
Ravenna: RaA, RaB	Excellent	Slight	Moderate	Moderate	Severe for conifers and hardwoods.	Moderate	Yellow-poplar, red oak, ash, sugar maple, black cherry.	Yellow-poplar, larch, Norway spruce, white spruce, white pine, black cherry.
RaC	Excellent	Moderate	Moderate	Moderate	Severe for conifers and hardwoods.	Moderate	Yellow-poplar, red oak, ash, sugar maple, black cherry.	Yellow-poplar, larch, Norway spruce, white spruce, white pine, black cherry.
Rexford: Re	Good	Slight	Moderate	Moderate	Severe for conifers; moderate for hardwoods.	Moderate	Black cherry, red oak, ash, sugar maple.	Black cherry, larch, Norway spruce, white spruce, white pine.
Strip mines: Sm.[1]								
Tyler: Ty	Very good	Slight	Moderate	Moderate	Severe for conifers and hardwoods.	Moderate	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, red pine, Norway spruce, white pine.

See footnote at end of table.

TABLE 2.—*Wood crops and factors in management*—Continued

Series and map symbols	Site quality	Hazards					Species to be favored—	
		Erosion hazard	Equipment limitations	Seedling mortality	Plant competition	Windthrow	In existing stands	For planting or seeding
Urban land: Um. No commercial timber on Urban land. For Monongahela part of Um, see Monongahela series.								
Wharton:								
WhB	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
WhC	Very good	Moderate	Slight	Slight	Severe for conifers; moderate for hardwoods.		Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, white pine.
Wooster:								
WoB, WoC	Very good	Slight	Slight	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.
WoD, WsD	Very good	Moderate	Moderate	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.
WsE	Very good	Severe	Severe	Slight	Severe for conifers; moderate for hardwoods.	Slight	Yellow-poplar, black cherry, red oak, ash, sugar maple.	Yellow-poplar, black cherry, larch, Norway spruce, red pine, white pine.

For revegetation of strip mines see Literature Cited (*15*) page 84.

and the expected yield at age 50 is about 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 board feet per acre.

Yield information for yellow-poplar is based on data from E. F. McCarthy, Central States Experiment Station (*10*). An *excellent* site has a site index of 95 or better, and the expected yield at age 50 is 32,150 board feet per acre. A site index of 85–95 is rated *very good*, and the expected yield at age 50 is about 24,400 board feet per acre. A site index of 75–85 is rated *good*, and the expected yield at age 50 is about 17,620 board feet per acre. A site index of 65–75 is rated *fair*, and the expected yield at age 50 is about 11,400 board feet per acre. A site index of 55–65 is rated *poor*, and the expected yield at age 50 is about 5,600 board feet per acre.

The site index for other trees, such as white pine, sugar maple, ash, and black cherry, varies somewhat. The better sites have the taller trees of the same species at an age of 50 years and then decrease accordingly. More information on site index for other tree species can be obtained from the U.S.D.A. Soil Conservation Service and the Bureau of Forests, Department of Environmental Resources.

Use of Soils as Wildlife Habitat [4]

In Venango County, as elsewhere, the kinds and amounts of wildlife greatly depend on the kinds of soil, although this relationship between soil and wildlife is not always easily distinguished. Soil affects wildlife through its influence on vegetation, which supplies food and cover for wildlife.

Under natural conditions, the pattern or combination of vegetation in an area depends on the distribution of the various kinds of soil. An area is inhabited by species of wildlife whose habitat requirements are met by the vegetation in the area. If the natural conditions in the area are altered by drainage or other practices used in managing farmland or woodland, the kinds and patterns of vegetation change. Along with this change in vegetation is a change in the kinds and amounts of wildlife.

White-tailed deer are a species of woodland wildlife, but they neither prefer nor do well in large, mature forests. They prefer a combination of brush and young trees, lesser amounts of mature trees, and small, open areas. Deer are found throughout Venango County. Excellent habitat supports a high population of heavy animals that have large racks. The same ideal food and cover seems to produce good populations of ruffed grouse year after year. No correlation between the distribution and abundance of these species and the different kinds of soil has been determined.

Black squirrels and gray squirrels are plentiful throughout woodland of the county. Fox squirrels inhabit the southern part of the county, where farmland is interspersed with woodland. All the soil associations of the county have some areas that are suitable for squirrels.

A moderate population of ring-necked pheasants exists in the extreme southwestern corner of Venango County, where corn and small grain are produced in the valleys. This area is classified by the Pennsylvania Game Commission as second-class pheasant range. This is range that has an established population and some natural reproduction. Supplemental stocking is required, however, if the population is maintained. Generally, the capacity to produce a desirable habitat for pheasants depends on soil fertility. Larger, healthier birds are generally found on the most fertile soils, where there is a balance of habitat elements.

Good populations of cottontail rabbits inhabit most soil associations of the county. They are most numerous in the Canfield-Ravenna and Hanover-Alvira soil associations, where cropland, grassland, and brushy areas are interspersed. Fewer rabbits are found in large cultivated fields and dense woodland.

Wild turkeys inhabit the heavily wooded areas of the county in fair numbers. These areas are primarily in or near the Hazleton-Gilpin soil association, which consists of steep and very steep soils on sides of valleys. The physical characteristics of these soils make them unsuitable for cultivation, and, therefore, the soils have remained in permanent woodland. During the brood-rearing period of summer, wild turkeys commonly utilize the more level openland and cultivated areas.

Black bear infrequently range into the northeastern corner of the county.

Venango County provides good habitat for woodcock. Excellent populations are found along streams throughout the fall migration period. They are in or near the Alton-Monongahela-Philo and Hazleton-Gilpin soil associations.

Small populations of mourning doves occur throughout the county, except in areas of the Hazleton-Gilpin soil association. Some Canada geese, mallards, black ducks, and wood ducks can be found along the Allegheny River and other waterways and on ponds within the county.

Muskrat, opossum, and raccoon are abundant. Fox, mink, weasel, and beaver are present in fewer numbers.

The Allegheny River and French Creek furnish 74 miles of excellent warm-water fishing. Sixteen streams within the county provide 87 miles of trout water.

In table 3 the soils of the county are rated according to their suitability for six kinds of wildlife food and cover, two kinds of water developments, and three kinds of wildlife (*1*). The categories rated in table 3 are described 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 sunflowers.

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, and alfalfa.

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, strawberries, beggarweed, goldenrod, and dandelion.

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

TABLE 3.—*Suitability of*

Soil series and map symbols	Wildlife habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Coniferous woody plants
Allegheny:					
AgA	Well suited	Well suited	Well suited	Well suited	Poorly suited
AgB	Suited	Well suited	Well suited	Well suited	Poorly suited
Alton:					
AhA, AhB, AhC	Suited	Well suited	Well suited	Suited	Suited
AhD	Poorly suited	Suited	Well suited	Suited	Suited
AhF	Not suited	Poorly suited	Well suited	Suited	Suited
Alvira:					
AlA	Suited	Suited	Well suited	Well suited	Well suited
AlB	Suited	Suited	Well suited	Well suited	Well suited
AlC	Suited	Suited	Well suited	Well suited	Well suited
ArB	Not suited	Poorly suited	Poorly suited	Suited	Suited
Armagh: As	Poorly suited	Suited	Suited	Suited	Suited
Atkins: At	Poorly suited	Suited	Suited	Suited	Suited
Brinkerton:					
BrA	Poorly suited	Suited	Suited	Suited	Suited
BrB	Poorly suited	Suited	Suited	Suited	Suited
Bt	Not suited	Poorly suited	Poorly suited	Suited	Suited
Canfield:					
CdB	Suited	Well suited	Well suited	Suited	Suited
CdC	Suited	Well suited	Well suited	Suited	Suited
CeB, CeD	Not suited	Poorly suited	Poorly suited	Suited	Suited
Cavode:					
ClA	Suited	Suited	Well suited	Well suited	Well suited
ClB	Suited	Suited	Well suited	Well suited	Well suited
ClC	Suited	Suited	Well suited	Well suited	Well suited
Cookport:					
CoA	Well suited	Well suited	Well suited	Well suited	Well suited
CoB	Suited	Well suited	Well suited	Well suited	Well suited
CoC	Suited	Well suited	Well suited	Well suited	Well suited
CpB, CpC	Not suited	Poorly suited	Poorly suited	Suited	Suited
Ernest:					
ErB	Suited	Well suited	Well suited	Well suited	Well suited
EsB, EsC	Not suited	Poorly suited	Poorly suited	Suited	Suited
Frenchtown:					
FeA	Poorly suited	Suited	Suited	Suited	Suited
FeB	Poorly suited	Suited	Suited	Suited	Suited
Gilpin:					
GlB, GlC	Suited	Well suited	Well suited	Suited	Suited
GlD	Poorly suited	Suited	Well suited	Suited	Suited
Hanover:					
HaA, HaB, HaC	Suited	Well suited	Well suited	Well suited	Well suited
HaD	Poorly suited	Suited	Well suited	Well suited	Well suited
HdB, HdD, HdE	Not suited	Poorly suited	Poorly suited	Suited	Suited
Hazleton:					
HeB, HeC	Suited	Well suited	Well suited	Well suited	Well suited
HeD	Poorly suited	Suited	Well suited	Well suited	Well suited
HlB, HnD, HnF	Not suited	Poorly suited	Poorly suited	Suited	Suited
Monongahela:					
MoA	Well suited	Well suited	Well suited	Well suited	Well suited
MoB	Suited	Well suited	Well suited	Well suited	Well suited
Philo: Ph	Poorly suited	Suited	Suited	Well suited	Well suited
Pope: Po	Poorly suited	Suited	Suited	Well suited	Well suited

See footnote at end of table.

soils as wildlife habitat

Wildlife habitat elements—Continued			Kinds of wildlife		
Wild herbaceous wetland plants	Shallow-water development	Shallow excavated ponds	Openland	Woodland	Wetland
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Not suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Well suited	Well suited	Poorly suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Well suited	Well suited	Poorly suited	Suited	Suited	Well suited.
Suited	Poorly suited	Suited	Poorly suited	Suited	Suited.
Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Suited	Not suited	Not suited	Suited	Suited	Not suited.
Well suited	Suited	Well suited	Poorly suited	Suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Well suited	Well suited	Well suited	Well suited	Suited	Well suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Well suited	Well suited	Poorly suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Well suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Suited	Well suited	Poorly suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.

TABLE 3.—*Suitability of soils*

Soil series and map symbols	Wildlife habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Coniferous woody plants
Ravenna:					
RaA	Suited	Suited	Well suited	Well suited	Well suited
RaB	Suited	Suited	Well suited	Well suited	Well suited
RaC	Suited	Suited	Well suited	Well suited	Well suited
Rexford: Re	Suited	Suited	Suited	Suited	Suited
Strip mines: Sm.[1]					
Tyler: Ty	Suited	Suited	Well suited	Well suited	Well suited
Urban land: Um.[1]					
Wharton:					
WhB, WhC	Suited	Well suited	Well suited	Well suited	Well suited
Wooster:					
WoB, WoC	Suited	Well suited	Well suited	Well suited	Well suited
WoD	Poorly suited	Suited	Well suited	Well suited	Well suited
WsD, WsE	Not suited	Poorly suited	Poorly suited	Suited	Suited

[1] Variable. Requires onsite investigation.

Hardwood trees, shrubs, and vines are deciduous trees, shrubs, and woody vines that produce fruit, nuts, buds, catkins, twigs, or foliage that is used extensively as food for wildlife. They commonly are established naturally but also may be planted. Examples are oak, beech, cherry, hawthorn, dogwood, viburnums, holly, maple, birch, and poplar. Smaller plants include grapes, honeysuckle, blueberries, briers, greenbrier, raspberries, and roses.

Coniferous woody 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 are commonly established naturally, but they also 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 to 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, wild rice, switchgrass, reed canarygrass, and cattails.

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

Shallow excavated ponds are dug-out areas or a combination of dug-out areas and low dikes that hold water of suitable quality, suitable depth, and ample supply for the production of wildlife. Such a pond should have an average depth of less than 5 feet. Also required is a permanently high water table or another source of unpolluted water of low acidity.

Openland wildlife consists of the birds and mammals commonly found in crop fields, meadows and pastures, and nonforested, overgrown land. Among these are quail, ring-necked pheasants, mourning doves, woodcock, cottontail rabbits, meadow larks, killdeer, and field sparrows.

Woodland wildlife consists of birds and mammals commonly found in wooded areas. Examples are ruffed grouse, wild turkeys, wood thrushes, warblers, vireos, deer, squirrels, and raccoon.

Wetland wildlife consists of birds and mammals commonly found in marshes and swamps. Examples are ducks, geese, heron, snipe, rails, coots, muskrat, mink, and beaver.

Each rating under "Kinds of wildlife" in table 3 is based on the ratings listed for habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood woody plants, and coniferous woody plants. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous upland plants, hardwood woody plants, and coniferous woody plants. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants, shallow-water developments, and shallow excavated ponds.

All the soils in the county are suitable for some kinds of wildlife, but some of the soils are more suitable for cultivated crops. On the soils in capability classes I, II, III, and IV, crops may be more valuable than wildlife, but wildlife may be plentiful on these soils and is a secondary crop. Soils in class VII are unsuitable for cropland but are suitable for wildlife and woodland.

Many practices used primarily to improve the soil and to increase crop production also benefit wildlife. Contour stripcropping provides a mixture of cover and increases 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 fertilization and liming.

as wildlife habitat—Continued

Wildlife habitat elements—Continued			Kinds of wildlife		
Wild herbaceous wetland plants	Shallow-water development	Shallow excavated ponds	Openland	Woodland	Wetland
Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Suited	Suited	Suited	Suited	Suited.
Suited	Suited	Suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.

Practices used primarily to benefit wildlife supplement the practices used primarily to increase crop yields. Plantings of grasses and legumes along field borders provide 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 soil. 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 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 develop shallow-water impoundments. The ponds can be stocked with fish, and they are also used by migratory waterfowl as resting places. If shrubs and trees are planted around these ponds, they will attract many other kinds of wildlife. Shallow-water impoundments are breeding grounds and feeding areas for waterfowl and shorebirds. Muskrat, mink, and other furbearers also benefit from these developments. Because many of the soils in the county are not suitable sites for ponds, the sites should be selected with care before a pond is planned.

The greatest damage to aquatic life in the waters of the county is from pollution and erosion sediments. Fish are killed by drainage from strip mines, industrial waste, oil spills, sewage, insecticides, and herbicides. The greatest danger to aquatic life in the county is drainage from strip mines. This drainage, commonly acid and high in content of iron, has been responsible for killing many fish. Several streams no longer support aquatic life because of mine drainage. Sediments from soil erosion are also damaging. As these sediments wash into rivers and streams, they settle and cover spawning beds and recently hatched fish. The sediments destroy food and food-producing areas. By filling pools, they cause water temperature to rise to a point that is harmful to fish. Erosion of streambanks, commonly caused by overgrazing, is particularly damaging. Streambanks can also be protected by plantings. Ideally, the entire watershed should be protected by carrying out a complete plan that protects every farm and all the land in the watershed.

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as foundation material upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, sheer strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain-size distribution, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and soil 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 recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.

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

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 kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of 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 4, 5, and 6, which show, respectively, results of engineering laboratory tests on soil samples, estimated soil properties significant in engineering, and interpretations for selected engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Inspection of sites, especially the small ones, is also needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used by soil scientists have different meanings in soil science than they have in engineering. The Glossary defines many such terms.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*22*) used by the Soil Conservation Service, the Department of Defense and other agencies, and the AASHO system adopted by the American Association of State Highway Officials (*2*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. 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, ML–CL.

The AASHO 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 that range 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 strength when wet and 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 subdivided as follows: A–1–a, A–1–b; A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5 and A–7–6. Within each group, 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 AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 4; the estimated classification, without group index numbers, for all soils mapped in the survey area is shown in table 5.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter.

Engineering test data

Table 4 contains the results of engineering tests performed by the Pennsylvania Department of Transportation on several major soils in Venango County. The table shows the location where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

Maximum dry density is the maximum unit dry weight of the soil when it has been compacted with optimum moisture by the prescribed method of compaction (ASTM D–698). The moisture content that gives the highest dry unit weight is called the optimum moisture content for the specific method of compaction.

Mechanical analysis shows the percentages, by weight, of soil particles that pass sieves of specified sizes. Sand and coarser materials do not pass the No. 200 sieve. Silt and clay particles pass the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes the No. 200 sieve, and clay is that fraction smaller than 0.002 millimeter in diameter that passes the No. 200 sieve.

The clay fraction was determined by the hydrometer method, rather than by the pipette method used by most soil scientists to determine the clay content of soil samples.

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 a solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes 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.

Estimated soil properties significant in engineering

Table 5 provides estimates of soil properties important in engineering. The estimates are based on field classification and descriptions, on physical and chemical tests of selected representative samples, on test data from comparable soils in adjacent areas, and on detailed experience with the individual kinds of soil in the survey area.

Depth to seasonal high water table indicates the depth to which free water will rise at least once a year, measured in feet from the surface.

Depth to bedrock is measured in feet from the surface. It is the range in which bedrock is encountered in most areas of a particular soil. Bedrock is considered the solid or fractured rock that underlies the soil and other unconsolidated material.

Depth from surface indicates the depth to the significant layers for which properties have been estimated. Those layers are described in the section "Descriptions of the Soils." The estimates of properties of significant layers that are given in succeeding columns are ranges of values for a representative soil profile. Variations from these values are to be expected. Most engineering interpretations are based on the soil material below a depth of 6 to 10 inches. The soil above this depth ordinarily contains too much organic matter to be used in engineering structures, but it is commonly saved and used as topsoil on benches and slopes to promote the growth of vegetation.

The coarse fraction greater than 3 inches was not included in the mechanical analysis; it is a field observation made at the time the sample was collected.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter.

Permeability, as used in table 5, relates to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties that result from use of the soils are not considered.

Available moisture capacity is the capacity of soils to hold water available for use by most plants. See Glossary.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The relative terms used to describe soil reaction are given in the Glossary.

Estimates for optimum moisture for compaction and maximum dry density, both of which are defined in the subsection "Engineering test data," are not given for the upper layer, because in most places this material is not used in engineering construction.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures built in, on, or with such materials.

Corrosion potential indicates the potential danger to uncoated metal or concrete structures through chemical action that dissolves or weakens the structural material. Structural materials may corrode when buried in soil, and a given material corrodes in some kinds of soil more rapidly than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon.

Engineering interpretations

Information useful to engineers and others who plan to use soil material in construction of highways, farm facilities, and pipelines is given in table 6. The ratings and interpretations in this table are based on the estimates of soil properties in table 5; on available test data, including those in table 4; and on field experience. Detrimental or undesirable features are emphasized.

Suitability of a soil for winter grading is based mainly on the occurrence of a seasonal high water table, which interferes with moving, mixing, and compacting the soil material when temperatures are below freezing.

A soil that has a surface layer relatively free of gravel, loamy in texture, and high in organic-matter content is rated good as a source of topsoil.

A soil that has a significant amount of relatively clean gravel or sand in the solum or substratum is rated good as a source of sand and gravel.

To be rated good as a source of road fill, a soil must be moderately well drained or well drained and at least moderately deep.

A high water table, stones, slopes, a flood hazard, and instability are detrimental features that have to be considered in selecting locations for highways.

A high water table, corrosion potential, wall stability, and depth to bedrock are features to be considered in pipeline construction.

The rate of permeability, which is an indication of the amount of water that will be lost through seepage, is a soil feature of major importance in the selection of the reservoir area for a pond. The embankment or dam is affected by stability, compaction characteristics, and permeability of the soil material.

Irrigation systems, drainage, terraces, diversions, and waterways are affected by slope, permeability, depth to the water table, stoniness, and the flood hazard.

Use of Soils in Town and Country Planning

This section provides information of special interest to those persons or organizations responsible for town and country plans, which rely on selective soil use for their success. The section provides a sound factual basis for developing wise plans for land use in Venango County and its political subdivisions. Interpretive maps to assist in determining the degree and kind of limitation of the soils of any given area can be made from the soil maps and the information in table 7.

The information in this section is presented for general guidance to officials and developers concerned with selecting suitable uses for soils and avoiding mistakes and costly changes in plans resulting from improper use. Although this information and the soil maps give general guidance, it is emphasized that the mapping and written information are restricted in detail by the map scale and should be used only in planning more detailed field investigations to determine the onsite condition of the soil.

Soil features alone are evaluated in this section, since the ease or difficulty of making improvements is largely controlled by the characteristics of the soils. It is recognized, however, that such factors as locations and other economic factors often determine the ultimate use of an area, regardless of soil limitations.

Table 7 lists all the soils in the county and shows the kinds and estimated degree of limitation for specific uses. Soil features that have an important effect on town and country planning uses are depth to bedrock, permeability, flooding, depth to seasonal water table, soil texture, soil slope, and stoniness. Relative degrees of limitation used are *slight*, *moderate*, and *severe*. A rating of *slight* indicates that the soil area generally has few limitations for the use being considered. A rating of *moderate* indicates that the soil has limitations that require special practices to overcome or correct them. A rating of *severe* indicates that the soil has limitations very difficult or expensive to overcome or correct.

TABLE 4.—*Engineering*

[Tests performed by the Pennsylvania Department of Transportation Soil Testing Laboratory, Harrisburg, Pennsyl-

Soil name and location	Parent material	Pennsylvania engineering report No.	Depth from surface	Moisture density[1]	
				Maximum dry density	Optimum moisture
			In.	*Lb./cu. ft.*	*Pct.*
Allegheny: 1 mile northwest of Hannasville	Alluvium.	67-37098	12-22	115	15
		67-37099	30-90	128	9
Alvira: 0.125 mile east of Sunville	Glacial till.	A-48104	21-29	114	16
		A-48105	43-55	121	12
Canfield: 4.25 miles northwest of Polk	Glacial till.	A-48110	13-19	110	17
		A-48111	57-62	125	8
Cookport: 5.75 miles east of Oil City	Sandstone, siltstone, and shale.	A-48100	13-20	117	14
		A-48101	38-60	119	13
Hanover: 1 mile north of Cherrytree	Glacial till.	67-37116	9-20	111	16
		67-37117	43-60	121	13
Monongahela: 0.85 mile south of Niles	Alluvium.	A-48116	14-26	108	18
		A-48117	67-72	116	11
Philo: 1.3 miles northeast of Cooperstown	Alluvium.	67-37092	9-22	101	20
		67-37093	37-60	111	14
Ravenna: 1.5 miles northeast of Utica	Glacial till.	67-37090	13-24	109	16
		67-37091	43-60	126	10
Wooster: 1 mile north of Hannasville	Glacial till.	67-37106	11-22	113	15
		67-37107	47-60	124	11

[1] Based on AASHO Designation: T 99-57 (*2*).
[2] Mechanical analysis according to AASHO 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 AASHO 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 coarser than 2

test data

vania, in accordance with standard procedures of the American Association of State highway Officials (2) (AASHO)]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						AASHO	Unified
3 inch	¾ inch	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.				
										Pct.			
100	98	92	90	86	82	76	50	25	18	31	7	A-4-(8)	ML
100	81	54	39	21	8	7	4	2	2	17	[3] NP	A-1-a(0)	GW-GM, SW-SM
100	84	79	77	73	60	55	39	25	18	29	8	A-4-(5)	CL
100	96	89	85	79	58	53	38	24	18	24	7	A-4-(5)	ML-CL
100	100	97	96	94	81	82	65	33	22	31	7	A-4-(8)	ML
100	93	79	73	63	32	30	16	6	4	NP	NP	A-2-4(0)	SM
100	100	92	85	80	57	54	38	24	18	27	4	A-4-(6)	ML
100	96	83	75	69	49	42	22	12	9	24	1	A-4-(3)	SM
100	88	85	82	78	66	60	45	27	21	31	9	A-4-(6)	CL
100	83	74	70	66	48	42	32	24	20	31	12	A-6-(3)	GC, SC
100	100	100	99	99	96	87	64	35	25	35	10	A-4-(8)	ML
100	94	84	78	66	18	12	5	2	2	NP	NP	A-2-4-(0)	SM
100	------	------	100	99	81	70	41	23	16	34	7	A-4-(8)	ML
100	------	------	100	100	54	40	22	12	8	21	NP	A-4-(4)	ML
100	99	98	97	95	87	80	56	31	24	32	10	A-4-(8)	CL
100	90	84	80	73	50	43	26	13	9	19	3	A-4-(3)	SM
100	87	70	62	49	42	39	30	16	9	29	4	A-4-(1)	GM
100	69	52	48	39	13	11	7	4	4	NP	NP	A-1-b	GM

millimeters in diameter. In the SCS soil survey 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 used in this table are not suitable for naming textural classes for soils.

[3] Nonplastic.

TABLE 5.—*Estimates of soil*

[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 soils in for referring to other series that appear in the first column of this

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	USDA texture (typical profile)	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*Ft.*	*In.*		*Pct.*				
Allegheny: AgA, AgB	>3	>6	0-8	Silt loam	0-15	75-100	70-100	50-100	30-80
			8-30	Silt loam, loam	0-15	70-100	70-100	65-95	45-95
			30-90	Gravelly sandy loam	0-45	50-95	30-70	20-60	5-55
Alton: AhA, AhB, AhC, AhD, AhF.	>3	>6	0-7	Gravelly loam	5-15	55-90	50-70	25-70	15-45
			7-40	Gravelly loam, gravelly sandy loam.	5-20	40-60	30-55	10-40	5-35
			40-60	Stratified sand and gravel.	5-20	40-55	30-55	10-40	1-12
*Alvira: AlA, AlB, AlC, ArB. For properties of Ravenna soils in ArB, see Ravenna series.	½-1½	>5	0-21	Silt loam	----------	90-100	85-100	85-100	65-90
			21-29	Gravelly silt loam	0-5	75-95	65-85	60-80	50-70
			29-72	Gravelly loam	0-15	70-90	60-85	55-75	50-70
Armagh: As	0-½	4-6	0-6	Silt loam	0-5	95-100	90-100	80-95	75-85
			6-61	Silty clay loam, silty clay.	0-5	85-95	80-90	70-85	65-85
			61	Fractured shale bedrock.					
Atkins: At	[1] 0-½	>6	0-6	Silt loam	----------	90-100	90-100	85-100	60-95
			6-40	Silt loam	----------	85-100	80-100	55-75	35-75
			40-60	Stratified cobblestones, gravel, and sand.	0-10	60-95	60-80	50-70	15-60
*Brinkerton: BrA, BrB, Bt. For properties of Frenchtown soils in Bt, see Frenchtown series.	0-½	>4	0-10	Silt loam	0-10	90-100	85-100	85-100	75-100
			10-41	Silty clay loam (fragipan).	0-10	90-100	85-100	85-100	65-95
			41-63	Silt loam	0-10	70-100	60-100	55-100	40-90
			63	Shale.					
Canfield: CdB, CdC, CeB, CeD.	1½-3	>5	0-22	Gravelly silt loam	0-5	75-100	70-100	55-95	45-90
			22-62	Gravelly sandy loam, gravelly loam (fragipan).	0-15	70-95	65-95	50-85	30-70
Cavode: ClA, ClB, ClC.	½-1½	3½-6	0-6	Silt loam	0-5	90-100	90-100	85-95	80-90
			6-39	Silty clay loam	0-5	80-95	75-95	70-90	60-90
			39-53	Very shaly silt loam	0-10	60-90	55-85	50-80	40-75
			53	Consolidated shale bedrock.					
Cookport: CoA, CoB, CoC, CpB, CpC.	1½-3	4-6	0-6	Loam	0-10	80-95	70-90	60-80	40-70
			6-38	Loam, channery loam (fragipan).	0-15	65-95	65-95	50-90	40-75
			38-60	Very channery loam	0-15	70-90	60-85	50-80	30-55
Ernest: ErB, EsB, EsC.	1½-3	>5	0-8	Silt loam	0-15	75-100	70-100	70-95	60-95
			8-23	Silty clay loam	0-15	75-100	75-100	70-95	65-95
			23-60	Clay loam, shaly clay loam (fragipan).	5-25	70-95	55-95	50-95	40-95

See footnote at end of table.

properties significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions table. The symbol > means more than; the symbol < means less than]

Engineering classification		Range in permeability	Range in available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosion potential	
Unified	AASHO							Steel	Concrete
		In./hr.	*In./in. of soil*	*pH*	*Pct.*	*Lb./cu. ft.*			
ML, SM	A–2, A–4	0.60–6.00	0.10–0.18	4.5–5.5	----------	----------	Low	Low	Moderate.
SM, ML, CL	A–4, A–6	0.60–2.00	0.10–0.14	4.5–5.5	10–15	110–125	Low	Low	Moderate.
ML, CL, SM, SW, GM, GW	A–1, A–2, A–4, A–6	0.60–6.00	0.08–0.14	4.5–5.5	5–10	125–130	Low	Low	High.
SM, GM	A–2, A–4	>6.00	0.10–0.14	5.1–6.0	----------	----------	Low	Low	Moderate.
GW, GP, GM, SM, SP	A–1, A–2	>6.00	0.04–0.06	5.1–6.0	8–12	118–130	Low	Low	Moderate.
GW, GP, GM, SP	A–1, A–2	>6.00	0.04 0.06	5.1–6.0	8–12	118–130	Low	Low	High.
ML, CL	A–4, A–6	0.60–2.00	0.14–0.20	4.5–6.0	----------	----------	Low	High	Moderate.
ML, CL	A–4, A–6	0.20–0.06	0.06–0.12	4.5–5.5	11–17	112–124	Low	High	High.
ML, CL	A–4, A–6	<0.20	0.06–0.12	4.5–5.5	10–15	112–126	Low	High	High.
ML, CL	A–4, A–6	0.60–2.00	0.18–0.22	5.1–6.5	----------	----------	Low	High	Moderate.
ML, CL	A–4, A–6, A–7.	<0.02	0.10–0.14	4.5–5.5	14–20	105–115	Moderate	High	High.
ML, CL	A–4, A–6	0.60–2.00	0.18–0.22	4.5–6.0	----------	----------	Low	High	Moderate.
CL, SM, SC	A–2, A–4, A–6.	0.20–0.60	0.14–0.18	4.5–5.5	12–18	105–110	Low	High	High.
ML, CL, SM, SC	A–2, A–4	0.20–6.30	0.08–0.16	4.5–5.5	8–14	108–120	Low	High	High.
ML, CL	A–4, A–6,	0.20–2.00	0.18–0.24	4.5–6.5	----------	----------	Low	High	Moderate.
ML, CL, MH, CH.	A–4, A–6, A–7.	0.20–0.60	0.14–0.18	4.5–6.0	16–22	100–112	Moderate	High	Moderate.
ML, CL, SM, SC, GM, GC.	A–4, A–6	0.20	0.08–0.12	4.5–6.0	12–17	110–120	Moderate	High	Moderate.
ML, SM, CL.	A–4, A–6	0–60–2.00	0.10–0.14	5.1–6.0	11–16	110–130	Low	Moderate	Moderate.
ML, CL, SM, SC	A–2, A–4	<0.20	0.04–0.08	5.6–7.3	8–16	110–125	Low	Moderate	Moderate.
ML, CL	A–4, A–6	0.60–2.00	0.18–0.22	5.1–6.0	----------	----------	Low	High	Moderate.
ML, CL	A–4, A–6, A–7	<0.20	0.10–0.14	4.5–5.5	15–18	100–110	Moderate	High	High.
ML, CL, GM, GC	A–4, A–6	<0.20	0.08–0.12	4.5–5.5	12–15	115–120	Moderate	High	High.
SM, ML	A–4	0.60–6.00	0.14–0.18	4.5–5.5	----------	----------	Low	Moderate	High.
ML, CL, SM	A–4, A–6	0.60–2.00	0.12–0.16	4.5–5.5	11–16	110–120	Low	Moderate	High.
ML, CL, SM, GM	A–2, A–4	<0.20	0.08–0.12	4.5–5.5	9–14	114–129	Low	Moderate	High.
ML, CL	A–4, A–6	0.60–2.00	0.14–0.20	4.5–5.5	----------	----------	Low	High	High.
ML, CL	A–4, A–6, A–7	0.60–2.00	0.12–0.16	4.5–5.5	15–19	102–112	Moderate	High	High.
ML, CL, GC, GM	A–4, A–6	0.2–0.6	0.08–0.12	4.5–5.5	12–17	114–120	Moderate	High	High.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	USDA texture (typical profile)	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	Ft.	In.		Pct.				
Frenchtown: FeA, FeB.	0–½	>5	0–10	Silt loam	0–5	90–100	90–100	85–100	75–95
			10–44	Silt loam, loam (fragipan).	0–5	90–100	90–100	85–100	65–95
			44–60	Silt loam	0–10	80–100	75–90	65–85	55–75
Gilpin: GlB, GlC, GlD.	>3	1½–3½	0–7	Silt loam	0–20	85–100	80–90	70–85	60–85
			7–18	Shaly light silty clay loam.	0–30	55–90	50–85	40–75	35–70
			18–28	Very shaly silt loam, shaly silt loam.	0–35	40–70	35–65	25–55	15–60
			28	Rippable shale bedrock.					
Hanover: HaA, HaB, HaC, HaD, HdB, HdD, HdE.	1½–3	>5	0–20	Silt loam	0–5	80–100	80–100	70–85	60–75
			20–60	Gravelly silt loam (fragipan).	0–10	70–100	65–95	60–85	45–75
*Hazleton: HeB, HeC, HeD, HlB, HnD, HnF. For properties of Gilpin soils in HnD and HnF, see Gilpin series.	>3	3½–6	0–9	Channery loam	----------	90–100	90–100	75–90	55–75
			9–37	Channery sandy loam.	0–15	65–85	55–75	50–70	30–55
			37–45	Very channery sandy loam.	0–30	60–85	50–80	45–70	25–55
			45	Hard gray sandstone.					
Monongahela: MoA, MoB.	1½–3	>6	0–10	Silt loam	----------	90–100	85–100	80–100	70–100
			10–53	Silt loam (fragipan)	0–10	80–100	75–100	70–100	55–100
			53–72	Sandy loam, loamy sand.	0–10	75–100	75–100	65–95	15–60
Philo: Ph	[1] 1½–3	>6	0–37	Silt loam	----------	95–100	90–100	80–100	60–85
			37–60	Fine sandy loam	----------	60–100	50–100	40–100	20–55
Pope: Po	[1] >3	>6	0–38	Loam, fine sandy loam, sandy loam.	0–5	70–100	60–100	55–100	30–60
			38–60	Sandy loam	0–5	50–100	45–100	40–100	20–55
Ravenna: RaA, RaB, RaC.	½–1½	>5	0–43	Silt loam	0–5	80–100	75–100	65–95	60–90
			43–60	Sandy loam (fragipan)	0–5	60–90	55–85	55–75	40–60
Rexford: Re	0–1	>6	0–23	Silt loam	----------	70–95	65–90	60–85	55–75
			23–60	Silt loam, gravelly silt loam.	----------	60–90	50–75	40–65	25–55
Strip mines: Sm. Properties too variable to be estimated.									
Tyler: Ty	½–1½	>6	0–19	Silt loam, silty clay loam.	----------	95–100	90–100	90–100	85–100
			19–60	Silty clay loam, gravelly sandy loam (fragipan).	----------	95–100	90–100	85–100	75–90
*Urban land: Um. No valid estimates for Urban land. For Monongahela part, see Monongahela series.									

See footnote at end of table.

significant in engineering—Continued

Engineering classification		Range in permeability	Range in available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosion potential	
Unified	AASHO							Steel	Concrete
		In./hr.	*In./in. of soil*	*pH*	*Pct.*	*Lb./cu. ft.*			
ML, CL	A-4	0. 2-2. 00	0. 20-0. 26	5. 1-6. 5	----------	----------	Low	High	Moderate.
ML, CL	A-4, A-6	<0. 20	0. 10-0. 16	4. 5-6. 5	14-17	110-115	Low	High	Moderate.
ML, CL	A-4, A-6	<0. 60	0. 10-0. 14	5. 6-7. 3	10-14	120-127	Low	High	Low.
ML	A-4	0. 60-2. 00	0. 16-0. 20	4. 5-5. 5	----------	----------	Low	Low	High.
ML, CL, SM, SC	A-4, A-6	0. 60-2. 00	0. 10-0. 14	4. 5-5. 5	13-15	114-118	Low	Moderate	High.
SM, SC, GM, GC, ML, CL	A-2, A-4	0. 60-2. 00	0. 06-0. 10	4. 5-5. 5	11-14	114-120	Low	Low	High.
ML, CL	A-4	0. 20-2. 00	0. 14-0. 18	4. 5-5. 5	14-18	106-113	Low	Moderate	High.
ML, CL, SM, SC, GC	A-4, A-6	0. 20-0. 60	0. 06-0. 10	5. 1-6. 0	11-16	115-122	Low	Moderate	Moderate.
ML	A-4	2. 00-6. 00	0. 12-0. 16	4. 0-5. 5	----------	----------	Low	Low	High.
SM, GC, SC, ML	A-2, A-4	2. 00-6. 00	0. 08-0. 12	4. 0-5. 5	12-16	115-122	Low	Low	High.
SM, GM, ML	A-2, A-4	2. 00-6. 00	0. 08-0. 12	4. 5-5. 5	10-14	118-125	Low	Low	High.
ML	A-4	0. 60-2. 00	0. 18-0. 24	4. 5-5. 5	----------	----------	Low	Moderate	High.
ML, CL	A-4, A-6	<0. 20	0. 10-0. 14	4. 5-5. 5	14-18	107-116	Low	High	High.
SM, ML, SC	A-2, A-4	0. 20-6. 00	0. 10-0. 14	4. 5-5. 5	11-16	115-122	Low	High	High.
ML, CL	A-4	0. 20-2. 00	0. 14-0. 18	4. 5-5. 5	15-20	100-115	Low	Moderate	High.
SM, ML, GM	A-2, A-4	2. 00-6. 00	0. 06-0. 10	4. 5-5. 5	10-17	110-120	Low	Moderate	High.
ML, SM	A-2, A-4	0. 60-6. 00	0. 12-0. 16	4. 5-6. 0	10-14	110-120	Low	Moderate	High.
ML, GM, SM	A-2, A-4	2. 00-6. 00	0. 06-0. 10	4. 5-5. 5	10-15	110-120	Low	Low	High.
ML, CL	A-4	0. 20-2. 00	0. 18-0. 24	4. 5-6. 0	13-19	105-113	Low	High	Moderate.
GM, SM, ML, CL	A-4, A-6	<0. 20	0. 08-0. 12	4. 5-6. 5	10-15	118-126	Low	High	Moderate.
ML	A-4	<0. 20	0. 08-0. 12	4. 5-5. 5	10-15	110-120	Low	High	High.
GM, SM, ML	A-2, A-4	0. 20-6. 00	0-04. 0. 08	4. 5-6. 0	10-15	115-125	Low	High	Moderate.
ML, CL	A-4, A-6	0. 60-2. 00	0. 18-0. 22	4. 0-5. 5	----------	----------	Low	High	High.
ML, CL, CH	A-6, A-7	<0. 20	0. 10-0. 14	5. 1-6. 0	15-20	105-115	Moderate	High	Moderate.

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TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth— Seasonal high water table	Depth— Bed-rock	Depth from surface (typical profile)	USDA texture (typical profile)	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*Ft.*	*In.*		*Pct.*				
Wharton: WhB, WhC	1½–3	4–6	0–9	Silt loam	0–5	95–100	90–100	80–95	70–95
			9–40	Silty clay loam, shaly silty clay loam, shaly clay.	0–5	95–100	90–100	80–95	70–95
			40–49	Very shaly silt loam	0–10	80–100	60–100	55–95	55–90
			49	Rippable shale bedrock.					
Wooster: WoB, WoC, WoD, WsD, WsE.	>3	>6	0–9	Gravelly silt loam	0–5	65–85	60–85	55–80	35–55
			9–36	Gravelly silt loam	0–10	55–85	45–85	40–80	20–60
			36–60	Gravelly loam, gravelly sandy loam (fragipan).	0–20	40–75	35–75	25–70	10–45

[1] Flooding.

TABLE 6.—*Soil interpretations*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The soils in instructions for referring to other series

Soil series and map symbols	Suitability for winter grading	Suitability as source of— Topsoil	Sand and gravel	Road fill	Soil features affecting— Highway location
Allegheny: AgA, AgB	Good	Good	Unsuitable for sand; locally good for gravel.	Fair to good: A–1, A–2, A–4, A–6.	Features generally favorable
Alton: AhA, AhB, AhC, AhD, AhF.	Good	Poor: gravelly	Good	Good	Cut slopes are droughty
*Alvira: AlA, AlB, AlC, ArB. For properties of Ravenna soil in ArB, see Ravenna series.	Fair: seasonal high water table.	Fair: seasonal high water table.	Unsuitable: too many fines.	Fair: A–4, A–6; seasonal high water table.	Seasonal high water table; seepage above fragipan; moderate frost heave potential; some areas stony.
Armagh: As	Poor: high water table; plastic material; forms large frozen clods.	Poor: high water table.	Unsuitable: too many fines.	Poor: high content of clay; A–4, A–6, A–7.	High water table; high content of clay; high frost heave potential; bedrock at depth of 4 to 6 feet.
Atkins: At	Poor: high water table; flooding.	Poor: high water table.	Unsuitable: too many fines; high water table.	Poor to fair: high water table; A–2, A–4, A–6.	Flooding; high water table; high frost heave potential.

significant in engineering—Continued

Engineering classification		Range in premeability	Range in available moisture capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosion potential	
Unified	AASHO							Steel	Concrete
		In./hr.	*In./in. of soil*	*pH*	*Pct.*	*Lb./cu. ft.*			
ML, CL	A-4, A-6	0. 60-2. 00	0. 16-0. 20	4. 5-6. 0	----------	----------	Low	High	Moderate.
ML, CL, MH, CH	A-4, A-6, A-7	0. 20-0. 60	0. 14-0. 18	5. 1-6. 0	16-22	102-112	Moderate	High	Moderate.
ML, CL, MH, CH	A-4, A-6, A-7	<0. 20	0. 08-0. 12	4. 5-5. 5	14-18	110-118	Moderate	High	High.
ML, SM	A-4	0. 60-2. 00	0. 12-0. 16	4. 5-5. 5	----------	----------	Low	Low	High.
ML, CL, SM, GM	A-2, A-4	0. 60-2. 00	0. 10-0. 14	4. 5-5. 5	10-15	112-120	Low	Low	High.
SM, GM	A-1, A-2, A-4	0. 20-0. 60	0. 04-0. 08	5. 1-6. 0	10-15	120-126	Low	Low	Moderate.

for selected engineering uses

such mapping units may have different properties and limitations, and for this reason it is necessary for the reader to follow carefully the that appear in the first column of this table]

Soil features affecting—Continued					
Pipeline construction and maintenance	Impoundments		Farm drainage	Irrigation	Terraces, diversions, or waterways
	Reservoir area	Embankment			
Features generally favorable.	Moderately rapid permeability in substratum.	Stable; moderate to rapid permeability when compacted.	Well drained	Features generally favorable.	Features generally favorable.
Subject to caving	Rapid permeability	Good stability; rapid permeability when compacted.	Well drained	Low available moisture capacity.	Irregular topography.
Seasonal high water table; some areas stony.	Some areas stony	Fair stability and compaction; fair resistance to piping.	Seasonal high water table; slow permeability; some areas stony.	Seasonal high water table; slow permeability.	Seasonal high water table; seepage above fragipan; some areas stony.
High water table; bedrock at depth of 4 to 6 feet.	Bedrock at depth of 4 to 6 feet.	Fair to poor stability; high content of clay.	Slow permeability; high water table.	High water table; slow permeability.	High water table.
High water table; flooding; subject to caving.	Flooding	Poor stability; erodible.	Moderately slow permeability; flooding; high water table; outlets difficult to find.	High water table; flooding; moderately slow permeability.	High water table; flooding.

TABLE 6.—*Soil interpretations for*

Soil series and map symbols	Suitability for winter grading	Suitability as source of—			Soil features affecting—
		Topsoil	Sand and gravel	Road fill	Highway location
*Brinkerton: BrA, BrB, Bt. For properties of Frenchtown soil in Bt, see Frenchtown series.	Poor: high water table; forms large frozen clods.	Poor: high water table.	Unsuitable: too many fines; high water table.	Poor: A–4, A–6, A–7; high water table.	High water table; high frost heave potential; bedrock below depth of 4 feet; some areas stony.
Canfield: CdB, CdC, CeB, CeD.	Fair: seasonal high water table.	Fair: gravelly.	Unsuitable: too many fines.	Fair to good: A–2, A–4, A–6; seasonal high water table.	Seasonal high water table; moderate frost heave potential; seepage above fragipan; some areas stony.
Cavode: ClA, ClB, ClC.	Poor: seasonal high water table; high clay content; forms large frozen clods.	Good	Unsuitable: too many fines.	Poor: A–4, A–6, A–7.	Seasonal high water table; fair to poor stability; high frost heave potential; bedrock at depth of 3½ to 6 feet.
Cookport: CoA, CoB, CoC, CpB, CpC.	Fair: seasonal high water table; forms large frozen clods.	Fair: poor on stony phases.	Unsuitable: too many fines.	Fair: A–4, A–6; seasonal high water table.	Seasonal high water table; moderately high frost heave potential; bedrock at depth of 4 to 6 feet; some areas stony.
Ernest: ErB, EsB, EsC.	Fair: seasonal high water table; forms large frozen clods.	Fair: poor on stony phases.	Unsuitable: too many fines.	Fair to poor: A–4, A–6, A–7; seasonal high water table.	Seasonal high water table; seepage above fragipan; high frost heave potential; some areas stony.
Frenchtown: FeA, FeB	Poor: high water table.	Poor: high water table.	Unsuitable: too many fines.	Fair to poor: A–4, A–6; high water table.	High water table; seepage above fragipan; some areas stony.
Gilpin: GlB, GlC, GlD	Fair: bedrock at depth of 1½ to 3½ feet.	Fair: limited quantity of suitable material.	Unsuitable: too many fines.	Fair: A–4, A–6.	Bedrock at depth of 1½ to 3½ feet; some areas stony.
Hanover: HaA, HaB, HaC, HaD, HdB, HdD, HdE.	Fair: seasonal high water table.	Fair: seasonal high water table.	Unsuitable: too many fines; some areas stony.	Fair: A–4, A–6; seasonal high water table.	Seasonal high water table; moderate frost heave potential; some areas stony.
*Hazleton: HeB, HeC, HeD, HlB, HnD, HnF. For properties of Gilpin soil in HnD and HnF, see Gilpin series.	Good	Poor: channery; some areas stony.	Poor: too many fines; some areas stony.	Good	Channery; bedrock at depth of 3½ to 6 feet; some areas stony.
Monongahela: MoA, MoB.	Fair: seasonal high water table; forms large frozen clods.	Good	Unsuitable for gravel; poor for sand; too many fines.	Fair: A–4, A–6.	Seasonal high water table; high frost heave potential.

selected engineering uses—Continued

Soil features affecting—Continued					
Pipeline construction and maintenance	Impoundments		Farm drainage	Irrigation	Terraces, diversions, or waterways
	Reservoir area	Embankment			
High water table; bedrock below depth of 4 feet; some areas stony.	Bedrock below depth of 4 feet.	Poor stability; fair to poor resistance to piping.	High water table; slow permeability; some areas stony.	High water table; slow permeability.	High water table; some areas stony.
Seasonal high water table; seepage above fragipan; some areas stony.	Features generally favorable.	Fair stability	Seasonal high water table; slow permeability; some areas stony.	Seasonal high water table; moderate available moisture capacity; slow permeability.	Seasonal high water table; seepage above fragipan; some areas stony.
Seasonal high water table; high clay content; bedrock at depth of 3½ to 6 feet.	Bedrock at depth of 3½ to 6 feet.	Fair to poor stability; erodibility.	Slow permeability; seasonal high water table.	Slow permeability; seasonal high water table.	Seasonal high water table; erodibility.
Seasonal high water table; bedrock at depth of 4 to 6 feet; some areas stony.	Bedrock at depth of 4 to 6 feet.	Fair stability; slow permeability when compacted.	Slow permeability; seasonal high water table; some areas stony.	Seasonal high water table; slow permeability.	Seasonal high water table; seepage above fragipan; some areas stony.
Seasonal high water table; some areas stony.	Features generally favorable.	Fair to poor stability; most areas stony.	Seasonal high water table; moderately slow permeability; some areas stony.	Seasonal high water table; moderately slow permeability.	Erodibility; seepage above fragipan; some areas stony.
High water table; some areas stony.	Features generally favorable.	Fair stability; poor resistance to piping.	High water table; slow permeability; some areas stony.	High water table; slow permeability.	High water table; seepage above fragipan; some areas stony.
Bedrock at depth of 1½ to 3½ feet; some areas stony.	Bedrock at depth of 1½ to 3½ feet.	Fair stability; limited quantity of suitable material.	Well drained	Bedrock at depth of 1½ to 3½ feet; low available moisture capacity.	Bedrock at depth of 1½ to 3½ feet; some areas stony.
Seasonal high water table; some areas stony.	May have rapid permeability in substratum.	Fair stability and compaction.	Seasonal high water table; moderately slow permeability; some areas stony.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; some areas stony.
Bedrock at depth of 3½ to 6 feet; some areas stony.	Moderately rapid permeability; bedrock at depth of 3½ to 6 feet.	Stony; permeable when compacted.	Well drained	Some areas stony	Some areas stony.
Seasonal high water table; seepage above fragipan.	May have rapid permeability in substratum.	Fair stability	Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seepage above fragipan.

TABLE 6.—*Soil interpretations for*

Soil series and map symbols	Suitability for winter grading	Suitability as source of—			Soil features affecting—
		Topsoil	Sand and gravel	Road fill	Highway location
Philo: Ph	Poor: seasonal high water table; flooding; forms large frozen clods.	Good	Poor: too many fines.	Fair: A–2, A–4; seasonal high water table.	Seasonal high water table; high frost heave potential; flooding.
Pope: Po	Fair: flooding	Good	Poor: too many fines.	Fair: A–2, A–4.	Moderate frost heave potential; flooding.
Ravenna: RaA, RaB, RaC.	Poor: seasonal high water table.	Fair: seasonal high water table.	Unsuitable: too many fines.	Fair to good: A–4, A–6; seasonal high water table.	Seasonal high water table; moderate frost heave potential; some areas stony.
Rexford: Re	Poor: high water table.	Poor: high water table.	Poor: too many fines; high water table.	Good: A–2, A–4; high water table.	High water table
Strip mines: Sm. Properties variable. Onsite investigation needed.					
Tyler: Ty	Poor: seasonal high water table.	Fair: high water table.	Unsuitable: too many fines.	Poor: A–6, A–7; high water table.	Seasonal high water table; poor stability.
*Urban land: Um. Urban land variable. Onsite investigation required. For Monongahela part of Um, see Monongahela series					
Wharton: WhB, WhC	Fair: seasonal high water table; high clay content.	Fair: seasonal high water table.	Unsuitable: too many fines.	Fair to poor: A–4, A–6, A–7.	Seasonal high water table; fair to poor stability; slips when saturated; moderate frost heave potential; bedrock at depth of 4 to 6 feet.
Wooster: WoB, WoC, WoD, WsD, WsE.	Good	Poor: gravelly	Good	Good	Some areas stony

selected engineering uses—Continued

Soil features affecting—Continued					
Pipeline construction and maintenance	Impoundments		Farm drainage	Irrigation	Terraces, diversions, or waterways
	Reservoir area	Embankment			
Seasonal high water table; flooding.	Moderately rapid permeability in substratum; flooding.	Fair stability; erodibility; piping hazard.	Seasonal high water table; flooding; moderately slow permeability.	Seasonal high water table; flooding; moderately slow permeability.	Seasonal high water table; flooding.
Flooding	Moderately rapid permeability in substratum; flooding.	Fair stability; piping hazard.	Well drained	Flooding	Flooding.
Seasonal high water table; seepage above fragipan; some areas stony.	Features generally favorable.	Features generally favorable.	Seasonal high water table; slow permeability; some areas stony.	Seasonal high water table; slow permeability.	Seasonal high water table; seepage above fragipan; some areas stony.
High water table; subject to caving.	Moderately rapid permeability in substratum.	Good stability; rapid permeability when compacted.	High water table; slow permeability.	Seasonal high water table; slow permeability.	High water table.
Seasonal high water table.	May have rapid permeability in substratum.	Fair stability; erodibility.	Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seasonal high water table.
Seasonal high water table; high clay content; bedrock at depth of 4 to 6 feet.	Bedrock at depth of 4 to 6 feet.	Fair to poor stability; erodibility.	Seasonal high water table; slow permeability; seeps at base of slope.	Seasonal high water table; slow permeability.	Seasonal high water table; slips when saturated.
Subject to caving; some areas stony.	May have rapid permeability in substratum.	Good stability; piping hazard; rapid permeability when compacted.	Well drained	Moderate available moisture capacity.	Irregular topography; some areas stony.

TABLE 7.—*Soil limitations for town and country planning*

Soil series and map symbols	Onsite disposal of effluent from septic tanks	Sewage lagoons	Homes of 3 stories or less with basements	Lawns and landscaping	Streets and parking lots for subdivisions	Sanitary land fills by the trench method [1]
Allegheny:						
AgA	Slight: hazard of ground water contamination.	Moderate: moderate permeability.	Slight	Slight	Slight	Slight.
AgB	Slight: hazard of ground water contamination.	Moderate: moderate permeability; slope.	Slight	Slight	Moderate: slope.	Slight.
Alton:						
AhA	Slight: hazard of ground water contamination.	Severe: rapid permeability.	Slight	Slight	Slight	Severe: rapid permeability.
AhB	Slight: hazard of ground water contamination.	Severe: rapid permeability; slope.	Slight	Slight	Moderate: slope.	Severe: rapid permeability.
AhC	Moderate: slope; hazard of ground water contamination.	Severe: rapid permeability; slope.	Moderate: slope	Moderate: slope.	Severe: slope	Severe: rapid permeability.
AhD	Severe: hazard of ground water contamination; slope.	Severe: rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: rapid permeability.
AhF	Severe: hazard of ground water contamination.	Severe: rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: rapid permeability; slope.
Alvira:						
AlA	Severe: slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
AlB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table.
AlC	Severe: slow permeability; seasonal high water table.	Severe: slope	Severe: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: slope	Severe: seasonal high water table.
ArB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.	Moderate: seasonal high water table; stony.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Armagh: As	Severe: slow permeability; high water table.	Moderate: bedrock at a depth of 4 to 6 feet.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Atkins: At	Severe: moderately slow permeability; high water table.	Severe: flooding	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.
Brinkerton:						
BrA	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
BrB	Severe: slow permeability; high water table.	Moderate: slope	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Bt	Severe: slow permeability; high water table.	Moderate: slope; stony.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.

See footnote at end of table.

TABLE 7.—*Soil limitations for town and country planning*—Continued

Soil series and map symbols	Onsite disposal of effluent from septic tanks	Sewage lagoons	Homes of 3 stories or less with basements	Lawns and landscaping	Streets and parking lots for subdivisions	Sanitary land fills by the trench method [1]
Canfield:						
CdB	Severe: slow permeability; seasonal high water table.	Moderate: slope; gravelly.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
CdC	Severe: slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table; slope.
CeB	Severe: slow permeability; seasonal high water table.	Moderate: slope; gravelly; stony.	Moderate: seasonal high water table; stony.	Moderate: stony.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; stony.
CeD	Severe: slow permeability; slope; seasonal high water table.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Cavode:						
ClA	Severe: slow permeability; seasonal high water table.	Moderate: bedrock at a depth of 3½ to 6 feet.	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; bedrock at a depth of 3½ to 6 feet.	Severe: seasonal high water table.
ClB	Severe: slow permeability; seasonal high water table.	Moderate: bedrock at a depth of 3½ to 6 feet; slope.	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope; bedrock at depth of 3½ to 6 feet.	Severe: seasonal high water table.
ClC	Severe: slow permeability; seasonal high water table.	Severe: slope	Severe: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: slope	Severe: seasonal high water table.
Cookport:						
CoA	Severe: slow permeability; seasonal high water table.	Moderate: bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table; bedrock at a depth of 4 to 6 feet.	Slight	Moderate: seasonal high water table; bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table.
CoB	Severe: slow permeability; seasonal high water table.	Moderate: slope; bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table; bedrock at a depth of 4 to 6 feet.	Slight	Moderate: seasonal high water table; slope; bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table.
CoC	Severe: slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table; slope; bedrock at a depth of 4 to 6 feet.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table.
CpB	Severe: slow permeability; seasonal high water table.	Moderate: bedrock at a depth of 4 to 6 feet; slope.	Moderate: seasonal high water table; stony; bedrock at a depth of 4 to 6 feet.	Moderate: stony.	Moderate: seasonal high water table; slope; bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table; stony.
CpC	Severe: slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table; slope; stony; bedrock at a depth of 4 to 6 feet.	Moderate: slope; stony.	Severe: slope	Moderate: seasonal high water table; stony.

See footnote at end of table.

TABLE 7.—*Soil limitations for town and country planning*—Continued

Soil series and map symbols	Onsite disposal of effluent from septic tanks	Sewage lagoons	Homes of 3 stories or less with basements	Lawns and landscaping	Streets and parking lots for subdivisions	Sanitary land fills by the trench method [1]
Ernest:						
ErB	Severe: moderately slow permeability; seasonal high water table.	Moderate: slope.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
EsB	Severe: moderately slow permeability; seasonal high water table.	Moderate: slope; stony.	Moderate: seasonal high water table; stony.	Moderate: stony.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; stony.
EsC	Severe: moderately slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table at a depth of 1 to 3½ feet; slope; stony.	Moderate: slope; stony.	Severe: slope.	Moderate: seasonal high water table; stony.
Frenchtown:						
FeA	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
FeB	Severe: slow permeability; high water table.	Moderate: slope	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Gilpin:						
GlB	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Moderate: rippable bedrock at a depth of 1½ to 3½ feet.	Moderate: rippable bedrock at a depth of 1½ to 3½ feet.	Moderate: slope; rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet.
GlC	Severe: rippable bedrock at a depth of 1½ to 3½ feet.	Severe: rippable bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: rippable bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: slope; rippable bedrock at a depth of 1½ to 3½ feet.	Severe: slope	Severe: rippable bedrock at a depth of 1½ to 3½ feet.
GlD	Severe: rippable bedrock at a depth of 1½ to 3½ feet; slope.	Severe: rippable bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: rippable bedrock at a depth of 1½ to 3½ feet.
Hanover:						
HaA	Severe: moderately slow permeability.	Slight	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
HaB	Severe: moderately slow permeability.	Moderate: slope	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
HaC	Severe: moderately slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table.
HaD	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
HdB	Severe: moderately slow permeability.	Moderate: slope; stony.	Moderate: seasonal high water table; stony.	Moderate: stony.	Moderate: seasonal high water table; stony.	Moderate: seasonal high water table; stony.
HdD	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; stony; seasonal high water table.

See footnote at end of table.

TABLE 7.—*Soil limitations for town and country planning*—Continued

Soil series and map symbols	Onsite disposal of effluent from septic tanks	Sewage lagoons	Homes of 3 stories or less with basements	Lawns and landscaping	Streets and parking lots for subdivisions	Sanitary land fills by the trench method [1]
Hanover—Con.						
HdE	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Hazelton:						
HeB	Moderate: bedrock at a depth of 3½ to 6 feet.	Severe: moderately rapid permeability.	Moderate: bedrock at a depth of 3½ to 6 feet.	Slight	Moderate: slope; bedrock at a depth of 3½ to 6 feet.	Severe: moderately rapid permeability.
HeC	Moderate: bedrock at a depth of 3½ to 6 feet; slope.	Severe: moderately rapid permeability; slope.	Moderate: slope; bedrock at a depth of 3½ to 6 feet.	Moderate: slope.	Severe: slope	Severe: moderately rapid permeability.
HeD	Severe: slope	Severe: moderately rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: moderately rapid permeability.
HlB	Moderate: bedrock at a depth of 3½ to 6 feet.	Severe: moderately rapid permeability.	Moderate: bedrock at a depth of 3½ to 6 feet; stony.	Moderate: stony.	Moderate: slope; bedrock at a depth 3½ to 6 feet.	Severe: moderately rapid permeability.
HnD	Severe: slope	Severe: moderately rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: moderately rapid permeability.
HnF	Severe: slope	Severe: moderately rapid permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope; moderately rapid permeability.
Monongahela:						
MoA	Severe: slow permeability; seasonal high water table.	Slight	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
MoB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Moderate: seasonal high water table.	Slight	Moderate: seaseasonal high water table; slope.	Moderate: seasonal high water table.
Philo: Ph	Severe: moderately slow permeability; flooding; seasonal high water table.	Severe: flooding	Severe: flooding	Moderate: flooding.	Severe: flooding.	Severe: flooding.
Pope: Po	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding.	Severe: flooding.	Severe: flooding.
Ravenna:						
RaA	Severe: slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
RaB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
RaC	Severe: slow permeability; seasonal high water table.	Severe: slope	Severe: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: slope	Severe: seasonal high water table.
Rexford: Re	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.

See footnote at end of table.

TABLE 7.—*Soil limitations for town and country planning*—Continued

Soil series and map symbols	Onsite disposal of effluent from septic tanks	Sewage lagoons	Homes of 3 stories or less with basements	Lawns and landscaping	Streets and parking lots for subdivisions	Sanitary land fills by the trench method [1]
Strip mines: Sm	Variable: slow to rapid permeability.	Variable: requires onsite investigation.	Severe: unstable materials; slope.	Severe: shaly; channery or stony.	Severe: slope; unstable materials.	Variable: requires onsite investigation.
Tyler: Ty	Severe: slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Urban land: Um. Urban land variable. Onsite investigation required. For Monongahela part of Um, see Monongahela series.						
Wharton:						
WhB	Severe: slow permeability; seasonal high water table.	Moderate: slope; bedrock at a depth of 4 to 6 feet.	Moderate: seasonal high water table.	Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.
WhC	Severe: slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table; slope.	Moderate: slope.	Severe: slope	Moderate: seasonal high water table.
Wooster:						
WoB	Severe: moderately slow permeability.	Moderate: slope; gravelly.	Slight	Slight	Moderate: slope.	Slight.
WoC	Severe: moderately slow permeability.	Severe: slope	Moderate: slope	Moderate: slope.	Severe: slope	Slight.
WoD	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
WsD	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
WsE	Severe: moderately slow permeability; slope.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

[1] Detailed onsite investigations of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water are needed for land fills deeper than 5 or 6 feet.

The various soil uses in town and country planning are evaluated in table 7 and described in the following paragraphs.

Onsite disposal of effluent from septic tanks is affected mainly by permeability, steepness of slope, depth to bedrock, and position of any water table that may occur. Also, in soils underlain by cavernous limestone, fractured slate or shale, and sand or gravel, underground water may become contaminated by seepage of effluent through rock crevices, coarse materials, or solution channels. Size of drainage field and type of disposal system used are affected in many places by the degree and kind of limitation. Soils that have a rating of *severe* should be carefully investigated before decisions are made concerning installation of disposal systems. Limitations for systems used only for short periods, such as in summer camps, may be less severe than those indicated in the table.

Sewage lagoons are affected mainly by permeability of the substratum, soil slope, depth to bedrock, stoniness, and flood hazard.

Homesite locations (3 stories or less with basement) are evaluated for locations of buildings of three stories or less that have less than an 8-foot excavation for basements. The main features that affect soil use for this purpose are depth to seasonal high water table, depth to and kind of bedrock, degree of slope, and flood hazard. Depth to bedrock and presence of a high water table are less severe limitations where buildings are constructed without basements.

Lawns and landscaping are rated without considering the needs for lime and fertilizer. Suitable soil material is needed in amounts sufficient to allow desirable trees and other plants to survive and grow. Among the factors considered are depth to seasonal high water table, soil slope, depth to bedrock, soil texture, presence of stones or rocks, and flood hazard.

Streets and parking lots, for subdivisions, are affected mainly by depth to seasonal high water table, soil slope, depth to and kind of bedrock, stoniness, and flood hazard. For roads outside subdivisions, slope limitations are generally less severe than those shown in the table.

Sanitary landfill is an area used for the disposal of trash and garbage by the trench method. The main requirement is enough soil material to cover the refuse and garbage. Bringing in fill or cover material is not considered in the ratings. The main features considered are depth to bedrock, flood hazard, seasonal high water table, and presence of stones or rocks. Sinkholes in limestone should not be used for refuse disposal because of risk of contamination of ground water supplies. Esthetic, economic, and sociological factors are important, but they are not considered in the ratings.

Use of Soils for Recreational Facilities

The information in this section can be used to make preliminary selection of sites for recreational facilities. Onsite investigation of each site is needed.

Table 8 shows the degree and, if the degree is moderate or severe, the kind of limitation for seven recreational uses. The degrees of limitation are expressed as *slight*, *moderate*, and *severe*. A rating of *slight* indicates that the soil generally has few limitations for the use specified. *Moderate* indicates that the soil requires special measures to overcome or correct the limitations. *Severe* indicates that the limitations are very difficult or expensive to correct or overcome.

The following paragraphs describe the facilities rated and give the main soil or topographic features that cause the limitations.

Campsites are areas suitable for tents or camping trailers and travel trailers and the accompanying activities for outdoor living. These areas are used frequently during the camping season, which normally extends from May 30 until Labor Day. The soils are rated assuming little site preparation other than shaping and leveling tent and parking areas. The site should be suitable for heavy traffic by people, horses, or vehicles. Suitability of soil for supporting vegetation is a separate item to be considered in the final evaluation in selecting sites for these uses.

Buildings (without basements) are rated for use as sites for washrooms, bathhouses, picnic shelters, service buildings without basements, and seasonal or year-round cottages. Among the limitations are seasonal high water table, stoniness, and flooding. Soil limitations for buildings with basements are given in table 7.

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Paths and trails are areas that are to be used for trails, hiking, bridle paths, and nonintensive uses that allow for random movement of people. It is assumed that these areas are to be used as they occur in nature and that little soil will be moved or excavated for the planned recreational use.

Picnic and play areas are areas developed for hiking, picnicking, and casual play where only light foot traffic is expected. The ratings are based on soil features only and do not include such other features as the presence of trees or lakes, which may affect the desirability of a site. The main soil features considered are depth to seasonal high water table, soil slope, depth to bedrock, flood hazard, and the presence of rocks and stones. Water supply, sewage disposal, and suitability of the soil for supporting vegetation are separate items to be considered in the final evaluation of a site for these uses.

Athletic fields are playgrounds for organized games, such as baseball, football, and badminton. Because areas selected for this use are subject to intensive foot traffic, a nearly level surface, good drainage, and soil texture and consistence that give a firm surface are generally required. The most desirable soils are also free of rock outcrops and coarse fragments. It is assumed that good vegetative cover can be established and maintained on areas where needed.

For golf fairways the soils are rated under the assumption that they will be used for turf, shrubs, and trees without adding topsoil. Traps, roughs, and greens are specialized features not considered in ratings for golf fairways. Among the factors considered are depth to seasonal high water table, soil slope, depth to bedrock, soil texture, presence of rocks or stones, and flood hazard.

Descriptions of the Soils

This section describes the soil series and mapping units in Venango County. Each soil series is described in detail, and then, briefly, each mapping unit in that series is described. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full 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, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit differs from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. The land type Strip mines, for example, does not belong to a soil series, but it is listed in alphabetic order along with the soil series.

TABLE 8.—*Soil limitations*

Soil series and map symbols	Campsites: Tents and camping trailers	Campsites: Travel trailers	Buildings without basements
Allegheny:			
AgA	Slight	Slight	Slight
AgB	Slight	Moderate: slope	Slight
Alton:			
AhA	Moderate: gravelly	Moderate: gravelly	Slight
AhB	Moderate: gravelly	Moderate: slope; gravelly	Slight
AhC	Moderate: slope; gravelly	Severe: slope	Moderate: slope
AhD	Severe: slope	Severe: slope	Severe: slope
AhF	Severe: slope	Severe: slope	Severe: slope
Alvira:			
AlA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
AlB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
AlC	Moderate: seasonal high water table; slope.	Severe: slope	Moderate: seasonal high water table; slope.
ArB	Moderate: seasonal high water table; slow permeability; stony.	Moderate: seasonal high water table; slow permeability; slope; stony.	Moderate: seasonal high water table.
Armagh: As	Severe: high water table	Severe: high water table	Severe: high water table
Atkins: At	Severe: high water table	Severe: high water table	Severe: high water table; flooding.
Brinkerton:			
BrA	Severe: high water table	Severe: high water table	Severe: high water table
BrB	Severe: high water table	Severe: high water table	Severe: high water table
Bt	Severe: high water table	Severe: high water table	Severe: high water table
Canfield:			
CdB	Moderate: slow permeability; gravelly.	Moderate: slow permeability; slope; gravelly.	Slight
CdC	Moderate: slow permeability; slope; gravelly.	Severe: slope	Moderate: slope
CeB	Moderate: slow permeability; stony; gravelly.	Moderate: slow permeability; slope; stony; gravelly.	Slight
CeD	Severe: slope	Severe: slope	Severe: slope
Cavode:			
ClA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
ClB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
ClC	Moderate: seasonal high water table; slow permeability; slope.	Severe: slope	Moderate: slope; seasonal high water table.
Cookport:			
CoA	Moderate: slow permeability.	Moderate: slow permeability.	Slight
CoB	Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight
CoC	Moderate: slow permeability; slope.	Severe: slope	Moderate: slope
CpB	Moderate: slow permeability; stony.	Moderate: slow permeability; slope; stony.	Slight
CpC	Moderate: slow permeability; slope; stony.	Severe: slope	Moderate: slope

for recreational uses

Paths and trails	Picnic and play areas (extensive use)	Athletic fields (intensive use)	Golf fairways
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: slope; gravelly	Severe: slope; gravelly	Moderate: slope; gravelly.
Moderate: slope; gravelly	Severe: slope	Severe: slope; gravelly	Severe: slope.
Severe: slope	Severe: slope	Severe: slope; gravelly	Severe: slope.
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.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Moderate: seasonal high water table; stony.	Moderate: seasonal high water table; stony.	Severe: seasonal high water table.	Moderate: seasonal high water table; stony.
Severe: high water table	Severe: high water table	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; flooding.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: slope; gravelly	Severe: slope; gravelly	Moderate: slope; gravelly.
Moderate: stony; gravelly	Slight	Severe: gravelly	Moderate: stony; gravelly.
Moderate: slope; stony; gravelly.	Severe: slope	Severe: slope; gravelly	Severe: slope.
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.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Slight	Slight	Moderate: seasonal high water table; slow permeability.	Slight.
Slight	Slight	Moderate: seasonal high water table; slow permeability; slope.	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: stony	Slight	Moderate: seasonal high water table; slow permeability; slope; stony.	Moderate: stony.
Moderate: stony	Moderate: slope	Severe: slope	Moderate: slope; steep.

TABLE 8.—*Soil limitations for*

Soil series and map symbols	Campsites		Buildings without basements
	Tents and camping trailers	Travel trailers	
Ernest:			
ErB	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight.
EsB	Moderate: moderately slow permeability; stony.	Moderate: moderately slow permeability; slope; stony.	Slight.
EsC	Moderate: moderately slow permeability; slope; stony.	Severe: slope.	Moderate: slope.
Frenchtown:			
FeA	Severe: high water table.	Severe: high water table.	Severe: high water table.
FeB	Severe: high water table.	Severe: high water table.	Severe: high water table.
Gilpin:			
GlB	Slight.	Moderate: slope.	Slight.
GlC	Moderate: slope.	Severe: slope.	Moderate: slope.
GlD	Severe: slope.	Severe: slope.	Severe: slope.
Hanover:			
HaA	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight.
HaB	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight.
HaC	Moderate: moderately slow permeability; slope.	Severe: slope.	Moderate: slope.
HaD	Severe: slope.	Severe: slope.	Severe: slope.
HdB	Moderate: moderately slow permeability; stony.	Moderate: moderately slow permeability; slope; stony.	Slight.
HdD	Severe: slope.	Severe: slope.	Severe: slope.
HdE	Severe: slope.	Severe: slope.	Severe: slope.
Hazleton:			
HeB	Moderate: channery.	Moderate: slope; channery.	Slight.
HeC	Moderate: slope; channery.	Severe: slope.	Moderate: slope.
HeD	Severe: slope.	Severe: slope.	Severe: slope.
HlB	Moderate: stony; channery.	Moderate: slope; stony; channery.	Slight.
HnD	Severe: slope.	Severe: slope.	Severe: slope.
HnF	Severe: slope.	Severe: slope.	Severe: slope.
Monongahela:			
MoA	Moderate: slow permeability.	Moderate: slow permeability.	Slight.
MoB	Moderate: slow permeability.	Moderate: slow permeability; slope.	Slight.
Philo: Ph	Moderate: moderately slow permeability; flooding.	Moderate: moderately slow permeability; flooding.	Severe: flooding.
Pope: Po	Moderate: flooding.	Moderate: flooding.	Severe: flooding.

recreational uses—Continued

Paths and trails	Picnic and play areas (extensive use)	Athletic fields (intensive use)	Golf fairways
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability; slope.	Slight.
Moderate: stony	Slight	Moderate: seasonal high water table; moderately slow permeability; slope; stony.	Moderate: stony.
Moderate: stony	Moderate: slope	Severe: slope	Moderate: slope; stony.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Slight	Slight	Moderate: slope; bedrock at depth of 1½ to 3½ feet.	Moderate: bedrock at depth of 1½ to 3½ feet.
Slight	Moderate: slope	Severe: slope	Moderate: slope; bedrock at depth of 1½ to 3½ feet.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Slight	Slight	Moderate: seasonal high water table at depth of 1½ to more than 3 feet; moderately slow permeability.	Slight.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability; slope.	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: stony	Slight	Moderate: seasonal high water table; moderately slow permeability; slope; stony.	Moderate: stony.
Moderate: slope; stony	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: channery	Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery	Moderate: slope; channery	Severe: slope; channery	Moderate: slope; channery.
Moderate: slope; channery	Severe: slope	Severe: slope; channery	Severe: slope.
Moderate: stony; channery	Moderate: channery	Severe: channery	Moderate: stony; channery.
Moderate: slope; stony; channery.	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Slight	Slight	Moderate: seasonal high water table; slow permeability.	Slight.
Slight	Slight	Moderate: seasonal high water table; slow permeability; slope.	Slight.
Slight	Moderate: flooding	Moderate: seasonal high water table; flooding; moderately slow permeability.	Moderate: flooding.
Slight	Moderate: flooding	Moderate: flooding	Moderate: flooding.

TABLE 8.—*Soil limitations for*

Soil series and map symbols	Campsites: Tents and camping trailers	Campsites: Travel trailers	Buildings without basements
Ravenna:			
RaA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
RaB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
RaC	Moderate: seasonal high water table; slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.
Rexford: Re	Severe: high water table	Severe: high water table	Severe: high water table
Strip mines: Sm. Properties variable. Onsite investigation required.			
Tyler: Ty	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
Urban land: Um. Urban land variable. Onsite investigation required. For Monongahela part of Um, see Monongahela series.			
Wharton:			
WhB	Moderate: slow permeability	Moderate: slow permeability; slope.	Slight
WhC	Moderate: slow permeability; slope.	Severe: slope	Moderate: slope
Wooster:			
WoB	Moderate: moderately slow permeability; gravelly.	Moderate: moderately slow permeability; gravelly; slope.	Slight
WoC	Moderate: moderately slow permeability; gravelly; slope.	Severe: slope	Moderate: slope
WoD	Severe: slope	Severe: slope	Severe: slope
WsD	Severe: slope	Severe: slope	Severe: slope
WsE	Severe: slope	Severe: slope	Severe: slope

recreational uses—Continued

Paths and trails	Picnic and play areas (extensive use)	Athletic fields (intensive use)	Golf fairways
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.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Slight	Slight	Moderate: seasonal high water table; slow permeability; slope.	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: slope; gravelly	Severe: slope; gravelly	Moderate: slope; gravelly.
Moderate: slope; gravelly.	Severe: slope	Severe: slope; gravelly	Severe: slope.
Moderate: slope; stony; gravelly.	Severe: slope	Severe: slope; gravelly	Severe: slope.
Severe: slope	Severe: slope	Severe: slope; gravelly	Severe: slope.

Following the name of each mapping unit is a symbol in parentheses. This symbol 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 for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 9. Many terms used in describing soils can be found in the Glossary at the back of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*20*).

Allegheny Series

The Allegheny series consists of deep, nearly level to gently sloping, well-drained soils on glacial outwash terraces. These soils formed in loamy material deposited by water. Slopes are convex. The native vegetation is maple, mixed oaks, ash, and black cherry.

A representative profile has a dark grayish-brown silt loam plow layer about 8 inches thick. The subsoil extends to a depth of 30 inches. To a depth of 22 inches, it is yellowish-brown, friable silt loam. Between depths of 22 and 30 inches, it is dark yellowish-brown, friable loam. The substratum, from a depth of 30 inches to 90 inches, is brown gravelly sandy loam.

Available moisture capacity is high, and permeability is moderate.

Representative profile of Allegheny silt loam, 3 to 8 percent slopes, in a cultivated field 1 mile northwest of Hannasville. This profile is identified as Pennsylvania report numbers 67-37098 and 67-37099 in table 4, Engineering Test Data:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable, nonsticky and nonplastic; strongly acid; abrupt, smooth boundary.

TABLE 9.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Allegheny silt loam, 0 to 3 percent slopes	300	0. 1
Allegheny silt loam, 3 to 8 percent slopes	1, 060	. 2
Alton gravelly loam, 0 to 3 percent slopes	360	. 1
Alton gravelly loam, 3 to 8 percent slopes	1, 790	. 4
Alton gravelly loam, 8 to 15 percent slopes	1, 700	. 4
Alton gravelly loam, 15 to 25 percent slopes	580	. 1
Alton gravelly loam, 25 to 80 percent slopes	430	. 1
Alvira silt loam, 0 to 3 percent slopes	6, 020	1. 4
Alvira silt loam, 3 to 8 percent slopes	24, 230	5. 6
Alvira silt loam, 8 to 15 percent slopes	3, 250	. 8
Alvira and Ravenna very stony silt loams, 0 to 8 percent slopes	6, 060	1. 4
Armagh silt loam	690	. 2
Atkins silt loam	7, 240	1. 7
Brinkerton silt loam, 0 to 3 percent slopes	3, 580	. 8
Brinkerton silt loam, 3 to 8 percent slopes	3, 370	. 7
Brinkerton and Frenchtown very stony silt loams	4, 240	1. 0
Canfield gravelly silt loam, 3 to 8 percent slopes	11, 850	2. 7
Canfield gravelly silt loam, 8 to 15 percent slopes	9, 080	2. 1
Canfield very stony silt loam, 0 to 8 percent slopes	1, 640	. 4
Canfield very stony silt loam, 8 to 25 percent slopes	6, 500	1. 5
Cavode silt loam, 0 to 3 percent slopes	2, 610	. 6
Cavode silt loam, 3 to 8 percent slopes	19, 550	4. 5
Cavode silt loam, 8 to 15 percent slopes	3, 300	. 8
Cookport loam, 0 to 3 percent slopes	2, 380	. 6
Cookport loam, 3 to 8 percent slopes	27, 160	6. 3
Cookport loam, 8 to 15 percent slopes	8, 470	2. 0
Cookport very stony loam, 0 to 8 percent slopes	25, 260	5. 9
Cookport very stony loam, 8 to 15 percent slopes	27, 430	6. 4
Ernest silt loam, 3 to 8 percent slopes	790	. 2
Ernest very stony silt loam, 0 to 8 percent slopes	3, 370	. 8
Ernest very stony silt loam, 8 to 15 percent slopes	3, 510	. 8
Frenchtown silt loam, 0 to 3 percent slopes	4, 010	. 9
Frenchtown silt loam, 3 to 8 percent slopes	1, 600	. 4
Gilpin silt loam, 3 to 8 percent slopes	820	. 2
Gilpin silt loam, 8 to 15 percent slopes	2, 480	. 6
Gilpin silt loam, 15 to 25 percent slopes	780	. 1
Hanover silt loam, 0 to 3 percent slopes	2, 730	0. 6
Hanover silt loam, 3 to 8 percent slopes	29, 230	6. 8
Hanover silt loam, 8 to 15 percent slopes	15, 990	3. 7
Hanover silt loam, 15 to 25 percent slopes	3, 600	. 8
Hanover very stony silt loam, 0 to 8 percent slopes	12, 560	2. 9
Hanover very stony silt loam, 8 to 25 percent slopes	26, 770	6. 2
Hanover very stony silt loam, 25 to 45 percent slopes	2, 910	. 7
Hazleton channery loam, 3 to 8 percent slopes	2, 570	. 6
Hazleton channery loam, 8 to 15 percent slopes	1, 470	. 3
Hazleton channery loam, 15 to 25 percent slopes	1, 520	. 4
Hazleton very stony loam, 0 to 8 percent slopes	4, 040	. 9
Hazleton and Gilpin very stony soils, 8 to 25 percent slopes	8, 680	2. 0
Hazleton and Gilpin very stony soils, 25 to 70 percent slopes	48, 510	11. 3
Monongahela silt loam, 0 to 3 percent slopes	630	. 1
Monongahela silt loam, 3 to 8 percent slopes	2, 050	. 5
Philo silt loam	6, 070	1. 5
Pope loam	3, 610	. 8
Ravenna silt loam, 0 to 3 percent slopes	980	. 2
Ravenna silt loam, 3 to 8 percent slopes	5, 360	1. 2
Ravenna silt loam, 8 to 15 percent slopes	970	. 2
Rexford silt loam	1, 390	. 3
Strip mines	5, 150	1. 2
Tyler silt loam	820	. 1
Urban land-Monongahela complex	1, 690	. 4
Wharton silt loam, 3 to 8 percent slopes	8, 400	1. 9
Wharton silt loam, 8 to 15 percent slopes	3, 430	. 8
Wooster gravelly silt loam, 3 to 8 percent slopes	245	. 1
Wooster gravelly silt loam, 8 to 15 percent slopes	360	. 1
Wooster gravelly silt loam, 15 to 25 percent slopes	1, 600	. 4
Wooster very stony silt loam, 8 to 25 percent slopes	625	. 1
Wooster very stony silt loam, 25 to 45 percent slopes	400	. 1
Gravel pits, quarries, and sand mines	150	([1])
Total	432, 000	0. 0

[1] Less than 0.05 percent.

B1—8 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable, nonsticky and slightly plastic; 5 percent gravel; very strongly acid; clear, wavy boundary.

B21t—12 to 22 inches, yellowish-brown (10YR 5/4) heavy silt loam; weak, medium, subangular blocky structure; friable, nonsticky and slightly plastic; few, thin, discontinuous clay films on ped faces and in pores; 10 percent gravel; very strongly acid; clear, wavy boundary.

B22t—22 to 30 inches, dark yellowish-brown (10YR 4/4) heavy loam; weak, fine, subangular blocky structure; friable, nonsticky and nonplastic; few, thin, discontinuous clay films on ped faces and in pores; 10 percent gravel; very strongly acid; clear, wavy boundary.

IIC—30 to 90 inches, brown (7.5YR 5/4) gravelly sandy loam; single grain; loose; 45 percent gravel; strongly acid.

The solum ranges from 30 to 40 inches thick. Depth to bedrock is more than 6 feet. The gravel content ranges from 0 to 10 percent in the solum and from 35 to 50 percent in the IIC horizon. The Ap horizon is dark grayish (10YR 4/2) to dark yellowish brown (10YR 4/4). The B horizon is brown (10YR 4/3) to yellowish-brown (10YR 5/4) heavy silt loam to loam.

Allegheny soils are associated on terraces with the well drained Alton soils, the moderately well drained Monongahela soils, the somewhat poorly drained to poorly drained Rexford soils, and the somewhat poorly drained Tyler soils. They contain less gravel throughout the solum than Alton soils.

Allegheny silt loam, 0 to 3 percent slopes (AgA).—This soil is on terraces near flood plains along the major streams in the county. It has a profile slightly deeper over gravel than the profile described as representative of the series. Most of the acreage is in the valley of Sugar Creek.

Included with this soil in mapping were small areas of Alton and Monongahela soils.

Most of the acreage of this Allegheny soil has been cleared and cultivated. This soil has few limitations for most uses. Capability unit I–2.

Allegheny silt loam, 3 to 8 percent slopes (AgB).—This soil is on terraces near flood plains along the major streams in the county. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Alton and Monongahela soils and a few areas where the Allegheny soil is shallower over gravel than is typical.

Most of the acreage of this Allegheny soil has been cleared and cultivated. The major limitation is the erosion hazard. Capability unit IIe–2.

Alton Series

The Alton series consists of deep, nearly level to very steep, well-drained soils on glacial outwash terraces and kames. These soils formed in gravel, sand, and silt deposited by running water. Slopes are convex. The native vegetation is maple, mixed oaks, ash, and black cherry.

A representative profile has a dark grayish-brown gravelly loam plow layer about 7 inches thick. The subsoil extends to a depth of 40 inches. To a depth of 18 inches, it is yellowish-brown, friable gravelly loam. Between depths of 18 and 40 inches, it is yellowish-brown, loose gravelly sandy loam. The substratum, from a depth of 40 inches to 60 inches, is stratified sand and gravel.

Available moisture capacity is low, and permeability is rapid. Most limitations are related to the rapid permeability and the low available moisture capacity.

Representative profile of Alton gravelly loam, 3 to 8 percent slopes, in an abandoned field about 1½ miles north of Hannasville:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) gravelly loam; very weak, fine, granular structure; friable, nonsticky and nonplastic; 20 percent gravel; medium acid; abrupt, smooth boundary.

B21—7 to 18 inches, yellowish-brown (10YR 5/4) gravelly loam; very weak, fine, subangular blocky structure; friable, nonsticky and nonplastic; 30 percent gravel; strongly acid; clear, wavy boundary.

B22—18 to 40 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; weak, medium, subangular blocky structure; loose, nonsticky and nonplastic; 45 percent gravel; strongly acid; clear, wavy boundary.

IIC—40 to 60 inches, stratified sand and gravel; 70 percent gravel; strongly acid.

The solum ranges from 40 to 55 inches thick. Depth to bedrock is more than 6 feet. The Ap horizon is very dark grayish brown (10YR 3/2) to dark yellowish brown (10YR 4/4). The gravel content ranges from 20 to 45 percent in the Ap horizon and from 30 to 50 percent in the B2 horizon. The B2 horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/4).

Alton soils are associated on terraces with the well drained Allegheny soils, the moderately well drained Monongahela soils, the somewhat poorly drained Rexford soils, and the somewhat poorly drained Tyler soils. They have a higher gravel content than those soils.

Alton gravelly loam, 0 to 3 percent slopes (AhA).—This soil is on terraces near flood plains along the major streams in the county.

Included with this soil in mapping were small areas of Allegheny and Monongahela soils.

Most of the acreage of this Alton soil has been cleared and cultivated. This soil has few limitations for most development uses. It is limited for farming by the low available moisture capacity. Capability unit IIIs–1.

Alton gravelly loam, 3 to 8 percent slopes (AhB).—This soil is on terraces near flood plains along the major streams in the county. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Allegheny and Monongahela soils.

Most of the acreage of this Alton soil has been cleared and cultivated. The major limitation for farming is the low available moisture capacity. Capability unit IIIs–1.

Alton gravelly loam, 8 to 15 percent slopes (AhC).—This soil is on terraces near the major streams in the county and on kames in uplands. Included with it in mapping were some small areas of gently sloping and moderately steep Alton soils and some areas of soils that have a surface layer of gravelly sandy loam. About three-fourths of the acreage of this Alton soil has been cleared and cultivated. The major limitation is the erosion hazard. Capability unit IVe–1.

Alton gravelly loam, 15 to 25 percent slopes (AhD).—This soil is on kames and on terrace edges near the major streams in the county. Included with it in mapping were some areas of steep Alton soils. About half the acreage of this Alton soil has been cleared and cultivated. The major limitation is the erosion hazard. Capability unit IVe-1.

Alton gravelly loam, 25 to 80 percent slopes (AhF).—This soil is on terrace escarpments and valley sides near the major streams in the county. Included with it in mapping were small areas where the surface layer is stony.

Most of the acreage of this Alton soil is wooded. The erosion hazard and the slope severely limit this soil for most uses. Capability unit VIIe-1.

Alvira Series

The Alvira series consists of deep, nearly level to sloping, somewhat poorly drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, shale, and siltstone. Slopes are convex. The native vegetation is chiefly mixed oaks, maple, ash, and black cherry.

A representative profile has a brown silt loam plow layer about 7 inches thick. The subsoil extends to a depth of 72 inches. To a depth of 14 inches, it is yellowish-brown silt loam mottled with light brownish gray. Between depths of 14 and 21 inches, it is yellow-brown silt loam mottled with light gray and reddish brown. Below a depth of 21 inches, it is mottled gray and yellowish-brown, brittle and firm gravelly silt loam and gravelly loam.

Available moisture capacity is moderate, and permeability is slow. The water table is within 6 to 18 inches of the soil surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Alvira silt loam, 3 to 8 percent slopes, in a cultivated field one-fourth of a mile southeast of village of Sunville, 1,000 feet southeast along road T. 434 from its intersection with route 60063 and 300 feet east into field. This profile is identified as S66-Pa-61-4 (1-8) in tables 12, 13, and 14 in the section "Laboratory Data," and as Pennsylvania report numbers A-48104 and A-48105 in table 4, Engineering Test Data:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable, slightly sticky and slightly plastic; 10 percent gravel; medium acid; abrupt, smooth boundary.

B1—7 to 14 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; 10 percent gravel; strongly acid; clear, wavy boundary.

B2tg—14 to 21 inches, yellowish-brown (10YR 5/4) silt loam; faces of peds light brownish gray (10YR 6/2); many, medium, distinct, light-gray (N 7/0) mottles and few, fine, prominent, reddish-brown (5YR 5/4) mottles; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces and in root channels; 10 percent gravel; strongly acid; clear, smooth boundary.

Bx1g—21 to 29 inches, yellowish-brown (10YR 5/4) gravelly silt loam, faces of prisms gray (10YR 5/1); many, medium, distinct, gray (N 5/0) mottles and few, fine, prominent, red (2.5YR 4/6) mottles; moderate, very coarse, prismatic structure parting to moderate, coarse, blocky; firm, brittle, slightly sticky and slightly plastic; thin, discontinuous clay films on faces of prisms and few clay films on blocks; 20 percent gravel; strongly acid; gradual, wavy boundary.

Bx2g—29 to 55 inches, yellowish-brown (10YR 5/4) gravelly loam; faces of prisms light gray (N 7/0); many, medium, distinct, gray (N 5/0) mottles; moderate, very coarse, prismatic structure parting to weak, thick, platy; firm, brittle, slightly sticky and slightly plastic; thin, continuous clay films on faces of prisms and few on plates; 20 percent gravel; strongly acid; gradual, wavy boundary.

Bx3g—55 to 72 inches, yellowish-brown (10YR 5/4) gravelly loam; faces of prisms light gray (N 7/0); many, medium, distinct, gray (N 5/0) mottles and few, fine, prominent, red (2.5YR 4/6) mottles; moderate, very coarse, prismatic structure parting to weak, very thick, platy; firm, brittle, slightly sticky and slightly plastic; thick, continuous clay films on faces of prisms and in pores; 25 percent gravel; strongly acid.

The solum ranges from 60 to 80 inches in thickness. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 19 to 28 inches. The gravel content ranges from 5 to 10 percent in the Ap horizon, from 5 to 20 percent in the B1 and B2t horizons, and from 10 to 30 percent in the Bx horizon. The Ap horizon is very dark grayish brown (2.5Y 3/2) to dark yellowish brown (10YR 4/4). The B2t horizon ranges from grayish brown (10YR 5/2) to yellowish brown (10YR 5/6). The Bx horizon has gray (10YR 5/1) or light-gray (N 7/0) coatings on faces of prisms and yellowish-brown (10YR 5/4) or brown (10YR 5/3) ped interiors.

Alvira soils are associated on the landscape with the moderately well drained to well drained Hanover soils and the poorly drained Frenchtown soils. They formed in material similar to that of Ravenna soils, but they are more acid below a depth of 40 inches than those soils.

Alvira silt loam, 0 to 3 percent slopes (AlA).—This soil is on hilltops.

Included with this soil in mapping were small areas of Hanover and Frenchtown soils, a few areas where the surface layer is gravelly silt loam, and some areas where the subsoil is more clayey or sandy than is typical.

About three-fourths of the acreage of this Alvira soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table (fig. 9). Capability unit IIIw-1.

Alvira silt loam, 3 to 8 percent slopes (AlB).—This soil is on hilltops and hillsides. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hanover and Frenchtown soils and a few areas that have a gravelly surface layer.

About three-fourths of the acreage of this Alvira soil has been cleared and cultivated. The major limitations are the restricted permeability, the seasonal high water table, and the erosion hazard (fig. 10). Capability unit IIIw-1.

Alvira silt loam, 8 to 15 percent slopes (AlC).—This soil is on hillsides. Included with it in mapping were small areas of Hanover and gently sloping Alvira soils. About half the acreage of this Alvira soil has been cleared and cultivated. The major limitations are the slope and the erosion hazard. Capability unit IIIe-1.

Alvira and Ravenna very stony silt loams, 0 to 8 percent slopes (ArB).—These nearly level to gently sloping soils were mapped together because stoniness outweighs all other properties that affect management. Any one mapped area may contain both of these soils or only one. About 90 percent of the total acreage is Alvira very stony silt loam, and 10 percent is Ravenna very stony silt loam.

These soils are in upland depressions, along drainageways, and on concave hillsides. The profile of each soil is similar to the one described as representative of the series, but each has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter occupy as much as 15 percent of the soil surface.

Included with these soils in mapping were small areas of the very stony Canfield and Hanover soils and small areas of the nonstony Frenchtown soils.

Nearly all the acreage is wooded. These soils are too stony for cultivation. The major limitations are stoniness,

Figure 9.—**Water ponds on Alvira silt loam, 0 to 3 percent slopes.**

slow permeability, and a seasonal high water table. Capability unit VIIs-1.

Armagh Series

The Armagh series consists of deep, nearly level, poorly drained soils on uplands. These soils formed in material weathered from shale and siltstone. The relief is level to concave.The native vegetation is mixed oaks, blue birch, and some hemlock.

A representative profile has a dark-gray silt loam plow layer about 6 inches thick. The subsoil extends to a depth of 40 inches. It is light-gray, firm silty clay loam that has strong-brown and yellowish-brown mottles. The substratum is gray silty clay that has a few yellowish-brown mottles. It is about 10 percent shale fragments. Shale bedrock is at a depth of 61 inches.

Available moisture capacity is moderate, and permeability is slow. The high water table is within a depth of 6 inches during winter and spring. Most limitations are related to the slow permeability and the high water table.

Representative profile of Armagh silt loam, in a cultivated field three-fourths of a mile east of Seneca:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; slightly acid if limed; abrupt, smooth boundary.

B21tg—6 to 18 inches, light-gray (10YR 6/1) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; clear, wavy boundary.

B22tg—18 to 30 inches, light-gray (10YR 6/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, blocky structure; firm, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; clear, wavy boundary.

B23tg—30 to 40 inches, light-gray (10YR 6/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR

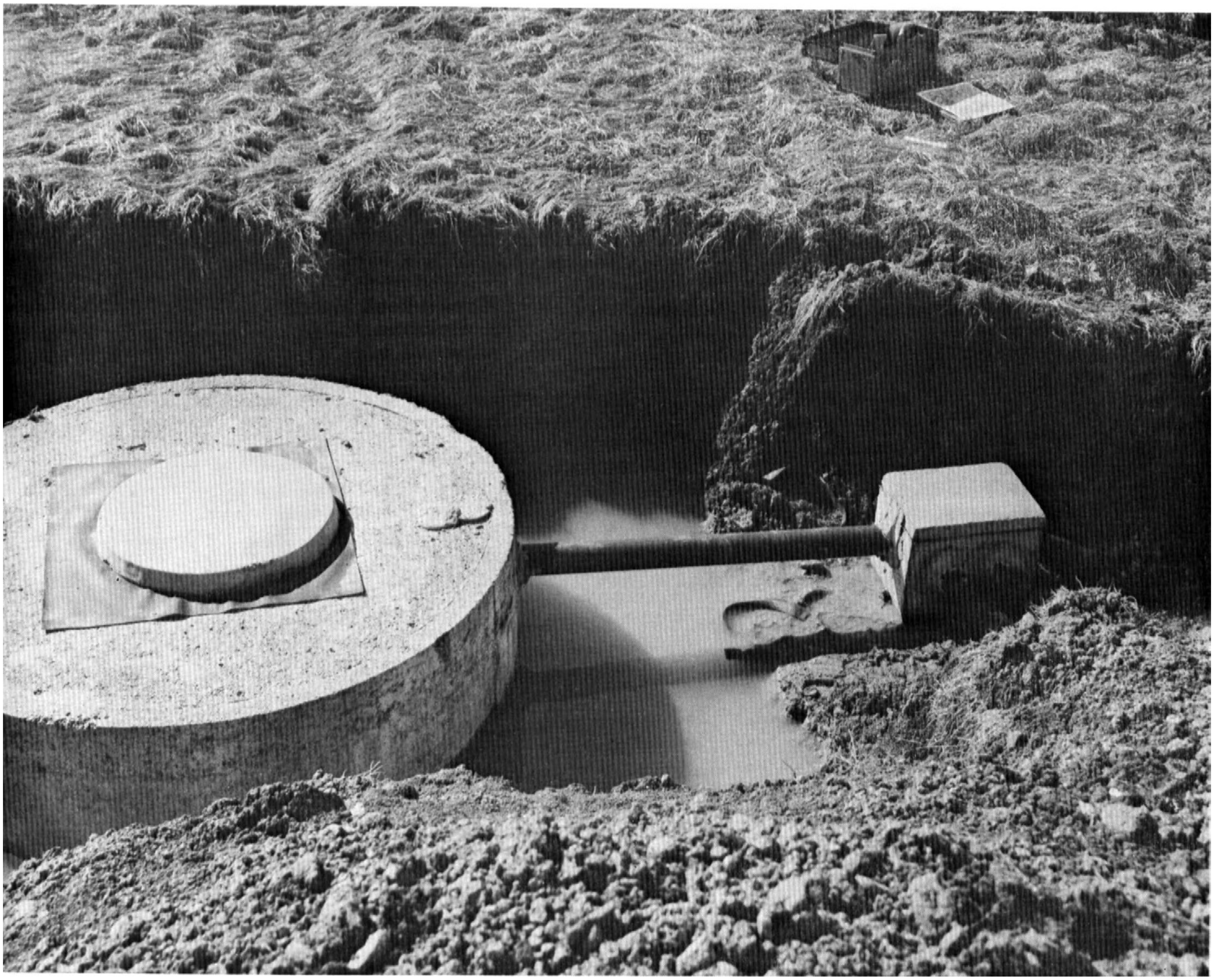

Figure 10.—**Installation of septic tank in Alvira silt loam, 3 to 8 percent slopes. The seasonal high water table is a severe limitation.**

5/4) mottles; moderate, coarse, blocky structure; firm, sticky and plastic; thin, continuous clay films in ped faces; 5 percent shale fragments; strongly acid; clear, wavy boundary.

Cg—40 to 61 inches, gray (N 5/0) silty clay; few, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; firm, sticky and plastic; 10 percent shale fragments; very strongly acid; abrupt, wavy boundary.

R—61 inches, fractured shale bedrock.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 4 to 6 feet. In some profiles the lower part of the B horizon is as much as 15 percent shale chips. The C horizon is 10 to 25 percent shale and siltstone fragments. The Ap horizon is dark gray (10YR 4/1) to dark grayish brown (10YR 4/2). The B horizon is silty clay loam or silty clay.

Armagh soils are associated on the landscape with the well drained Gilpin soils, the moderately well drained Wharton soils, and the somewhat poorly drained Cavode soils.

Armagh silt loam (As).—This nearly level soil is in depressions and on benches in uplands. The areas mapped are 5 to 40 acres in size and are generally oval in shape.

Included in mapping were small areas of Cavode and Brinkerton soils.

Most of the acreage of this Armagh soil has been cleared and cultivated or is used for pasture. The major limitations are the restricted permeability and the high water table. Capability unit IVw-1.

Atkins Series

The Atkins series consists of deep, nearly level, poorly drained soils on flood plains of streams that overflow. These soils formed in sediment washed from surrounding uplands. The native vegetation is hickory, ash, and elm.

A representative profile has a dark grayish-brown silt loam plow layer about 6 inches thick. The subsoil extends to a depth of 40 inches. It is dark-gray and gray silt loam mottled with yellowish red and strong brown. The substratum extends to a depth of 60 inches or more. To a depth of 45 inches, it is gray sandy loam. Below a depth of 45 inches, it is stratified cobblestones, gravel, and sand to a depth of 60 inches or more.

Available moisture capacity is high, and permeability is moderately slow. The water table is within a depth of 6 inches during winter and spring. Most limitations are related to the seasonal high water table and flooding.

Representative profile of Atkins silt loam, in a cultivated field along Mill Creek, about 4 miles north of Emlenton:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable, nonsticky and nonplastic; medium acid; clear, smooth boundary.

B21g—6 to 20 inches, dark-gray (10YR 4/1) silt loam; common, medium, distinct, yellowish-red (5YR 5/8) mottles; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; strongly acid; clear, wavy boundary.

B22g—20 to 40 inches, gray (N 5/0) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; strongly acid; clear, smooth boundary.

IIC1g—40 to 45 inches, gray (N 5/0) sandy loam; massive; loose, nonsticky and nonplastic; strongly acid; abrupt, wavy boundary.

IIIC2g—45 to 60 inches, stratified cobblestones and gravel; voids filled with sand; 90 percent cobblestones and gravel; strongly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock is more than 6 feet. The Ap horizon is grayish brown (10YR 5/2) to dark gray (10YR 4/1). The B2 horizon ranges from dark gray (10YR 4/1) to light gray (10YR 7/1) and from silty clay loam to sandy loam.

Atkins soils are associated on flood plains with the moderately well drained Philo soils and the well drained Pope soils.

Atkins silt loam (At).—This nearly level soil is in long, narrow bands along small streams and in narrow strips near the edges of flood plains along major streams.

Included with this soil in mapping were small areas of Philo soils and small areas of very poorly drained soils. Also included, in the western part of the county along small streams, were some soils that are less acid than the Atkins soil and some organic soils identified on the soil map by a "wet spot" symbol (fig. 11).

About half the acreage of this Atkins soil has been cleared and is used for cultivated crops or pasture. The major limitations are the flood hazard and the seasonal high water table. Capability unit IIIw-2.

Brinkerton Series

The Brinkerton series consists of deep, nearly level to gently sloping, poorly drained soils on uplands along narrow drainageways and at the base of steeper slopes. These soils formed in colluvium weathered from shale and sand-

Figure 11.—**Area of organic soil mapped with Atkins silt loam.**

stone. Slopes are concave. The native vegetation is white oak, red oak, chestnut oak, red maple, and some hickory and ash.

A representative profile has a dark grayish-brown silt loam plow layer about 10 inches thick. The subsoil extends to a depth of 41 inchs. To a depth of 23 inches, it is light brownish-gray and light-gray, friable to firm light silty clay loam mottled with gray, yellowish brown, and olive yellow. Between depths of 23 and 41 inches, it is light brownish-gray, very firm light silty clay loam mottled with yellowish brown. The substratum is mottled, brown and light-gray, firm silt loam. Shale bedrock is at a depth of 63 inches.

Available moisture capacity is moderate, and permeability is slow. The water table is within a depth of 6 inches during winter and spring. Most limitations are related to the seasonal high water table and the slow permeability.

Representative profile of Brinkerton silt loam, 0 to 3 percent slopes, in a cultivated field 1⅛ miles east of Seneca:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; slightly acid if limed; abrupt, wavy boundary.

B21tg—10 to 15 inches, light brownish-gray (2.5Y 6/2) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; strongly acid; clear, wavy boundary.

B22tg—15 to 23 inches, light-gray (10YR 6/1) light silty clay loam; many, medium, distinct, gray (N 6/0) and olive-yellow (2.5Y 6/8) mottles; moderate, coarse, prismatic structure; firm, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; gradual, wavy boundary.

Bxg—23 to 41 inches, light brownish-gray (10YR 6/2) light silty clay loam; faces of peds light gray (10YR 6/1); many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, very coarse, prismatic structure; very firm and brittle, sticky and plastic; thin, continuous clay films on ped faces; 5 percent shale chips; strongly acid; gradual, wavy boundary.

C—41 to 63 inches, brown (10YR 5/3) silt loam; faces of peds light gray (10YR 6/1); many, medium, distinct, light-gray (10YR 6/1) mottles; weak, very coarse, prismatic structure; firm, sticky and plastic; 10 percent shale chips; strongly acid; abrupt, wavy boundary.

R—63 inches, shale bedrock.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock ranges from 4 to 9 feet. Depth to the fragipan ranges from 16 to 28 inches. The content of shale or sandstone fragments ranges from 0 to 10 percent in the B2 horizon, from 2 to 10 percent in the Bx horizon, and from 10 to 20 percent in the C horizon. The B2 horizon is light brownish-gray (2.5Y 6/2) to light-gray (10YR 6/1) silt loam to light silty clay loam. The Bx horizon is grayish-brown (10YR 5/2) to gray (10YR 6/1) loam to silty clay loam. The C horizon ranges from silt loam to loam.

Brinkerton soils are associated on the landscape with the moderately well drained Ernest soils. They contain less sand and more silt above the Bx horizon than the similar Frenchtown soils.

Brinkerton silt loam, 0 to 3 percent slopes (BrA).—This soil is around the heads of streams, in drainageways, and at the foot of long toe slopes. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Ernest and Atkins soils.

About three-fourths of the acreage of this Brinkerton soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IVw–1.

Brinkerton silt loam, 3 to 8 percent slopes (BrB).—This soil is around the heads of streams, in drainageways, and at the foot of long slopes. Included with it in mapping were small areas of Ernest and Atkins soils and nearly level Brinkerton soils. About three-fourths of the acreage of this gently sloping Brinkerton soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IVw–1.

Brinkerton and Frenchtown very stony silt loams (Bt).—These nearly level and gently sloping soils were mapped together because stoniness outweighs all other properties that affect management. Any one mapped area may contain both of these soils or only one. About 75 percent of the total acreage is Brinkerton very stony silt loam, and 25 percent is Frenchtown very stony silt loam.

These soils are in upland depressions, around the heads of streams, in drainageways, and at the foot of long slopes. The profile of each soil is similar to the one described as representative of the series, but each has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter occupy 15 percent of the soil surface.

Included with these soils in mapping were small areas of Ernest and Atkins soils.

Nearly all the acreage is wooded. These soils are too stony for cultivation. The major limitations are stoniness, slow permeability, and a seasonal high water table. Capability unit VIIs–1.

Canfield Series

The Canfield series consists of deep, gently sloping to moderately steep, moderately well drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, shale, and some limestone. Slopes are convex. The native vegetation is chiefly mixed oaks, maple, ash, and black cherry.

A representative profile has a dark grayish-brown gravelly silt loam plow layer about 10 inches thick. The subsoil extends to a depth of 62 inches or more. To a depth of about 22 inches, it is light yellowish-brown and yellowish-brown, friable gravelly silt loam mottled with light brownish gray, light gray, yellowish brown, and strong brown. Between depths of 22 and 47 inches, it is dark-brown and brown, brittle and firm gravelly loam and gravelly sandy loam mottled with strong brown and grayish brown. Below a depth of 47 inches, it is brown gravelly sandy loam mottled with light brownish gray.

Available moisture capacity is moderate, and permeability is slow. The water table is within 18 to 36 inches of the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Canfield gravelly silt loam, 3 to 8 percent slopes, in a cultivated field 4¼ miles northwest of Polk. This profile is identified as S66-Pa-61-7 (1–8) in tables 12, 13, and 14 in the section "Laboratory Data" and as Pennsylvania report numbers A–48110 and A–48111 in table 4, Engineering Test Data:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; moderate, medium, granular structure; friable, nonsticky and nonplastic; 15 percent gravel; medium acid; abrupt, smooth boundary.

B1—10 to 13 inches, yellowish-brown (10YR 5/4) gravelly silt loam; few, medium, faint, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/8) mottles; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; friable, nonsticky and nonplastic; few thin clay films in pores; 15 percent gravel; strongly acid; clear, wavy boundary.

B21t—13 to 19 inches, yellowish-brown (10YR 5/4) gravelly silt loam; many, medium, distinct, yellowish-brown (10YR 5/8) and light brownish-gray (10YR 6/2) mottles; moderate, medium, prismatic structure parting to weak, medium, subangular blocky; friable, slightly sticky and slightly plastic; thin, discontinuous clay films in pores; 15 percent gravel; strongly acid; clear, wavy boundary.

B22t—19 to 22 inches, light yellowish-brown (10YR 6/4) gravelly silt loam; few, medium, distinct, light-gray (10YR 7/2) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces; 20 percent gravel; medium acid; clear, wavy boundary.

Bxlg—22 to 37 inches, dark-brown (10YR 4/3) gravelly loam; faces of prisms gray (10YR 5/1); many, medium, prominent, strong-brown (7.5YR 5/8) mottles; moderate, very coarse, prismatic structure parting to weak, medium, platy; firm and brittle, slightly sticky and slightly plastic; thick, continuous clay films on ped faces; 30 percent gravel; medium acid; gradual, irregular boundary.

IIBx2—37 to 47 inches, brown (10YR 5/3) gravelly sandy loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm and brittle, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces; 20 percent gravel; neutral; gradual, wavy boundary.

IIB31—47 to 57 inches, brown (10YR 5/3) gravelly sandy loam; moderate, very coarse, prismatic structure parting to weak, coarse, subangular blocky; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces; 20 percent gravel; neutral; gradual, wavy boundary.

IIB32—57 to 62 inches, brown (10YR 5/3) gravelly sandy loam; few, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, very coarse, prismatic structure parting to weak, coarse, subangular blocky; friable, nonsticky and nonplastic; 20 percent gravel; neutral.

The solum ranges from 48 to 70 inches in thickness. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 16 to 28 inches. The gravel content ranges from 15 to 25 percent above the Bxlg horizon and from 15 to 30 percent in the IIBx2 horizon. The Ap horizon is dark grayish brown (10YR 4/2) to brown (10YR 5/3). The B2 horizon ranges from yellowish-brown (10YR 5/4) to light yellowish-brown (10YR 6/4) gravelly loam to gravelly silty clay loam. The Bx horizon has gray (10YR 5/1) to brown (10YR 5/3) prism faces and dark-brown (10YR 4/3) to yellowish-brown (10YR 5/4) interiors.

Canfield soils are associated on the landscape with the somewhat poorly drained Ravenna soils, the poorly drained Frenchtown soils, and the well-drained Wooster soils. They formed in material similar to that of Hanover soils, but are less acid in the Bx horizon than those soils.

Canfield gravelly silt loam, 3 to 8 percent slopes (CdB).—This soil is on hilltops. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Wooster and Ravenna soils and some nongravelly Canfield soils.

About three-fourths of the acreage of this Canfield soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe-1.

Canfield gravelly silt loam, 8 to 15 percent slopes (CdC).—This soil is on hillsides. Its profile is a few inches deeper to mottling than the one described as representative of the series.

Included with this soil in mapping were small areas of Wooster and Ravenna soils and some areas of nongravelly Canfield soils.

About three-fourths of the acreage of this Canfield soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIIe-2.

Canfield very stony silt loam, 0 to 8 percent slopes (CeB).—This soil is on hilltops. Its profile is similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of stony Ravenna and Wooster soils.

Nearly all the acreage of this Canfield soil is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the slow permeability, and the seasonal high water table. Capability unit VIs-1.

Canfield very stony silt loam, 8 to 25 percent slopes (CeD).—This soil is on hillsides. Its profile is similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of stony Wooster and Ravenna soils.

Nearly all the acreage of this Canfield soil is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the slow permeability, and the seasonal high water table. Capability unit VIs-1.

Cavode Series

The Cavode series consists of deep, nearly level to sloping, somewhat poorly drained soils on uplands. These soils formed in material weathered from acid clay shale and siltstone. Slopes are concave. The native vegetation is mixed oaks, cherry, and soft maple.

A representative profile has a dark yellowish-brown silt loam plow layer about 6 inches thick. The subsoil extends to a depth of 39 inches. To a depth of 10 inches, it is yellowish-brown, friable silty clay loam mottled with light gray. Between depths of 10 and 39 inches, it is light brownish-gray and brown silty clay loam mottled with light gray and yellowish brown. The upper part of this layer is friable, and the lower part is firm. The substratum is dark yellowish-brown very shaly silt loam. Shale bedrock is at a depth of 53 inches.

Available moisture capacity is high, and permeability is slow. The water table is within 6 to 18 inches of the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Cavode silt loam, 3 to 8 percent slopes, in a cultivated field 4 miles west of Venus:

Ap—0 to 6 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; medium acid; abrupt, smooth boundary.

B21t—6 to 10 inches, yellowish-brown (10YR 5/4) silty clay loam; few, medium, distinct, light-gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; clear, wavy boundary.

B22tg—10 to 24 inches, brown (10YR 5/3) silty clay loam; faces of peds light gray (10YR 6/1); common, medium distinct, light-gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; gradual, wavy boundary.

B23tg—24 to 39 inches, light brownish-gray (10YR 6/2) silty clay loam; faces of peds light gray (10YR 6/1); common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure; firm, sticky and plastic; thin, continuous clay films on ped faces; strongly acid; clear, wavy boundary.

C—39 to 53 inches, dark yellowish-brown (10YR 4/4) very shaly silt loam; massive; friable, nonsticky and nonplastic; 80 percent shale; strongly acid; abrupt, smooth boundary.

R—53 inches, consolidated shale bedrock.

The solum ranges from 36 to 54 inches in thickness. Depth to bedrock ranges from 3½ to 6 feet. The content of coarse fragments ranges from 0 to 10 percent in the B2 horizon and from 10 to 80 percent in the C horizon. In some places small fragments of coal are present. The Ap horizon is dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4). The B21t horizon ranges from dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) or brown (10YR 5/3) silty clay loam to silty clay. The B22tg and B23tg horizons have gray (10YR 5/1) to light-gray (10YR 6/1) ped faces and ped interiors of light brownish gray (10YR 6/2) to brown (10YR 5/3). The B22tg and B23tg horizons range from silty clay loam to silty clay. The C horizon ranges from gray (5YR 6/1) to dark yellowish-brown (10YR 4/4) very shaly silt loam to silty clay loam.

Cavode soils are associated on the landscape with the moderately well drained Wharton and the poorly drained Armagh soils.

Cavode silt loam, 0 to 3 percent slopes (CIA).—This soil is on hilltops.

Included with this soil in mapping were small areas of Wharton, Cookport, and Armagh soils and some areas where the subsoil of this Cavode soil is less clayey and more sandy than is typical.

About three-fourths of the acreage of this Cavode soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIIw-1.

Cavode silt loam, 3 to 8 percent slopes (CIB).—This soil is on hilltops and benches on hillsides. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Wharton, Cookport, and Armagh soils and some areas where the subsoil of this Cavode soil is less clayey and more sandy than is typical.

About three-fourths of the acreage of this Cavode soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIIw-1.

Cavode silt loam, 8 to 15 percent slopes (CIC).—This soil is on hillsides.

Included with this soil in mapping were some areas where this soil is more sandy and less clayey than is typical and small areas of Wharton, Cookport, and Armagh soils.

About three-fourths of the acreage of this Cavode soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIIe-1.

Cookport Series

The Cookport series consists of deep, nearly level to sloping, moderately well drained soils on uplands. These soils formed in material weathered from gray sandstone, siltstone, and shale. Slopes are convex. The native vegetation is mixed oaks, maple, cherry, and some hemlock.

A representative profile in a wooded area has a thin, very dark grayish-brown and black organic layer over a 2-inch surface layer of dark-brown loam. The 4-inch subsurface layer is brown, friable loam. The subsoil extends to a depth of 38 inches. To a depth of 20 inches, it is yellowish-brown, friable loam. Below a depth of 20 inches, it is brittle, firm, dark-brown loam and channery loam mottled with light brownish gray and light gray. The substratum extends to a depth of 60 inches and is dark-gray very channery loam.

Available moisture capacity is moderate, and permeability is slow. The water table is at a depth of 18 to 36 inches during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Cookport loam, 0 to 3 percent slopes, in woodland about 5¾ miles east of Oil City. This profile is identified as S66-Pa-61-2 (1-9) in tables 12, 13, and 14 in the section "Laboratory Data" and as Pennsylvania report numbers A-48100 and A-48101 in table 4, Engineering Test Data:

O1—1 to ½ inch, very dark grayish-brown (10YR 3/2) partly decomposed leaf litter; 5 percent coarse fragments; extremely acid; clear, smooth boundary.

O2—½ inch to 0, black (N 2/0) decomposed organic matter; 5 percent sandstone fragments; extremely acid; abrupt, smooth boundary.

A1—0 to 2 inches, dark-brown (7.5YR 3/2) loam; weak, medium and fine, granular structure; slightly hard when dry, friable, nonsticky and nonplastic; 5 percent sandstone fragments; extremely acid; clear, wavy boundary.

A2—2 to 6 inches, brown (10YR 5/3) loam; weak, medium and fine, granular structure; friable, nonsticky and nonplastic; 10 percent sandstone fragments; very strongly acid; clear, wavy boundary.

B1—6 to 13 inches, yellowish-brown (10YR 5/4) loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few, thin, discontinuous clay films on ped faces; 10 percent sandstone fragments; very strongly acid; gradual, wavy boundary.

B2t—13 to 20 inches, yellowish-brown (10YR 5/4) loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on ped faces and in pores; 10 percent sandstone fragments; very strongly acid; clear, wavy boundary.

Bx1g—20 to 28 inches, dark-brown (10YR 4/3) loam; light brownish-gray (10YR 6/2) coating on very coarse prism faces, yellowish-brown (10YR 5/4) coating on medium prism faces; few, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, very coarse, prismatic structure parting to moderate, medium, prismatic and weak, medium, platy; firm and brittle, slightly sticky and slightly plastic; thick, discontinuous clay films in pores; 10 percent sandstone fragments; strongly acid; gradual, diffuse boundary.

Bx2g—28 to 38 inches, dark-brown (10YR 4/3) channery loam; light-gray (N 6/0) coating on very coarse prism faces, yellowish-brown (10YR 5/4) coating on blocky ped faces; common, medium, distinct, light brownish-gray (10YR 6/2) and light-gray (N 6/0) mottles; weak, very coarse, prismatic structure parting to moderate, medium, subangular blocky; firm and brittle, slightly sticky and slightly plastic; thick, discontinuous clay films in pores; 25 percent sandstone fragments; strongly acid; clear, wavy boundary.

C—38 to 60 inches, dark gray (10YR 4/1) very channery loam; massive; 80 percent soft shale and sandstone; very strongly acid.

The solum ranges from 30 to 40 inches thick. Depth to bedrock ranges from 4 to 6 feet. Depth to fragipan ranges from 16 to 27 inches. The content of coarse fragments ranges from 0 to 20 percent in the A1 and A2 or Ap horizons, from 5 to 20 percent in the B2t horizon, from 5 to 30 percent in the Bx horizon, and from 30 to 85 percent in the C horizon. The A1 horizon is dark brown (7.5YR 3/2) to very dark brown (10YR 2/2). The A2 horizon ranges from yellowish brown (10YR 5/4) to brown (10YR 5/3). Where present, the Ap horizon ranges from dark brown (7.5YR 3/2) to dark yellowish brown (10YR 4/4). The B1 and B2t horizons are yellowish-brown (10YR 5/4) or dark yellowish-brown (10YR 4/4) loam to sandy loam. The Bx horizon ranges from loam to channery sandy loam.

Cookport soils are associated on the landscape with the well-drained Hazleton soils. They are more sandy in the B horizon than the similar Alvira soils and are mottled at a greater depth than those soils.

Cookport loam, 0 to 3 percent slopes (CoA).—This soil is on broad flats and hilltops. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hazleton, Wharton, and Cavode soils and some areas where the surface layer is channery loam.

About three-fourths of the acreage of this Cookport soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIw–1.

Cookport loam, 3 to 8 percent slopes (CoB).—This soil is on hilltops and broad upland flats. It has a profile similar to the one described as representative of the series, but the surface layer has been plowed.

Included with this soil in mapping were small areas of Hazleton, Wharton, and Cavode soils and some areas where the surface layer is channery loam.

About three-fourths of the acreage of this Cookport soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe–1.

Cookport loam, 8 to 15 percent slopes (CoC).—This soil is on hillsides. It has a profile similar to the one described as representative of the series, but the surface layer has been plowed.

Included with this soil in mapping were small areas of Hazleton, Wharton, and Cavode soils and some areas of a Cookport soil that is steeper than 15 percent.

About three-fifths of the acreage of this Cookport soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIIe–2.

Cookport very stony loam, 0 to 8 percent slopes (CpB).—This soil is on upland flats. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area. Nearly all the acreage is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the slow permeability, and the seasonal high water table. Capability unit VIs–1.

Cookport very stony loam, 8 to 15 percent slopes (CpC).—This soil is on hillsides. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of poorly drained soils.

Nearly all the acreage is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the slow permeability, and the seasonal high water table. Capability unit VIs–1.

Ernest Series

The Ernest series consists of deep, nearly level to sloping, moderately well drained soils on uplands. These soils formed in colluvial material weathered from sandstone and shale. Slopes are concave. The native vegetation is mixed oaks, maple, ash, and black cherry.

A representative profile has a dark yellowish-brown silt loam plow layer about 8 inches thick. The subsoil extends to a depth of 46 inches. To a depth of about 23 inches, it is yellowish-brown, friable to firm silty clay loam mottled in the lower part with light gray and strong brown. Below a depth of 23 inches, it is brittle and firm, yellowish- brown clay loam mottled with light gray. The substratum extends to a depth of about 60 inches and is firm shaly clay loam.

Available moisture capacity is moderate, and permeability is moderately slow. The water table is within 18 to 36 inches of the surface during spring and winter. Most limitations are related to the restricted permeability and the seasonal high water table.

Representative profile of Ernest silt loam, 3 to 8 percent slopes, in a cultivated field 1½ miles west of Emlenton:

Ap—0 to 8 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, fine, granular structure; friable; 5 percent shale chips; very strongly acid; clear, wavy boundary.

B21t—8 to 16 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, continuous clay films on ped faces; 5 percent shale chips; strongly acid; clear, wavy boundary.

B22t—16 to 23 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, light-gray (10YR 6/1) and strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; firm, sticky and plastic; thin, continuous clay films on ped faces; 5 percent shale chips; strongly acid; clear, wavy boundary.

Bx1g—23 to 30 inches, yellowish-brown (10YR 5/4) clay loam; light-gray (10YR 6/1) coating on prism faces; common, medium, distinct, light-gray (10YR 6/1) mottles; moderate, coarse, prismatic structure; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 10 percent shale chips; strongly acid; gradual, wavy boundary.

Bx2g—30 to 46 inches, yellowish-brown (10YR 5/4) clay loam; light-gray (10YR 6/1) coating on prism faces; common, medium, distinct, light-gray (10YR 6/1) mottles; moderate, very coarse, prismatic structure; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 10 percent shale chips; strongly acid; gradual, wavy boundary.

C—46 to 60 inches, yellowish-brown (10YR 5/4) shaly clay loam; many, medium, distinct, light-gray (10YR 6/1) mottles; massive; firm, slightly sticky and slightly plastic; 25 percent shale chips; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 20 to 30 inches. The shale content ranges from 5 to 15 percent in the B2 horizon, from 10 to 30 percent in the Bx horizon, and from 10 to 40 percent in the C horizon. The Ap horizon is grayish brown (10YR 5/2) to dark yellowish brown (10YR 4/4). The B2 horizon ranges from silt loam to silty clay loam. The Bx horizon has light-gray (10YR 6/1) prism faces and brown (10YR 4/3) to yellowish-brown (10YR 5/4) interiors. The Bx horizon ranges from silt loam to clay loam.

Ernest soils are associated on the landscape with the poorly drained Brinkerton soils.

Ernest silt loam, 3 to 8 percent slopes (ErB).—This soil is around the heads of streams, in drainageways, and at the foot of long slopes. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Brinkerton and Philo soils and nearly level Ernest soils.

About three-fourths of the acreage of this Ernest soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe–1.

Ernest very stony silt loam, 0 to 8 percent slopes (EsB).—This soil is around the heads of streams and in drainageways. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were some areas where the texture is loam.

All the acreage of this Ernest soil is wooded. It is too stony for cultivation. The major limitations are the stoniness, the restricted permeability, and the seasonal high water table. Capability unit VIs–1.

Ernest very stony silt loam, 8 to 15 percent slopes (EsC).—This soil is around the heads of streams and in drainageways. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of stony Brinkerton soils.

Nearly all the acreage of this Ernest soil is wooded. It is too stony for cultivation. The major limitations are the stoniness, the restricted permeability, and the seasonal high water table. Capability unit VIs–1.

Frenchtown Series

The Frenchtown series consists of deep, nearly level to gently sloping, poorly drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, shale, and some limestone. Slopes are concave. The native vegetation is mixed oaks, elm, maple, and ash.

A representative profile has a dark grayish-brown silt loam plow layer about 10 inches thick. The subsoil extends to a depth of 44 inches. To a depth of about 19 inches, it is friable, gray silt loam mottled with strong brown. Below that depth, it is firm and brittle, grayish-brown and gray silt loam and loam mottled with strong brown and yellowish red. The substratum extends to a depth of about 60 inches and is firm, gray silt loam.

Available moisture capacity is moderate, and permeability is slow. The water table is within 6 inches of the surface during spring and winter. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Frenchtown silt loam, 0 to 3 percent slopes, in a cultivated field in Barkeyville:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; slightly acid if limed; abrupt, smooth boundary.

B2tg—10 to 19 inches, gray (10YR 5/1) silt loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, prismatic structure parting to weak, thick, platy; friable, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; medium acid; clear, smooth boundary.

Bx1g—19 to 24 inches, grayish-brown (10YR 5/2) silt loam; faces of peds gray (10YR 5/1); many, medium, distinct, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/8) mottles; moderate, coarse, prismatic structure parting to moderate, thick, platy; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 10 percent gravel; medium acid; clear, wavy boundary.

Bx2g—24 to 44 inches, grayish-brown (10YR 5/2) loam; faces of peds gray (N 5/0); many, medium, distinct, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/8) mottles; moderate, very coarse, prismatic structure; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 10 percent gravel; medium acid; gradual, wavy boundary.

Cg—44 to 60 inches, gray (N 5/0) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure; firm, nonsticky and nonplastic; 10 percent gravel; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 15 to 24 inches. The gravel content ranges from 0 to 5 percent in the Ap horizon, from 0 to 15 percent in the B2tg horizon, and from 10 to 30 percent in the Bx horizon. The Ap horizon is dark gray (10YR 4/1) to dark grayish brown (10YR 4/2). The B2tg horizon ranges from gray (10YR 5/1) to grayish-brown (10YR 5/2) silt loam to light silty clay loam. The Bx horizon is gray (10YR 5/1) to grayish-brown (10YR 5/2) silt loam to loam.

Frenchtown soils are associated with the well drained Wooster soils, the moderately well drained Canfield soils, the moderately well drained and well drained Hanover soils, and the somewhat poorly drained Alvira and Ravenna soils. They are more sandy and less silty above the Bx horizon than the similar Brinkerton soils.

Frenchtown silt loam, 0 to 3 percent slopes (FeA).—This soil is in drainageways, potholes, and depressions in the uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Alvira soils.

About three-fourths of the acreage of this Frenchtown soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIIw–3.

Frenchtown silt loam, 3 to 8 percent slopes (FeB).—This soil is in broad upland flats, on benches, and along drainageways.

Included with this soil is mapping were a few areas of sloping soils and a few small areas of Alvira soils.

About three-fourths of the acreage of this Frenchtown soil has been cleared and cultivated. The major limitations are the restricted permeability and the high water table. Capability unit IIIw–3.

Gilpin Series

The Gilpin series consists of moderately deep, gently sloping to very steep, well-drained soils on uplands. These soils formed in material weathered from gray shale and siltstone. Slopes are convex. The native vegetation is red oak, white oak, chestnut oak, scarlet oak, and some white pine and hemlock.

A representative profile has a dark yellowish-brown silt loam plow layer about 7 inches thick. The subsoil extends to a depth of about 24 inches. It is friable, yellowish-brown shaly silty clay loam and shaly silt loam. The substratum is yellowish-brown very shaly silt loam. Rippable shale bedrock is at a depth of 28 inches.

Available moisture capacity is low, and permeability is moderate. Most limitations are related to the depth to bedrock.

Representative profile of Gilpin silt loam, 3 to 8 percent slopes, in a cultivated field 1¼ miles west of Venus:

Ap—0 to 7 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 10 percent shale chips; strongly acid; abrupt, smooth boundary.

B2t—7 to 18 inches, yellowish-brown (10YR 5/6) shaly light silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, continuous clay films on ped faces; 20 percent shale chips; strongly acid; clear, wavy boundary.

B3—18 to 24 inches, yellowish-brown (10YR 5/4) shaly silt loam; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; thin, continuous clay films on ped faces; 40 percent shale chips; strongly acid; clear, wavy boundary.

C—24 to 28 inches, yellowish-brown (10YR 5/4) very shaly silt loam; massive; friable; 85 percent shale fragments; strongly acid; clear, smooth boundary.

R—28 inches +, rippable shale bedrock.

The solum ranges from 20 to 36 inches in thickness. Depth to rippable shale bedrock ranges from 1½ to 3½ feet. The content of shale fragments ranges from 10 to 40 percent in the B horizon and from 30 to 90 percent in the C horizon. The Ap horizon is dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4). The B horizon ranges from silt loam to light silty clay loam.

Gilpin soils are associated on the landscape with the moderately well drained Wharton soils, the somewhat poorly drained Cavode soils, and the poorly drained Armagh soils. They formed in material similar to that of Hazleton soils, but they are shallower over bedrock than those soils.

Gilpin silt loam, 3 to 8 percent slopes (GlB).—This soil is on convex hillsides and ridgetops. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Wharton and Hazleton soils, areas of Gilpin soils that have a shaly surface layer, and some areas of shaly soils that are less than 20 inches deep over bedrock.

Almost all the acreage of this Gilpin soil has been cleared and cultivated. The major limitations are the erosion hazard and the moderate depth to bedrock. Capability unit IIe-2.

Gilpin silt loam, 8 to 15 percent slopes (GlC).—This soil is on convex hillsides and ridgetops. It has a profile similar to the one described as representative of the series, but it is a few inches thinner and has more shale fragments in the surface layer.

Included with this soil in mapping were small areas of Wharton and Hazleton soils, areas of Gilpin soils that have a shaly surface layer, and some areas of shaly soils that are less than 20 inches deep over bedrock.

Almost all the acreage of this Gilpin soil has been cleared and cultivated. The major limitations are the erosion hazard, the slope, and the moderate depth to bedrock. Capability unit IIIe-3.

Gilpin silt loam, 15 to 25 percent slopes (GlD).—This soil is on hillsides. It has a profile similar to the one described as representative of the series, but it is a few inches thinner and has more shale fragments in the surface layer.

Included with this soil in mapping were small areas of sloping Gilpin soils, small areas of Hazleton soils, and some areas of shaly soils that are less than 20 inches deep over bedrock.

About half the acreage of this Gilpin soil has been cleared and cultivated. The major limitations are the slope, the erosion hazard, and the moderate depth to bedrock. Capability unit IVe-1.

Hanover Series

The Hanover series consists of deep, nearly level to very steep, moderately well drained and well drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, siltstone, and shale. Slopes are convex. The native vegetation is mixed oaks, maple, ash, and black cherry.

A representative profile has a dark-brown silt loam plow layer about 9 inches thick. The subsoil extends to a depth of 60 inches. To a depth of about 20 inches, it is yellowish-brown, friable silt loam. Below a depth of 20 inches, it is yellowish-brown, brittle and firm gravelly silt loam mottled with strong brown and light gray.

Available moisture capacity is moderate, and permeability is moderately slow. The water table is at a depth of 18 to 36 inches during winter and spring. Most limitations are related to the restricted permeability and the seasonal high water table.

Representative profile of Hanover silt loam, 3 to 8 percent slopes, in a cultivated field 1 mile north of Cherrytree. This profile is identified as Pennsylvania report numbers 67-37116 and 67-37117 in table 4, Engineering Test Data:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 5 percent sandstone gravel; strongly acid; abrupt, smooth boundary.

B2t—9 to 20 inches, yellowish-brown (10YR 5/6) silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 10 percent gravel; strongly acid; clear, wavy boundary.

Bx1g—20 to 43 inches, yellowish-brown (10YR 5/4) gravelly silt loam; light-gray (10YR 6/1) coating on prism faces; common, medium, distinct, strong-brown (7.5YR 5/8) and light-gray (N 6/0) mottles; moderate, very coarse, prismatic structure; firm, brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 20 percent gravel; strongly acid; clear, wavy boundary.

Bx2g—43 to 60 inches, yellowish-brown (10YR 5/4) gravelly silt loam; light-gray (10YR 6/1) coating on prism faces; common, medium, distinct, strong-brown (7.5YR 5/6) and light-gray (N 6/0) mottles; moderate, very coarse, prismatic structure parting to moderate, medium, platy; firm, brittle, nonsticky and nonplastic; thin, continuous clay films on ped faces; 20 percent gravel; some black (N 2/0) coatings; strongly acid.

The solum ranges from 50 to 80 inches in thickness. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 17 to 26 inches. The gravel content ranges from 5 to 10 percent in the Ap horizon, from 5 to 20 percent in the B2t horizon, and from 5 to 25 percent in the Bx horizon. The Ap horizon is dark brown (10YR 4/3) to dark grayish brown (10YR 4/2). The B2t horizon ranges from yellowish-brown (10YR 5/6) to strong-brown (7.5YR 5/6) silt loam to gravelly loam. The Bx horizon has light-gray (10YR 6/1) or gray (10YR 5/1) prism faces and yellowish-brown (10YR 5/4) or brown (10YR 5/3) interiors. It ranges from silt loam to gravelly loam.

Hanover soils are associated on the landscape with the somewhat poorly drained Alvira soils and the poorly drained Frenchtown soils. They formed in material similar to that of Canfield soils, but they are more acid throughout the Bx horizon than those soils.

Hanover silt loam, 0 to 3 percent slopes (HaA).—This soil is on hilltops and upland flats.

Included with this soil in mapping were small areas of Alvira soils and a few areas of Hanover soils that are more sandy throughout the profile than is typical.

About three-fourths of the acreage of this Hanover soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIw–1.

Hanover silt loam, 3 to 8 percent slopes (HaB).—This soil is on hilltops on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Alvira soils and a few areas of Hanover soils that are more sandy throughout the profile than is typical.

About three-fourths of the acreage of this Hanover soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe–1.

Hanover silt loam, 8 to 15 percent slopes (HaC).—This soil is on hillsides.

Included with this soil in mapping were small areas of Alvira soils and a few areas of Hanover soils that are more sandy throughout the profile than is typical.

About three-fifths of the acreage of this Hanover soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIIe–2.

Hanover silt loam, 15 to 25 percent slopes (HaD).—This soil is on hillsides.

Included with this soil in mapping were small areas of Hazelton soils, small seep areas of Alvira soils, and a few areas of Hanover soils that are more sandy throughout the profile than is typical.

About half the acreage of this Hanover soil has been cleared and cultivated. The major limitations are the erosion hazard, the slope, the restricted permeability, and the seasonal high water table. Capability unit IVe–1.

Hanover very stony silt loam, 0 to 8 percent slopes (HdB).—This soil is on narrow and broad flats on uplands. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of stony Alvira soils and some areas of Hanover soils that are more sandy throughout the profile than is typical.

Nearly all the acreage of this Hanover soil is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the restricted permeability, and the seasonal high water table (fig. 12). Capability unit VIs–1.

Hanover very stony silt loam, 8 to 25 percent slopes (HdD).—This soil is on hillsides. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were areas where this soil is more sandy throughout the profile than is typical.

Nearly all the acreage is wooded. This soil is too stony for cultivation. The major limitations are the stoniness, the restricted permeability, the slope, and the seasonal high water table. Capability unit VIs–1.

Hanover very stony silt loam, 25 to 45 percent slopes (HdE).—This soil is on valley sides. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer and it contains more coarse fragments. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of the sloping, nonstony Hanover soils and small areas of the stony Hazleton soils.

Nearly all the acreage of this Hanover soil is wooded. This soil is too stony and too steep for cultivation. The major limitations are the stoniness and the steep slopes. Capability unit VIIs–2.

Hazleton Series

The Hazleton series consists of deep, nearly level to very steep, well-drained soils on uplands. These soils formed in material weathered from gray sandstone. Slopes are convex. The native vegetation is mixed oaks, sugar maple, red maple, and cherry.

A representative profile has a black organic layer 1 inch thick over a dark yellowish-brown mineral layer one-half inch thick. Next is a 9-inch layer of brown channery loam. The subsoil extends to a depth of about 37 inches. To a depth of about 14 inches, it is yellowish-brown, friable and very friable channery sandy loam. Below a depth of 14 inches, it is yellowish-brown and brownish-yellow, friable channery sandy loam. The substratum is brownish-yellow very channery sandy loam. Sandstone bedrock is at a depth of 45 inches.

Available moisture capacity is low, and permeability is moderately rapid. Most limitations are related to the high content of sandstone fragments in the soil.

Representative profile of Hazleton channery loam in an area of Hazleton very stony loam, 0 to 8 percent slopes, in woodland, 2¾ miles north of Cooperstown:

O2—1 inch to 0, black (N 2/0) organic layer; extremely acid; abrupt, wavy boundary.

A1—0 to ½ inch, dark yellowish-brown (10YR 4/4) channery loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 15 percent sandstone fragments; extremely acid; clear, wavy boundary.

A2—½ inch to 9 inches, brown (10YR 5/3) channery loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 20 percent sandstone fragments; extremely acid; clear, wavy boundary.

B1—9 to 14 inches, yellowish-brown (10YR 5/4) channery sandy loam; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; 20 percent

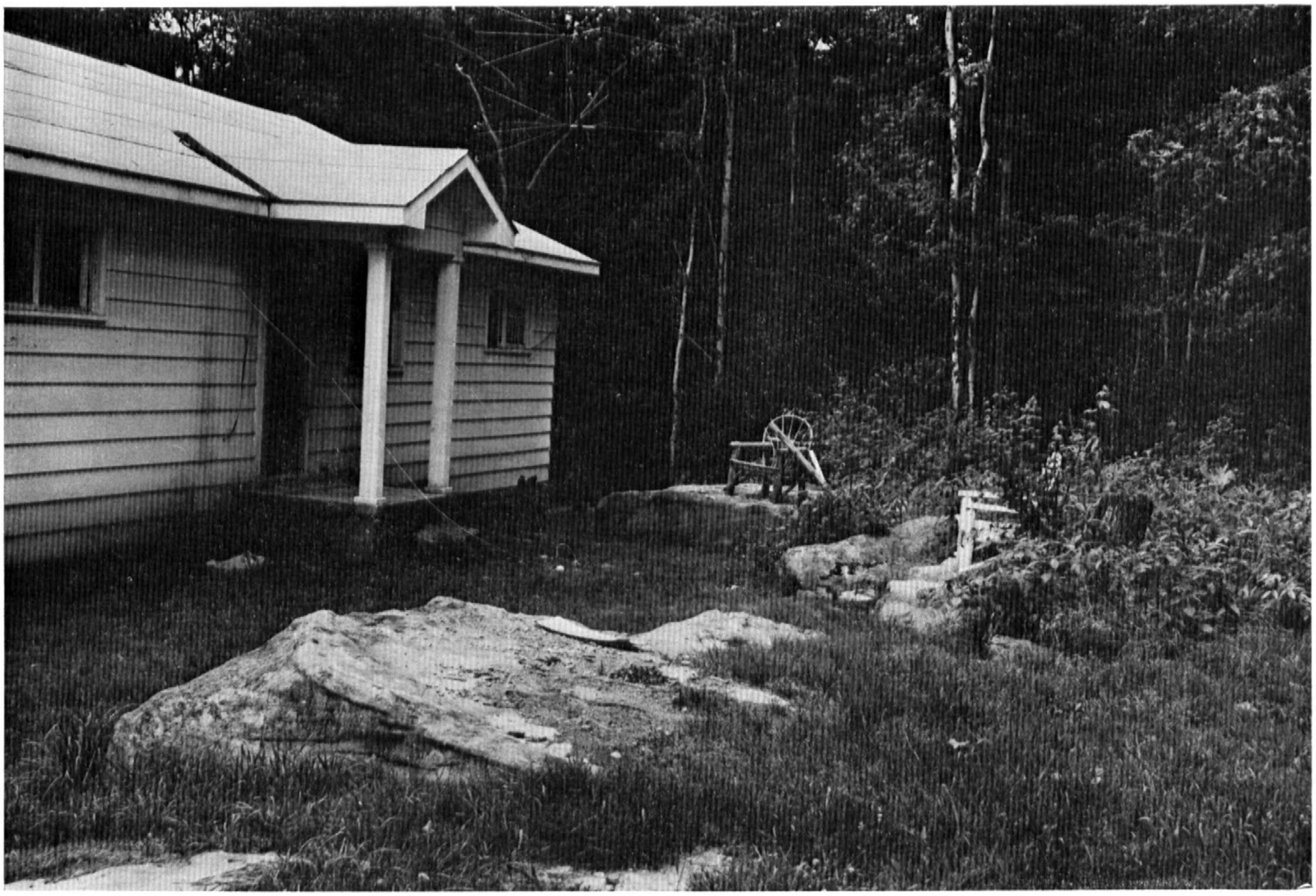

Figure 12.—Home built on Hanover very stony silt loam, 0 to 8 percent slopes. Stones limit the area where a lawn can be established.

sandstone fragments; extremely acid; clear, wavy boundary.

B2—14 to 29 inches, yellowish-brown (10YR 5/6) channery sandy loam; weak, medium, subangular blocky structure; friable, nonsticky and nonplastic; 40 percent sandstone fragments; extremely acid; clear, wavy boundary.

B3—29 to 37 inches, brownish-yellow (10YR 6/6) channery sandy loam; very weak, medium, subangular blocky structure; very friable, nonsticky and nonplastic; 45 percent sandstone fragments; very strongly acid; clear, wavy boundary.

C—37 to 45 inches, brownish-yellow (10YR 6/6) very channery sandy loam; massive; very friable, nonsticky and nonplastic; 70 percent sandstone fragments; very strongly acid; clear, wavy boundary.

R—45 inches, hard gray sandstone.

The solum ranges from 25 to 40 inches in thickness. Depth to bedrock ranges from 3½ to 6 feet. The content of coarse fragments ranges from 15 to 50 percent in the solum and increases with increasing depth. The weighted average is 35 percent or more between depths of 10 and 40 inches. The C horizon is 50 to 90 percent coarse fragments. In cultivated areas, the plow layer ranges from dark grayish brown to dark brown. The A1 and A2 horizons range from very dark grayish brown (10YR 3/2) to brown (10YR 5/3). The B horizon ranges from yellowish-brown (10YR 5/4) to brownish-yellow (10YR 6/6) loam to sandy loam.

Hazleton soils are associated on the landscape with the moderately well drained Cookport soils. They formed in material similar to that of Gilpin soils, but are deeper over bedrock than those soils.

Hazleton channery loam, 3 to 8 percent slopes (HeB).—This soil is on convex hilltops. It has a profile similar to the one described as representative of the series, but the surface horizons have been mixed by plowing.

Included with this soil in mapping were small areas of Cookport soils and Gilpin soils, some areas of Hazleton soils that have a surface layer of sandy loam, and some areas of moderately deep soils.

About three-fifths of the acreage of this Hazleton soil has been cleared and cultivated. The major limitation is the erosion hazard. Capability unit IIe-2.

Hazleton channery loam, 8 to 15 percent slopes (HeC).—This soil is on hillsides. It has a profile similar to the one described as representative of the series, but the surface horizons have been mixed by plowing.

Included with this soil in mapping were small areas of Cookport soils and some areas of soils that are only moderately deep over bedrock.

About half the acreage of this Hazleton soil has been cleared and cultivated. The major limitations are the slope and the erosion hazard. Capability unit IIIe-3.

Hazleton channery loam, 15 to 25 percent slopes (HeD).—This soil is on hillsides. Included with it in

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mapping were some areas of soils that are only moderately deep over bedrock. About one-fourth of the acreage has been cleared and cultivated. The major limitations are the slope and the erosion hazard. Capability unit IVe-1.

Hazleton very stony loam, 0 to 8 percent slopes (HlB).—This soil is on convex hilltops. It has the profile described as representative of the series. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of Cookport and nonstony Hazleton soils.

Most of the acreage of this Hazleton soil is wooded. This soil is too stony for cultivation. The major limitation is the stoniness. Capability unit VIs-2.

Hazleton and Gilpin very stony soils, 8 to 25 percent slopes (HnD).—These sloping to moderately steep soils were mapped together because stoniness outweighs all other properties that affect management. Any one mapped area may contain both of these soils or only one. About 75 percent of the total acreage is Hazleton very stony loam, and 25 percent is Gilpin very stony silt loam.

These soils are on hillsides. The surface layer ranges from silt loam to channery loam. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with these soils in mapping were small areas of very stony Cookport soils.

Most of the acreage is wooded. These soils are too stony for cultivation. The major limitation is the stoniness. Capability unit VIs-2.

Hazleton and Gilpin very stony soils, 25 to 70 percent slopes (HnF).—These steep and very steep soils were mapped together because stoniness and steepness outweigh all other properties that affect management. Any one mapped area may contain both of these soils or only one. About 75 percent of the total acreage is Hazleton very stony loam, and 25 percent is Gilpin very stony silt loam.

These soils are on valley sides and hillsides. The surface layer ranges from silt loam to channery loam. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with these soils in mapping were some outcrops of bedrock.

Most of the acreage is wooded. These soils are too steep and too stony for cultivation. The major limitations are the slopes and the stoniness. Capability unit VIIs-2.

Monongahela Series

The Monongahela series consists of deep, nearly level to gently sloping, moderately well drained soils on terraces. These soils formed in sediment deposited by streams. The native vegetation is mixed oaks, red maple, beech, and hickory.

A representative profile has a dark-brown silt loam plow layer about 10 inches thick. The subsoil extends to a depth of 67 inches. To a depth of about 26 inches, it is dark yellowish-brown and yellowish-brown, friable silt loam. Between depths of 26 and 53 inches, it is dark yellowish-brown, firm and brittle silt loam mottled with yellowish brown and light brownish gray. Below a depth of 53 inches, it is dark-brown, friable sandy loam mottled with light brownish gray and strong brown. The substratum extends to a depth of 72 inches and is light yellowish-brown loamy sand.

Available moisture capacity is moderate, and permeability is slow. The water table is within 18 to 36 inches of the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Monongahela silt loam, 0 to 3 percent slopes, in a cultivated field 0.85 mile south of Niles. This profile is identified as S66-Pa-61-10 (1-7) in tables 12, 13, and 14 in the section "Laboratory Data" and as Pennsylvania report numbers A-48116 and A-48117 in table 4, Engineering Test Data:

Ap—0 to 10 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; hard when dry, friable, nonsticky and nonplastic; 8 percent gravel; very strongly acid; abrupt, smooth boundary.

B1—10 to 14 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, medium, subangular blocky structure; friable, nonsticky and slightly plastic; a few clay films in pores; 5 percent gravel; very strongly acid; clear, wavy boundary.

B2t—14 to 26 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous clay films in pores and on ped faces; 5 percent gravel; very strongly acid; abrupt, wavy boundary.

Bx1—26 to 38 inches, dark yellowish-brown (10YR 4/4) silt loam; light-gray (10YR 7/2) coating on prism faces and on subangular blocky ped faces; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; strong, very coarse, prismatic structure parting to moderate, medium, subangular blocky and weak, thin, platy; firm and brittle, slightly sticky and slightly plastic; thick clay films in pores and thin, discontinuous clay films on ped faces; 5 percent gravel; strongly acid; gradual, wavy boundary.

Bx2—38 to 53 inches, dark yellowish-brown (10YR 4/4) silt loam; light brownish-gray (10YR 6/2) coating on prism faces; few, medium and coarse, faint, yellowish-brown (10YR 5/6) mottles and common, medium, distinct, light brownish-gray (10YR 6/2) mottles; strong, very coarse, prismatic structure parting to moderate, medium, subangular blocky and weak, thin, platy; firm and brittle, slightly sticky and slightly plastic; thick, continuous clay films in pores and thin, discontinuous clay films on ped faces; 10 percent gravel; strongly acid; clear, wavy boundary.

IIB3—53 to 67 inches, dark-brown (10YR 4/3) sandy loam; many, medium, distinct, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure parting to weak, thin and medium, platy; friable, nonsticky and nonplastic; thin, continuous clay films in pores; 5 percent gravel; strongly acid; clear, wavy boundary.

IIIC—67 to 72 inches, light yellowish-brown (10YR 6/4) loamy sand; massive; loose, nonsticky and nonplastic; 10 percent gravel; strongly acid.

The solum ranges from 40 to 70 inches in thickness. Depth to bedrock is more than 6 feet. Depth to the fragipan ranges from 18 to 30 inches. The gravel content ranges from 0 to 10 percent in the Ap, B1, and B2t horizons; from 3 to 15 percent in the Bx horizon; and from 10 to 40 percent in the C horizon. The Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The B1 and B2t horizons range from silt loam to silty clay loam. The Bx horizon has light-gray (10YR 7/2) to yellowish-brown (10YR 5/4) prism faces and dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) prism interiors.

Monongahela soils are associated on terraces with the well-drained Allegheny and Alton soils, the somewhat poorly drained Tyler soils, and the somewhat poorly drained to poorly drained Rexford soils.

Monongahela silt loam, 0 to 3 percent slopes (MoA).—This soil is on terraces in stream valleys. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Allegheny and Tyler soils and small areas where the surface layer is gravelly.

Most of the acreage of this Monongahela soil has been cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIw-1.

Monongahela silt loam, 3 to 8 percent slopes (MoB).—This soil is on terraces in stream valleys (fig. 13).

Included with this soil in mapping were small areas of Allegheny and Tyler soils and some areas where the surface layer is gravelly.

Most of the acreage of this Monongahela soil has been cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe-1.

Philo Series

The Philo series consists of deep, nearly level, moderately well drained soils on flood plains of streams. These soils formed in sediments washed from surrounding uplands. The native vegetation is red oak, white oak, hickory, ash, cherry, and elm.

A representative profile has a dark grayish-brown silt loam plow layer about 9 inches thick. The subsoil extends to a depth of 37 inches. To a depth of 22 inches, it is dark yellowish-brown, friable silt loam. Below a depth of 22 inches, it is brown, friable silt loam mottled with gray and strong brown. The substratum extends to a depth of 60 inches and is gray fine sandy loam mottled with yellowish red.

Available moisture capacity is high, and permeability is moderately slow. The water table is within 18 to 36 inches of the surface during winter and spring. Most limitations are related to the seasonal high water table and the flooding.

Representative profile of Philo silt loam, in a pasture 1.3 miles northeast of Cooperstown. This profile is identified as Pennsylvania report numbers 67-37092 and 67-37093 in table 4, Engineering Test Data:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; strongly acid; abrupt, smooth boundary.

Figure 13.—Foreground: Corn stubble on Monongahela silt loam, 3 to 8 percent slopes. Background: Hazleton and Gilpin very stony soils, 25 to 70 percent slopes.

B1—9 to 22 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; strongly acid; clear, wavy boundary.

B2—22 to 37 inches, brown (10YR 5/3) silt loam; many, fine, distinct, gray (5YR 5/1) mottles and many, medium, prominent, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; strongly acid; clear, wavy boundary.

C—37 to 60 inches, gray (N 5/0) fine sandy loam; many medium, prominent, yellowish-red (5YR 5/8) mottles; massive; friable, nonsticky and nonplastic; strongly acid.

The solum ranges from 24 to 40 inches in thickness. Depth to bedrock is more than 6 feet. The content of coarse fragments ranges from 0 to 5 percent in the A and B horizons and from 0 to 30 percent in the C horizon. The Ap horizon is very dark grayish brown (10YR 3/2) to brown (10YR 4/3). The B horizon ranges from silt loam to sandy loam.

Philo soils are associated on flood plains with the well-drained Pope soils and the poorly drained Atkins soils.

Philo silt loam (Ph).—This nearly level soil is in long, narrow bands along small streams and in strips on the flood plains of major streams.

Included with this soil in mapping were small areas of Pope and Atkins soils. Also included, in the western part of the county along some streams, were a few acres of soils that are less acid than Philo soils.

About three-fourths of the acreage of this Philo soil has been cleared and is used for cultivated crops. The major limitations are the flooding and the seasonal high water table. Capability unit IIw–2.

Pope Series

The Pope series consists of deep, nearly level, well-drained soils on flood plains of streams. These soils formed in sediment washed from surrounding uplands. The native vegetation is mixed oaks, maple, elm, and sycamore.

A representative profile has a dark grayish-brown loam plow layer about 7 inches thick. The subsoil extends to a depth of 38 inches. To a depth of 18 inches, it is dark-brown, friable fine sandy loam. Below a depth of 18 inches, it is dark yellowish-brown, very friable sandy loam. The substratum extends to a depth of 60 inches and is dark yellowish-brown, loose sandy loam.

Available moisture capacity is high, and permeability is moderate. Most limitations are related to flooding.

Representative profile of Pope loam, in a cultivated field west of President, 10 miles east of Oil City. This profile is identified as Pennsylvania report numbers 67–37118 and 67–37119 in table 4, Engineering Test Data:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable, nonsticky and nonplastic; very strongly acid; abrupt, smooth boundary.

B21—7 to 18 inches, dark-brown (10YR 4/3) fine sandy loam; weak, fine, granular structure; friable, nonsticky and nonplastic; some clay as bridges between sand grains; very strongly acid; clear, wavy boundary.

B22—18 to 38 inches, dark yellowish-brown (10YR 4/4) sandy loam; weak, fine, granular structure; very friable, nonsticky and nonplastic; strongly acid; clear, wavy boundary.

C—38 to 60 inches, dark yellowish-brown (10YR 4/4) sandy loam; massive; loose, nonsticky and nonplastic; strongly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock is more than 6 feet. The gravel content ranges from 0 to 10 percent in the Ap horizon, from 0 to 20 percent in the B2 horizon, and from 0 to 40 percent in the C horizon. The Ap horizon is dark brown (10YR 4/3) to dark grayish brown (10YR 4/2). The B2 horizon ranges from loam to sandy loam. The C horizon ranges from gravelly loamy sand to loam.

Pope soils are associated on flood plains with the moderately well drained Philo soils and the poorly drained Atkins soils.

Pope loam (Po).—This nearly level soil is near the channels of the larger streams in the county and in narrow bands adjacent to small streams. Included with it in mapping were small areas of Philo soils and gravelly Pope soils. Most of the acreage of this Pope soil has been cleared and is used for cultivated crops. The major limitation is the flooding hazard. Capability unit I–1.

Ravenna Series

The Ravenna series consists of deep, nearly level to sloping, somewhat poorly drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, shale, and some limestone. Slopes are concave. The native vegetation is mixed oaks, maple, ash and black cherry.

A representative profile has a dark grayish-brown silt loam plow layer about 9 inches thick. The subsoil extends to a depth of about 60 inches. To a depth of about 24 inches, it is pale-brown and light brownish-gray, friable silt loam mottled with yellowish red and light gray. Below a depth of 24 inches, it is firm and brittle, brown silt loam and dark yellowish-brown sandy loam mottled with yellowish red and light gray.

Available moisture capacity is moderate, and permeability is slow. The water table is within 6 to 18 inches of the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Ravenna silt loam, 3 to 8 percent slopes, in a cultivated field about 1½ miles northeast of Utica. This profile is identified as Pennsylvania report numbers 67–37090 and 67–37091 in table 4, Engineering Test Data:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable, nonsticky and nonplastic; strongly acid; abrupt, smooth boundary.

B1—9 to 13 inches, pale-brown (10YR 6/3) silt loam; few, fine, faint, light-gray (10YR 6/1) mottles and few, medium, prominent, yellowish-red (N 7/0) mottles; weak, medium, subangular blocky structure; friable, sticky and plastic; strongly acid; clear, wavy boundary.

B2tg—13 to 24 inches, light brownish-gray (10YR 6/2) heavy silt loam; many, medium, distinct, light-gray (N 7/0) mottles and many, medium, distinct, yellowish-red (5YR 5/8) mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; friable, sticky and plastic; thin, continuous clay films on ped faces; 5 percent gravel; strongly acid; clear, wavy boundary.

Bx1g—24 to 43 inches, brown (10YR 5/3) silt loam; gray (N 5/0) coating on prism faces; many, large, prominent, yellowish-red (5YR 5/8) and light-gray (N 7/0) mottles; moderate, very coarse, prismatic structure parting to moderate, medium, platy; firm and brittle, sticky and plastic; thin, continuous clay films on ped faces; 10 percent gravel; strongly acid; clear, wavy boundary.

Bx2g—43 to 60 inches, dark yellowish-brown (10YR 4/4) sandy loam; gray (N 5/0) coating on prism faces; many, medium, prominent, light-gray (N 7/0) mottles and many, medium, distinct, yellowish-red (5YR 5/8) mottles; moderate, very coarse, prismatic structure parting to moderate, medium, platy; firm, nonsticky and nonplastic; thin, discontinuous clay films on ped faces; 10 percent gravel; medium acid.

The solum ranges from 40 to 72 inches thick. Depth to bedrock is more than 5 feet. Depth to the fragipan ranges from 16 to 30 inches. The gravel content ranges from 0 to 10 percent in the Ap horizon, from 0 to 15 percent in the B1 and B2tg horizons, and from 5 to 20 percent in the Bx horizon. The Ap horizon is dark grayish brown (10YR 4/2) to dark brown (10YR 4/3). The B1 and B2tg horizons are pale-brown (10YR 6/3) to grayish-brown (10YR 5/2) silt loam to loam. The Bx horizon ranges from silt loam to gravelly sandy loam.

Ravenna soils are associated on the landscape with the well drained Wooster soils, the moderately well drained Canfield soils, and the poorly drained Frenchtown soils. They formed in material similar to that of Alvira soils, but they are less acid below a depth of 40 inches than those soils.

Ravenna silt loam, 0 to 3 percent slopes (RaA).—This soil is in depressions, potholes, and flats in uplands. Included with it in mapping were some small areas of Canfield and Frenchtown soils and some areas of Ravenna soils that have a surface layer of gravelly silt loam. About three-fourths of the acreage of this Ravenna soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIIw–1.

Ravenna silt loam, 3 to 8 percent slopes (RaB).—This soil is in depressions, potholes, and drainageways in uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Canfield and Frenchtown soils and some areas of Ravenna soils that have a surface layer of gravelly silt loam.

About three-fourths of the acreage of this Ravenna soil has been cleared and cultivated. The major limitations are the restricted permeability and the seasonal high water table. Capability unit IIIw–1.

Ravenna silt loam, 8 to 15 percent slopes (RaC).—This soil is on concave hillsides. Included with it in mapping were small areas of Canfield soils and small areas of Ravenna soils that have a surface layer of gravelly silt loam. About half the acreage of this Ravenna soil has been cleared and cultivated. The major limitations are the erosion hazard, the slope, the restricted permeability, and the seasonal high water table. Capability unit IIIe–1.

Rexford Series

The Rexford series consists of deep, nearly level, somewhat poorly drained to poorly drained soils on terraces. These soils formed along streams in gravel, sand, and silt deposited by running water. The native vegetation is mixed oaks, elm, and maple.

A representative profile has a dark grayish-brown silt loam plow layer about 9 inches thick. The subsoil extends to a depth of 40 inches. To a depth of 13 inches, it is brown, friable silt loam. Between depths of 13 and 23 inches, it is light brownish-gray, friable silt loam mottled with yellowish brown and light gray. Below a depth of 23 inches, it is light-gray, brittle and firm gravelly silt loam mottled with strong brown. The substratum extends to a depth of 60 inches and is light-gray silt loam mottled with strong brown.

Available moisture capacity is moderate, and permeability is slow. The water table is within 12 inches of the surface during spring and winter. Most limitations are related to the slow permeability and the high water table.

Representative profile of Rexford silt loam, in a cultivated field 2 miles east of Utica:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 5 percent gravel; strongly acid; abrupt, smooth boundary.

B21—9 to 13 inches, brown (10YR 5/3) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and nonplastic; 5 percent gravel; strongly acid; clear, wavy boundary.

B22—13 to 23 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles and common, fine, faint, light-gray (N 6/0) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; 5 percent gravel; strongly acid; clear, wavy boundary.

IIBxg—23 to 40 inches, light-gray (10YR 6/1) gravelly silt loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; moderate, very coarse, prismatic structure parting to weak, thick, platy; firm and brittle, nonsticky and nonplastic; 15 percent gravel; strongly acid; gradual, wavy boundary.

IIC—40 to 60 inches, light-gray (10YR 6/1) silt loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; massive; firm, nonsticky and nonplastic; 5 percent gravel; medium acid.

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock is more than 6 feet. Depth to the fragipan ranges from 18 to 24 inches. The gravel content ranges from 5 to 25 percent in the solum and from 0 to 60 percent in the C horizon. The Ap horizon is dark gray (10YR 4/1) to dark grayish brown (10YR 4/2). The B21 horizon ranges from silt loam to gravelly loam. The B22 horizon ranges from gray (10YR 5/1) to light brownish-gray (10YR 6/2) or grayish-brown (10YR 5/2) silt loam to gravelly loam. The IIBxg horizon ranges from gray (10YR 5/1) to light-gray (10YR 6/1) gravelly silt loam to sandy loam.

Rexford soils are associated on the landscape with the well drained Alton and Allegheny soils, the moderately well drained Monongahela soils, and the somewhat poorly drained Tyler soils. They are more sandy than Tyler soils and contain more coarse fragments in the B2 and Bx horizons than those soils. All formed in similar material.

Rexford silt loam (Re).—This nearly level soil is on terraces near streams in the western part of the county. Included with it in mapping were small areas of Tyler silt loam and a few areas of very poorly drained soils. About half the acreage of this Rexford soil has been cleared and cultivated. The major limitations are the seasonal high water table and the restricted permeability. Capability unit IIIw–1.

Strip Mines

Strip mines (Sm) are areas that have been disturbed by excavating or by stripping off the soil and rock overburden in order to gain access to underlying beds of coal. Most of the stripping for coal has been done in the southern part of Venango County.

In strip mining, the usual procedure is to remove the topsoil and part of the better subsoil material, then the geological material, and then the coal. After removal of the coal, the overburden is generally backfilled in the reverse order of removal. A typical opened strip mine has a high wall or vertical cliff, a spoil pile, and a wide cut between the high wall and the spoil pile. Coal strippings normally curve around or along the slopes in successive bands.

Unless the mines are backfilled, surface and ground water collect in the low-lying cut positions and slopes range up to 80 percent (fig. 14). The concentrated flow of water cuts deep gullies in many spoil piles. Drainage waters from the strip mines are extremely acid and pollute the streams.

Establishing vegetation on a strip-mine spoil is difficult because the material varies widely in acidity. The few places that are not too acid revegetate naturally, ordinarily several years after stripping. No capability classification.

Tyler Series

The Tyler series consists of deep, nearly level, somewhat poorly drained soils on terraces above flood plains. These soils formed in gravel, sand, and silt deposited by running water. The native vegetation is chiefly mixed oaks, maple, and ash.

A representative profile has a dark-brown silt loam plow layer about 8 inches thick. The subsoil extends to a depth of 42 inches. To a depth of 11 inches, it is yellowish-brown, friable silt loam. Between depths of 11 and 19 inches, it is light brownish-gray, friable silty clay loam mottled with light yellowish brown and light gray. Below a depth of 19 inches, it is brown, firm and brittle silty clay loam that has light brownish-gray coatings on structural faces and is mottled with light gray and strong brown. The substratum extends to a depth of about 60 inches and is dark yellowish-brown gravelly sandy loam.

Available moisture capacity is moderate, and permeability is slow. The water table is within 6 to 18 inches of the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Tyler silt loam, in a cultivated field 2¼ miles north of Cooperstown:

Figure 14.—Typical area of Strip mines that has not been backfilled.

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

B1—8 to 11 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, prominent, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; very strongly acid; clear, wavy boundary.

B2t—11 to 19 inches, light brownish-gray (10YR 6/2) silty clay loam; few, medium, prominent, light yellowish-brown (10YR 6/4) mottles and common, fine, faint, light-gray (N 7/0) mottles; moderate, medium, prismatic structure; friable, sticky and plastic; thin, continuous clay films on ped faces and in pores; strongly acid; clear, wavy boundary.

Bx—19 to 42 inches, brown (10YR 5/3) silty clay loam; light brownish-gray (10YR 6/2) coating on prism faces; many, medium, prominent, light-gray (10YR 6/1) and strong-brown (7.5YR 5/6) mottles; moderate, very coarse, prismatic structure parting to moderate, thick, platy; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on ped faces and in pores; medium acid; clear, wavy boundary.

IIC—42 to 60 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam; massive; loose, nonsticky and nonplastic; 40 percent gravel; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 6 feet. Depth to the fragipan ranges from 15 to 24 inches. The gravel content ranges from 0 to 2 percent throughout the solum. The Ap horizon is dark brown (10YR 4/3) to dark grayish brown (10YR 4/2). The B1 horizon ranges from silty clay loam to silt loam, and the B2t horizon is heavy silt loam or silty clay loam. The Bx horizon has light brownish-gray (10YR 6/2) to gray (10YR 5/1) ped surfaces and brown (10YR 5/3) to yellowish-brown (10YR 5/6) ped interiors. It ranges from clay loam to silty clay loam.

Tyler soils are associated on terraces with the well drained Allegheny and Alton soils, the moderately well drained Monongahela soils, and the somewhat poorly drained to poorly drained Rexford soils. They are less sandy than Rexford soils and contain fewer coarse fragments in the B2 and Bx horizon than those soils.

Tyler silt loam (Ty).—This nearly level soil is on terraces near streams in the western part of the county. Included with it in mapping were small areas of Rexford and Monongahela soils. About three-fourths of the acreage of this Tyler soil has been cleared and cultivated. The major limitations are the seasonal high water table and the restricted permeability. Capability unit IIIw–1.

Urban Land

Urban land is almost completely covered with buildings and pavement. It is mostly on terraces and flood plains. Because so much of the surface is covered, identification of the soils is impossible. In many places, the original soil profile has been completely destroyed.

Urban land is used for home sites, shopping centers, schools, factories, railroads, and other industrial facilities. Most of this land is in Franklin and Oil City.

Urban land-Monongahela complex (Um).—This is a complex mixture of Urban land and Monongahela silt loam, so intermingled that it was impractical to map them separately. About 65 percent of the acreage is Urban land, and 35 percent is Monongahela silt loam, 0 to 3 percent slopes. Urban land ranges from well drained to poorly drained, and Monongahela silt loam is moderately well drained. Small areas of Urban land in Oil City and Franklin are subject to flooding.

Included with this unit in mapping were small areas of Allegheny soils and small areas of Urban land on uplands.

The engineering properties of this mapping unit are extremely variable. A thorough investigation is needed of each individual site to determine its suitability for the proposed use. This unit has no capability classification because it varies widely in suitability for farming.

Wharton Series

The Wharton series consists of deep, gently sloping and sloping, moderately well drained soils on uplands. These soils formed in material weathered from clay shale. Slopes are concave. The native vegetation is mixed oaks, maple, cherry, and ash.

A representative profile has a dark-brown silt loam plow layer about 9 inches thick. The subsoil extends to a depth of 40 inches. To a depth of 30 inches, it is yellowish-brown, friable silty clay loam and shaly silty clay loam mottled with gray below a depth of 18 inches. Below a depth of 30 inches, it is strong-brown, firm shaly clay mottled with gray. The substratum is strong-brown very shaly silt loam. Shale bedrock is at a depth of 49 inches.

Available moisture capacity is moderate, and permeability is slow. The water table is 18 to 36 inches below the surface during winter and spring. Most limitations are related to the slow permeability and the seasonal high water table.

Representative profile of Wharton silt loam, 3 to 8 percent slopes, in a cultivated field 1⅝ miles west of Venus:

Ap—0 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 10 percent shale fragments; medium acid if limed; abrupt, smooth boundary.

B21t—9 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, continuous clay films on ped faces; 10 percent shale fragments; medium acid; clear, wavy boundary.

B22t—18 to 30 inches, yellowish-brown (10YR 5/6) shaly silty clay loam; gray (10YR 5/1) coating on prism faces; many, medium, distinct, gray (10YR 5/1) mottles; moderate, medium, prismatic structure; friable, sticky and plastic; thin, continuous clay films on ped faces; 15 percent coarse fragments; strongly acid; clear, wavy boundary.

B3t—30 to 40 inches, strong-brown (7.5YR 5/8) shaly clay; gray (5Y 5/1) coating on prism faces; many, medium, distinct, gray (5Y 5/1) mottles; moderate, coarse, prismatic structure; firm, sticky and plastic; thin, continuous clay films on ped faces; 30 percent shale fragments; strongly acid; clear, wavy boundary.

C—40 to 49 inches, strong-brown (7.5YR 5/8) very shaly silt loam; massive; friable; 85 percent shale fragments; strongly acid; clear, wavy boundary.

R—49 inches, rippable shale bedrock.

The solum ranges from 40 to 54 inches in thickness. The depth to bedrock ranges from 4 to 6 feet. The shale content ranges from 0 to 15 percent in the Ap, B21t, and B22t horizons and from 5 to 40 percent in the B3t horizon. The Ap horizon is dark brown (10YR 4/3) to dark grayish brown (10YR 4/2). The B21t horizon is brown (10YR 5/3) to yellowish-brown (10YR 5/4) silty clay loam to silty clay. The B22t horizon ranges from yellowish-brown (10YR 5/6) or strong-brown (7.5YR 5/6) to brown (10YR 5/3) silty clay loam to silty clay and has gray (10YR 5/1) prism faces. The B3t horizon is strong-brown (7.5YR 5/8) or yellowish-brown (10YR 5/8) silty clay loam to shaly clay and has gray (5Y 5/1) prism faces.

Wharton soils are associated on the landscape with the well-drained Gilpin soils, the somewhat poorly drained Cavode soils, and the poorly drained Armagh soils.

Wharton silt loam, 3 to 8 percent slopes (WhB).—This soil is on hilltops and upland benches. It has the profile described as representative of the series.

Included with this soil in mapping were small nearly level areas, a few acres of soils that have neutral reaction in the subsoil, and small areas of Cavode soils.

About three-fourths of the acreage of this Wharton soil has been cleared and cultivated. The major limitations are the erosion hazard, the restricted permeability, and the seasonal high water table. Capability unit IIe-1.

Wharton silt loam, 8 to 15 percent slopes (WhC).—This soil is on concave hillsides. Included with it in mapping were a few areas where slopes are steeper than 15 percent, a few areas of soils that have neutral reaction in the subsoil, and small areas of Cavode soils.

About three-fourths of the acreage of this Wharton soil has been cleared and cultivated. The major limitations are the erosion hazard, the slope, the restricted permeability, and the seasonal high water table. Capability unit IIIe-2.

Wooster Series

The Wooster series consists of deep, gently sloping to very steep, well-drained soils on uplands. These soils formed in material weathered from glacial till containing sandstone, shale, and some limestone. Slopes are convex. The native vegetation is chiefly mixed oaks, maple, ash, and black cherry.

A representative profile has a dark-brown gravelly silt loam plow layer about 9 inches thick. The subsoil extends to a depth of 47 inches. To a depth of about 36 inches, it is yellowish-brown, friable gravelly silt loam. Below that depth, it is yellowish-brown, brittle and firm gravelly loam. The substratum extends to a depth of about 60 inches or more and is brown gravelly sandy loam.

Available moisture capacity is moderate, and permeability is moderately slow. Most limitations are related to the high gravel content and the restricted permeability.

Representative profile of Wooster gravelly silt loam, 15 to 25 percent slopes, in a cultivated field about 1 mile north of Hannasville. This profile is identified as Pennsylvania report numbers 67-37106 and 67-37107 in table 4, Engineering Test Data:

Ap—0 to 9 inches, dark-brown (10YR 4/3) gravelly silt loam; weak, fine, granular structure; friable, nonsticky and nonplastic; 20 percent gravel; very strongly acid; abrupt, smooth boundary.

B1—9 to 11 inches, yellowish-brown (10YR 5/6) gravelly silt loam; moderate, medium, subangular blocky structure; friable, nonsticky and nonplastic; thin, discontinuous clay films on ped faces; 20 percent gravel; strongly acid; clear, wavy boundary.

B21t—11 to 22 inches, yellowish-brown (10YR 5/6) gravelly silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 25 percent gravel; strongly acid; clear, wavy boundary.

B22t—22 to 36 inches, yellowish-brown (10YR 5/6) gravelly silt loam; moderate, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, continuous clay films on ped faces; 30 percent gravel; strongly acid; clear, wavy boundary.

Bx—36 to 47 inches, yellowish-brown (10YR 5/4) gravelly loam; moderate, coarse, prismatic structure parting to moderate, thick, platy; firm and brittle, nonsticky and nonplastic; thin, continuous clay films on ped faces; 30 percent gravel; strongly acid; abrupt, wavy boundary.

IIC—47 to 60 inches, brown (10YR 5/3) gravelly sandy loam; massive; friable, nonsticky and nonplastic; 35 percent gravel; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 6 feet. Depth to the fragipan ranges from 30 to 40 inches. The gravel content ranges from 15 to 25 percent in the Ap horizon and from 10 to 30 percent in the B horizon. The Ap horizon ranges from brown (10YR 5/3) to dark grayish brown (10YR 4/2). The B2 and Bx horizons range from silt loam to gravelly loam.

Wooster soils are associated on the landscape with the moderately well drained Canfield soils, the somewhat poorly drained Ravenna soils, and the poorly drained Frenchtown soils.

Wooster gravelly silt loam, 3 to 8 percent slopes (WoB).—This soil is on convex hilltops on uplands. Included with it in mapping were a few areas of soils that have a surface layer of silt loam and small areas of Canfield soils. About three-fourths of the acreage of this Wooster soil has been cleared and cultivated. The major limitations are the erosion hazard, the high gravel content, and the restricted permeability. Capability unit IIe-2.

Wooster gravelly silt loam, 8 to 15 percent slopes (WoC).—This soil is on convex hillsides. Included with it in mapping were a few areas of soils that have a surface layer of silt loam and small areas of Canfield soils. About three-fifths of the acreage of this Wooster soil has been cleared and cultivated. The major limitations are the slope and the erosion hazard. Capability unit IIIe-3.

Wooster gravelly silt loam, 15 to 25 percent slopes (WoD).—This soil is on hillsides and valley sides. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Alton soils and Canfield soils.

About half the acreage of this Wooster soil has been cleared and cultivated. The major limitations are the slope and the erosion hazard. Capability unit IVe-1.

Wooster very stony silt loam, 8 to 25 percent slopes (WsD).—This soil is on hillsides and valley edges. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of nonstony Wooster soils and small areas of Canfield soils.

Nearly all the acreage of this Wooster soil is wooded. This soil is too stony for cultivation. The major limitation is the stoniness. Capability unit VIs-2.

Wooster very stony silt loam, 25 to 45 percent slopes (WsE).—This soil is on valley sides. It has a profile similar to the one described as representative of the series, but it has a natural sequence of surface horizons instead of a plowed surface layer. Stones and boulders 1 to 3 feet or more in diameter cover as much as 15 percent of the surface area.

Included with this soil in mapping were small areas of stony Hazelton soils.

Nearly all the acreage of this Wooster soil is wooded. This soil is too stony and too steep for cultivation. The major limitations are the steepness of slopes and the stoniness. Capability unit VIIs-2.

Formation, Morphology, and Classification of the Soils

The first part of this section explains the main factors that affect soil formation, and the second part tells how major soil horizons form. The third part defines the categories in the system of classification currently used and shows how the soils of Venango County are classified in that system. The fourth part contains three tables showing data on physical properties, chemical properties, and percolation rates for selected soils.

Formation of Soils

Soils form through the interaction of five major factors. These factors are climate, plant and animal life, parent material, topography, and time. The relative influence of each factor generally varies from place to place. Local variations in soils are due to differences in kind of parent material and in topography and drainage. In places one factor may dominate the formation of a soil and determine most of its properties.

Climate

The climate of Venango County is a humid, continental type marked by extreme seasonal temperature changes. The county has annual precipitation of about 40 to 42 inches and a mean annual temperature of about 49° F. Rainfall is nearly uniform during the growing season of May through September; it averages about 14 to 20 inches. The cool temperature is an important factor in the accumulation of organic matter in the surface layers of the soils. For more detailed information on climate, refer to the section "General Nature of the County."

Plant and animal life

Living organisms, such as plants, animals, bacteria, and fungi, contribute to a number of soil properties. Plants provide the bulk of soil organic matter which affects soil fertility and the color of the surface layer. Plant roots and such animals as earthworms, cicada, and burrowing rodents help to keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food. Man has greatly influenced the soil surface where he has cleared forests and plowed land. He has added fertilizers, mixed some of the soil horizons, and has moved soil material from place to place.

Parent material

Parent material is the unconsolidated mass from which soils form. It influences the initial mineralogical and chemical composition of the soil and the rate and balance of soil-forming processes.

In Venango County, soils formed in glacial till; sandstone, siltstone, and shale residuum; colluvium; glacial outwash; and recent alluvium. Table 10 shows the parent material in which the soils of Venango County formed. Soils that formed entirely in glacial till are in the northwestern half of the county. A compact subsoil is their distinguishing characteristic. Canfield, Hanover, and Alvira soils are examples. Examples of soils formed in residuum are Wharton and Hazleton soils. Soils that formed in colluvium occur at the base of slopes in the western part of the county. Ernest and Brinkerton soils are examples. Soils, such as Pope, Philo, and Atkins soils, that formed in water-laid material or recent alluvium have little or no profile development.

Topography

Venango County is in glaciated and unglaciated sections of the Allegheny Plateau of the Appalachian Highlands (*4*), mostly within the Allegheny River drainage system. In places the plateau is dissected to depths of several hundred feet. The walls of the Allegheny Valley rise sharply to the dissected plateau. In many places there is as much as 500 feet difference in elevation in one-fifth of a mile.

Within the plateau itself there may be a difference in elevation of 200 feet between the top of the plateau and lower elevations. Average elevations over much of the county are between 1,100 and 1,500 feet above sea level. The uplands are gently sloping over broad areas, and side slopes are sloping to steep. The shape of the land surface, commonly called the lay of the land; the slope; and the position in relation to the water table have had great influence on the formation of soils in the county. Sloping soils, which formed where runoff is medium to rapid, generally are well drained; have a bright-colored, unmottled subsoil; and in most places are leached to a greater depth than wetter soils in the same general area. More gently sloping soils, which formed where runoff is slower, are often wet for short periods of time and are mottled in the subsoil. Level soils or soils in slight depressions, which formed in areas where the water table is at or near the surface for long periods, show evidence of wetness to a marked degree. They have a dark-colored, thick surface layer and a strongly mottled or grayish subsoil. The length, steepness, and configuration of the slopes and the permeability of the soil material influence the kind of soil that forms from place to place. Local differences in soils are largely the result of differences in parent material and topography.

Time

The effect of climate, relief, and living organisms in changing parent material into soil is governed by the time these factors have been in action. The degree of profile development generally indicates the age of a soil.

The Pope, Philo, and Atkins soils are on flood plains and are younger than other soils of the county. Organic matter has accumulated in the surface layer, but the subsoil horizons are less distinct than those in soils of the uplands and terraces. The soils on glaciated uplands are of different ages. The soils that formed in older glacial material have moderate development in the B horizon and are strongly leached. Examples of this glacial era are the Hanover and Alvira soils. The soils that formed in younger glacial material, however, show moderate development in the B horizon and are moderately leached. Soils of the Canfield and Wooster series are examples. The oldest soils in the county are found in nonglaciated areas in the eastern part of the county. They have well-developed, distinct, argillic horizons. Wharton and Cavode are typical soils in this area.

Interrelationship of Soils

Table 10 shows the position, parent material, and drainage relationship of soils in Venango County.

Morphology of Soils

The first part of this subsection is a brief description of the horizon nonmenclature. The second part describes the processes involved in horizon development.

The results of the soil-forming factors are reflected in the different horizons developed in a soil profile. The soil profile extends from the surface downward to materials that are little altered by the soil-forming processes.

Most soils contain three major horizons, called A, B, and C (*20*). These major horizons may be further subdivided by the use of subscripts and letters to indicate changes within one horizon. An example would be the B2t horizon, a layer within the B horizon that contains translocated clay illuviated from the A horizon.

The A horizon is the surface layer. It consists of an A1 horizon, which has the largest accumulation of organic matter, and an A2 horizon, which has maximum leaching, or eluviation of clay and iron. The A2 horizon of some soils in Venango County shows the brownish colors that result from oxidation of iron.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation of clay, iron, aluminum, or other compounds leached from the A horizon. In some soils the B horizon formed by alteration in place rather than by illuviation. Alteration can be caused by the oxidation and reduction of iron or by the weathering of primary silicates to clay minerals. The B horizon has blocky or prismatic structure and is generally firmer and lighter colored than the A1 horizon but darker colored than the C horizon.

The C horizon is below the B horizon. It consists of materials that may have been modified by weathering, but it is relatively unaffected by the biological, physical, and many chemical changes involved in formation of the A and B horizons. If no B horizon has formed, the C horizon is directly below the A horizon.

Several processes affect the formation of soil horizons in the soils of Venango County. These include the accumulation of organic matter, the leaching of soluble salts, the reduction and translocation of iron, the formation of soil structure, and some translocation and loss of clay minerals, aluminum, silica, and iron. These processes are continually taking place, generally at the same time throughout the profile.

The accumulation of organic matter takes place with the decomposition of plant residue. This process darkens the surface layer and helps to form the A1 horizon.

It is believed that in order for soils to have distinct soil horizons, lime and other soluble salts are leached before the translocation of clay minerals. Many factors affect this leaching, such as the kinds and amount of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile.

An important process of soil horizon formation in Venango County is the formation and translocation of clay minerals. The kinds and amount of clay minerals in a soil profile depend on the kinds and amount of minerals in the parent material. The amount of clay varies from one soil horizon to another. Clay minerals are generally moved from the A horizon down into the B horizon. Evidence of such movement is greater clay content of the B horizon and clay films on ped faces, in pores, and along root channels in many soils. Clay films in the B22t horizon of Wharton silt loam are evidence of clay mineral translocation.

The oxidation and reduction of iron are associated mainly with the height of the water table. The yellowish-

TABLE 10.—*Position, parent material, and drainage relationships of the soils*

Parent material	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained
SOILS OF UPLANDS				
Glacial till:				
Moderately leached	Wooster	Canfield	Ravenna	Frenchtown.
Strongly leached	Hanover	Hanover	Alvira	Frenchtown.
Shale and siltstone	Gilpin	Wharton	Cavode	Armagh.
Colluvium		Ernest		Brinkerton.
Sandstone, siltstone, and shale	Hazleton	Cookport		
SOILS OF TERRACES				
Glacial outwash:				
Silt loam over stratified gravel, sand, and silt.	Allegheny	Monongahela	Tyler	
Stratified gravel, sand, and silt	Alton		Rexford	Rexford.
SOILS OF THE FLOOD PLAINS				
Recent alluvium	Pope	Philo		Atkins.

brown B horizon of such well-drained soils as Wooster and Gilpin soils indicates the presence of oxidized iron compounds and the absence of a water table within the profile. Brownish or yellowish soils mottled with gray indicate some reduction of iron resulting from a seasonal high water table. Poorly drained soils, such as Brinkerton soils, have a grayish B horizon, which is indicative of iron reduction caused by a year-round high water table.

A fragipan has formed in the subsoil of many moderately well drained and somewhat poorly drained soils. Hanover, Alvira, and Canfield soils are examples. The fragipan is firm and brittle when moist and hard when dry. Clay, silica, and oxides of aluminum are the most likely cementing agents that cause the brittleness and hardness. Soil particles are tightly packed so that bulk density is high and pore space is low.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. 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 us to understand their behavior and their response to manipulation. First through classification, and then through 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 managing farms, fields, and woodlands; in developing rural areas; in engineering work; 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. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*21*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis are grouped together. In table 11, the soil series of Venango County are placed in three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER.—Ten soil 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). As shown in table 11, four soil orders are represented in Venango County: Inceptisols, Ultisols, Alfisols, and Entisols.

SUBORDER.—Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes that have the greatest genetic 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 waterlogging or soil differences that result from the climate or vegetation. The names of suborders have two syllables, the last of which indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol). Suborders are not shown in table 11.

GREAT GROUP.—Suborders are divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; those that contain a pan that interferes

TABLE 11.—*Classification of soil series into higher categories*

Series	Family	Subgroup	Order
Allegheny	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Alton	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Alvira	Fine-loamy, mixed, mesic	Aeric Fragiaquults	Ultisols.
Armagh	Clayey, mixed, mesic	Typic Ochraquults	Ultisols.
Atkins	Fine-loamy, mixed, acid, mesic	Typic Fluvaquents	Entisols.
Brinkerton	Fine-silty, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Canfield	Fine-loamy, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Cavode	Clayey, mixed, mesic	Aeric Ochraquults	Ultisols.
Cookport	Fine-loamy, mixed, mesic	Aquic Fragiudults	Ultisols.
Ernest	Fine-loamy, mixed, mesic	Aquic Fragiudults	Ultisols.
Frenchtown	Fine-loamy, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Gilpin	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Hanover	Fine-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Hazleton	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Monongahela	Fine-loamy, mixed, mesic	Typic Fragiudults	Ultisols.
Philo	Coarse-loamy, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Pope	Coarse-loamy, mixed, mesic	Fluventic Dystrochrepts	Inceptisols.
Ravenna	Fine-loamy, mixed, mesic	Aeric Fragiaqualfs	Alfisols.
Rexford	Coarse-loamy, mixed, mesic	Aeric Fragiaquepts	Inceptisols.
Strip mines	Loamy-skeletal, mixed, acid, mesic	Typic Udorthents	Entisols.
Tyler	Fine-silty, mixed, mesic	Aeric Fragiquults	Ultisols.
Wharton	Clayey, mixed, mesic	Aquic Hapludults	Ultisols.
Wooster	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.

with the growth of roots or movement of water, or both; and those that have a thick, dark-colored surface horizon. 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 Haplaquents (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *ent*, from Entisol). The great group is not shown separately in table 11, because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are divided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of one group and also one or more properties of another great group, suborder, or order. Subgroups may also be established if soil properties intergrade outside the range of any 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 Hapludults (a typical Hapludult). Allegheny soils are Typic Hapludults.

FAMILY.—Soil families are separated within a subgroup primarily on the basis of properties important to growth of plants or 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 as family differentiae (see table 11). An example is the fine-loamy, mixed, acid, mesic family of Typic Fluvaquents.

SERIES.—The series has the narrowest range of characteristics of the categories in the classification system. It is defined under the heading "How This Survey Was Made."

Laboratory Characterization Data [6]

In Venango County, soils of the Alvira, Canfield, Cookport, and Monongahela series were sampled for laboratory analysis. Tables 12, 13, and 14 show physical, chemical, mineralogical, and percolation data resulting from the analysis. Descriptions of the soils sampled are contained in the section "Descriptions of the Soils."

Methods of analysis

Coarse fragments larger than 19 millimeters (3/4 inch) in diameter were sieved from each sample, weighed in the field, and discarded. At the laboratory the samples were crushed with a wooden rolling pin and sieved to remove remaining coarse fragments larger than 2 millimeters. Coarse-fragment data are presented as percent by weight, based on the weight of coarse fragments plus air-dried soil. Volume percentage of coarse fragments was calculated by first multiplying the weight percentage by the bulk density of the total soil mass and then dividing by the density of the coarse fragments. Particle-size distribution of material smaller than 2 millimeters was determined by the pipette method (*8*) and is presented as weight percent of oven-dried material.

When possible, triplicate 1- by 2-inch cores were taken from each horizon with a modified Uhland core sampler (*18, 19*). Bulk density of the material smaller than 2 millimeters in the cores was determined by subtracting the weight and volume of coarse fragments from the total weight and volume. Bulk density of the total soil mass was calculated by taking into account the weight percent (bulk sample) and density of the coarse fragments and the weight percent (bulk sample) and bulk density of the material smaller than 2 millimeters. Density of coarse fragments was measured on the density of those found in the cores. Both bulk-density values correspond to moisture content as found at sampling time.

Cores were also equilibrated at 1/3-bar on a tension plate (*19*), and percent moisture by weight was determined and calculated on the basis of material smaller than 2 millimeters with the assumption that no water was in the coarse fragments. The percent moisture by weight of sieved material smaller than 2 millimeters was determined at 15 bars in a pressure membrane apparatus (*19*). Available moisture capacity was estimated by subtracting percent moisture at 15-bar tension from that at 1/3-bar tension and multiplying by the percentage of material smaller than 2 millimeters and the bulk density of the total soil mass in order to express the available water as a percent by volume.

Organic carbon content was determined by a modification (*14*) of the Walkley-Black wet oxidation method. The Kjeldahl method (*3*) was used for determination of total nitrogen content.

Calcium, magnesium, sodium, and potassium were extracted with neutral 1*N* ammonium acetate solution (*14*), except in calcareous samples, where a barium chloride-triethanolamine extraction was used for calcium and magnesium (*7*). Calcium and magnesium were determined by atomic absorption spectrophotometry, and sodium and potassium were determined by flame emission spectrophotometry. A barium chloride-triethanolamine extract, pH 8.1, was back titrated with 0.05*N* hydrochloric acid solution to determine extractable acidity (*11*). Cation exchange capacity is the sum of extractable calcium, magnesium, sodium, potassium, and acidity (aluminum is included in the acidity measurement). Aluminum was extracted with 1*N* potassium chloride and determined by the aluminon method (*6*).

Soil pH was measured with a pH meter and glass electrode on samples that had been air dried using a 1:1 soil to solution ratio.

Clay minerals were identified by X-ray diffraction using Geiger counter and chart recorder using a copper target. Before the 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 (*12*), and iron content was determined colorimetrically with orthophenanthroline. Clay (particles smaller than 0.002 millimeter) was separated with a centrifuge; one portion was then saturated with potassium ions and one portion with magnesium ions. The suspensions of clay were placed on

[6] Samples were collected and laboratory determinations and interpretation of data were made by R. P. MATELSKI, R. L. CUNNINGHAM, R. W. RANNEY, E. J. CIOLKOSZ, and the staff of the Pennsylvania State University Soil Characterization Laboratory.

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 slide was heated to 300° C. and 550° C., successively. Diffraction traces were interpreted on the basis of peak height and relationship to known soil-clay mixtures by a method developed by Dr. L. J. Johnson, associated professor of soil mineralogy. Estimates were made to the nearest 5 to 10 percent.

The percolation rates shown in table 14 were determined as outlined by the U.S. Public Health Service (*23*). Four holes of 4-inch diameter and four holes of 12-inch diameter were dug to a 36-inch depth near each sampling site. After presoaking the previous day, the depth of water in the holes was adjusted to 6 inches from the bottom and the rate of water level decrease was measured in inches per hour while maintaining the water level between 4 and 6 inches from the bottom. The test was run continuously for several hours.

Summary of data

Particle-size distribution and coarse-fragment content.—The size of the various mineral particles in these soils is governed chiefly by the parent material in which the soils formed. The Canfield and Alvira soils inherit the rock fragments, sand, silt, and clay that were in the parent glacial till. Monongahela soils formed in sediments deposited by moving water and, thus, have well-sorted particle-size distribution. Cookport soils formed in residuum of weathering sandstone. The sandstone, more nearly siltstone at this particular site, has been broken down by weathering to primary mineral particles. Some unweathered pieces remain as coarse fragments or coarse sand. Alteration and breakdown of the primary mineral particles themselves have been relatively minor in all these soils. Movement of clay downward in the soil is indicated by the presence of clay films and by the slightly higher clay content in the B horizon, as shown in table 12. Clay accumulation is not strongly evident in most soils of Venango County.

Content of coarse fragments in these soils is not a limitation for most uses. The medium texture of the fine earth (smaller than 2 millimeters) is favorable for most uses. The chief limiting factors in these soils are explained in subsequent paragraphs.

Bulk density.—Bulk density is an expression of the weight of soil (oven-dry basis) per unit of bulk volume (volume including pore space). Low bulk-density values of 1.25 or less indicate a high percentage of pores and a high degree of aeration, unless soil is waterlogged. Soils that have low bulk density are generally desirable for farming. The subsoil generally has a bulk density of at least 1.4 grams per cubic centimeter, based on material smaller than 2 millimeters. Bulk-density values of 1.7 or higher in medium-textured and fine-textured horizons indicate compactness and restricted permeability. All the soils listed in table 12 have fine earth bulk densities near or above 1.7 grams per cubic centimeter in some part of the subsoil. This is typical of the dense, slowly permeable fragipan layer found in many soils of the county. The fragipan impedes free drainage of water through the soil and also prevents penetration of most plant roots. The fragipan places major limitation on these soils for many uses.

The bulk density of the whole soil, including coarse fragments, is not a good indicator of soil compactness, since the magnitude varies with the amount and density of the fragments. It would be useful, for instance, in estimating the total weight of material taken from an excavation of known volume.

Available moisture capacity.—The 1/3-bar moisture determination is a rough approximation of the field moisture capacity, or the amount of water held against gravity after drainage through the soil has essentially stopped. The 15-bar moisture determination is an approximation of the permanent wilting point, or the soil water content at which plants wilt without recovery. Subtraction of the moisture held at 15 bars from that held at 1/3-bar tension gives an estimate, on a weight-percentage basis, of the moisture available to plants. In table 12 this available moisture capacity figure is reported on a volume basis or in inches of water per inch of soil and has been adjusted to show the effect of coarse fragments, which hold little or no available water.

Available moisture capacity is generally moderately high, which is typical for medium-textured soils. These data must be used very carefully, however, in any attempt to relate them to moisture supplies for plants under field conditions. It should be remembered that plant roots generally penetrate very little of the fragipan, or Bx horizon, so that the effective depth of soil from which the plants can use water is reduced where a fragipan is present. On the other hand, a fragipan restricts free drainage of water and causes soils to remain wet for longer than normal periods in spring or after heavy rain.

Organic carbon and nitrogen.—For most surface horizons, the organic carbon value multiplied by two gives an estimate of the content of total organic matter. For example, the Ap horizon of the Alvira soil contains slightly more than 4 percent organic matter by weight and about 96 percent mineral material. The percentage of organic matter on a volume basis would be perhaps two or three times more, since organic matter is much less dense than soil mineral material. Organic matter, mostly dark, humified material, has beneficial effects on the structure and workability and the nutrient-holding capacity. Organic matter is concentrated in the surface layer, where plants and other organisms leave most of their remains for decay.

Soil organic matter contains nitrogen, which becomes available to plants only when released by microbial activity. The surface horizon of a typical farm soil has a carbon-nitrogen ratio of 10 to 12. Soils under forest, such as the Cookport soils shown in table 13, have a higher carbon-nitrogen ratio because the carbonaceous material decomposes more slowly in a forest environment. The lower carbon-nitrogen ratio in the subsurface horizon is probably due to fixing of nitrogen on clay minerals.

Extractable cations.—Some soil mineral and organic particles absorb positively charged ions (cations), including calcium, magnesium, sodium, and potassium (bases); as well as acidic cations, including aluminum and hydrogen ions (acidity reported in table 13 includes aluminum). All these cations are held in the soil against leaching by water but may be displaced by other cations in solution.

TABLE 12.—*Physical*

[Dashes in columns indicate material

Soil series and sample number	Horizon	Depth from surface	Particle-size distribution (less than 2.0 mm.): Very coarse sand (2.0–1.0 mm.)	Coarse sand (1.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.005 mm.)	Silt (0.005–0.002 mm.)	Total sand (2.0–0.05 mm.)	Total silt (0.05–0.002 mm.)	Total clay (less than 0.002 mm.)
Alvira:		*In.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
S66 Pa 61-4-1	Ap	0–7	1. 0	1. 2	1. 8	1. 3	2. 9	41. 7	8. 3	8. 2	68. 9	22. 9
2	B1	7–14	1. 3	1. 6	2. 3	3. 8	4. 7	37. 4	8. 0	13. 5	62. 3	24. 0
3	B2t	14–21	. 2	1. 5	3. 7	4. 4	6. 0	35. 6	7. 0	15. 8	61. 1	23. 1
4	Bx1g	21–29	1. 2	2. 5	5. 7	7. 5	7. 9	27. 9	6. 7	24. 7	51. 0	24. 4
5	Bx2g	29–37	2. 9	4. 1	8. 5	11. 3	10. 7	22. 7	9. 0	37. 5	41. 1	21. 3
6	Bx3g,Bx2g	37–43	2. 7	3. 4	8. 0	11. 6	11. 4	23. 3	8. 9	37. 1	42. 8	20. 2
7	Bx4g,Bx2g	43–55	1. 9	3. 1	9. 1	11. 7	11. 6	23. 3	5. 8	37. 2	42. 2	20. 6
8	Bx3g	55–72	4. 7	5. 2	10. 3	12. 8	11. 5	21. 1	5. 5	44. 5	39. 6	15. 9
Canfield:												
S66 Pa 61-7-1	Ap	0–10	1. 2	2. 0	7. 5	3. 7	2. 1	38. 4	11. 4	16. 4	62. 4	21. 2
2	B1	10–13	. 9	1. 8	1. 9	2. 0	2. 8	42. 3	11. 0	9. 5	67. 5	23. 0
3	B21t	13–19	. 8	1. 2	1. 6	2. 8	3. 6	35. 4	6. 3	10. 0	61. 2	28. 8
4	B22t	19–22	1. 4	2. 2	5. 4	7. 0	7. 3	22. 1	4. 8	23. 4	50. 2	26. 4
5	Bx1g	22–37	2. 0	4. 3	9. 9	17. 3	15. 7	13. 2	2. 9	49. 2	36. 0	14. 8
6	IIBx2	37–47	5. 5	6. 6	17. 6	19. 0	13. 6	12. 3	1. 9	62. 3	27. 2	10. 5
7	IIB31	47–57	4. 6	7. 8	17. 1	19. 2	12. 0	12. 9	2. 4	60. 7	27. 3	12. 1
8	IIB32	57–62	5. 9	7. 7	16. 1	17. 6	14. 7	11. 5	2. 0	62. 0	30. 9	7. 1
Cookport:												
S66 Pa 61-2-1	O1	1–½	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
2	O2	½–0	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
3	A1	0–2	4. 4	4. 2	3. 7	6. 3	18. 9	22. 5	3. 1	37. 5	41. 4	21. 1
4	A2	2–6	2. 6	2. 0	2. 1	5. 9	22. 3	26. 4	7. 9	34. 9	45. 6	19. 5
5	B1	6–13	3. 2	3. 6	3. 4	7. 3	22. 1	22. 7	6. 8	39. 7	41. 9	18. 3
6	B2t	13–20	3. 4	4. 1	4. 3	7. 7	19. 8	21. 0	8. 1	39. 5	37. 3	23. 3
7	Bx1g	20–28	1. 8	2. 6	3. 6	7. 0	20. 8	21. 7	7. 3	35. 8	39. 1	25. 1
8	Bx2g	28–38	2. 5	3. 0	3. 4	6. 5	20. 5	21. 0	6. 5	35. 8	40. 5	23. 6
9	C	38–60	6. 0	4. 6	5. 1	7. 9	21. 4	18. 5	6. 4	44. 8	36. 3	18. 9
Monongahela:												
S66 Pa 61-10-1	Ap	0–10	. 2	2. 0	4. 7	5. 2	2. 8	41. 7	7. 8	14. 9	65. 9	19. 2
2	B1	10–14	. 5	1. 3	1. 4	1. 2	2. 2	40. 7	10. 5	6. 5	70. 6	22. 8
3	B2t	14–26	. 4	. 8	2. 2	2. 4	1. 9	41. 9	8. 0	7. 7	67. 7	24. 6
4	Bx1	26–38	. 8	1. 4	4. 5	5. 8	4. 9	30. 2	4. 4	17. 4	64. 1	18. 4
5	Bx2	38–53	. 5	1. 9	5. 6	6. 8	5. 7	29. 6	4. 9	20. 5	64. 1	15. 3
6	IIB3	53–67	1. 9	6. 0	16. 8	16. 6	11. 9	14. 5	3. 4	53. 2	35. 0	11. 8
7	IIIC	67–72	2. 9	5. 5	16. 6	21. 7	17. 3	4. 1	1. 4	64. 1	32. 7	3. 2

[1] Figures not adjusted for effects of a fragipan or seasonal high water table (see discussion in section on Laboratory Characterization Data.)

properties of selected soils

not present or determination not made]

Textural class	Coarse fragments (larger than 2.0 mm.)				Bulk density at field moisture content		Moisture held at—		Available moisture (total soil mass) [1]
	Larger than 19 mm.	19–2.0 mm.	Total by weight	Total by volume	Less than 2 mm. material in cores	Total soil mass including coarse fragments	⅓-bar tension (less than 2 mm. material in cores)	15-bar tension (less than 2 mm. material sieved)	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*G./cc.*	*G./cc.*	*Pct.*	*Pct.*	*In./in. of soil*
Silt loam	3	5	8	4	1. 19	1. 25	26. 6	11. 9	0. 16
Silt loam	1	12	13	8	1. 32	1. 40	26. 0	10. 8	. 18
Silt loam	2	13	15	10	1. 44	1. 53	23. 9	10. 1	. 17
Silt loam	12	20	32	21	1. 42	1. 64	20. 3	10. 2	. 10
Loam	7	19	25	17	1. 49	1. 65	19. 5	9. 1	. 13
Loam	8	16	24	18	1. 70	1. 84	16. 0	8. 2	. 11
Loam	2	17	19	15	1. 80	1. 90	15. 6	8. 1	. 11
Loam	12	21	34	28	1. 82	1. 98	15. 0	6. 7	. 10
Silt loam	5	6	11	7	1. 27	1. 33	28. 7	8. 2	. 23
Silt loam	2	7	9	6	1. 42	1. 47	24. 1	8. 3	. 21
Silty clay loam	5	8	13	8	1. 32	1. 41	26. 7	7. 8	. 22
Silt loam	2	12	13	8	1. 31	1. 39	22. 8	3. 8	. 23
Loam	14	27	41	31	1. 56	1. 89	19. 2	2. 9	. 17
Fine sandy loam	13	34	47	34	1. 45	1. 79	14. 7	3. 0	. 10
Fine sandy loam	15	31	46	38	1. 66	1. 90	12. 1	4. 7	. 07
Fine sandy loam	10	30	40	34	1. 91	2. 10	15. 3	2. 5	. 16
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Loam	----------	5	5	3	----------	----------	----------	----------	----------
Loam	1	12	13	5	. 87	. 94	35. 6	10. 8	. 19
Loam	1	19	20	13	1. 36	1. 49	21. 2	6. 2	. 17
Loam	1	28	28	19	1. 50	1. 69	18. 8	9. 4	. 11
Loam	----------	9	9	6	1. 64	1. 70	18. 3	10. 1	. 13
Loam	2	13	15	11	1. 65	1. 73	19. 4	8. 4	. 17
Loam	4	31	35	27	1. 58	1. 79	17. 4	6. 5	. 13
Silt loam	3	2	5	3	. 96	. 98	31. 4	9. 4	. 20
Silt loam	----------	2	2	1	1. 42	1. 43	24. 9	10. 8	. 20
Silt loam	----------	17	17	11	1. 50	1. 62	23. 5	10. 8	. 16
Silt loam	----------	5	5	3	1. 56	1. 59	20. 2	8. 1	. 18
Silt loam	1	8	8	6	1. 68	1. 73	17. 4	6. 7	. 17
Fine sandy loam	1	15	16	12	1. 72	1. 80	12. 6	4. 4	. 12
Fine sandy loam	5	18	23	17	1. 49	1. 60	4. 6	1. 9	. 03

TABLE 13.—*Chemical*

[Dashes in column indicate material not present or

Soil series and sample number	Horizon	Depth from surface	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Calcium-magnesium ratio	Extractable cations (milliequivalents per 100 grams of soil)					
							Calcium	Magnesium	Sodium	Potassium	Total acidity	Aluminum [1]
Alvira:												
S66 Pa		*In.*	*Pct.*	*Pct.*								
61-4-1	Ap	0-7	2.06	0.18	11.1	5.2	2.6	0.5	0.1	0.3	25.1	2.9
2	B1	7-14	.38	.06	6.6	6.5	2.6	.4	.1	.1	14.3	4.2
3	B2t	14-21	.21	--------	--------	3.4	2.4	.7	.1	.1	13.7	4.2
4	Bx1g	21-29	.17	--------	--------	1.9	1.9	1.0	.1	.2	14.6	4.7
5	Bx2g	29-37	.12	--------	--------	.6	1.1	1.9	.1	.1	11.9	4.5
6	Bx2g	37-43	.11	--------	--------	.4	.8	1.8	.1	.1	10.9	3.3
7	Bx2g	43-55	.12	--------	--------	.4	.8	1.8	.1	.1	11.2	1.7
8	Bx3g	55-72	.12	--------	--------	.4	.7	1.7	.1	.1	10.0	1.7
Canfield:												
S66 Pa												
61-7-1	Ap	0-10	2.39	.19	1.28	8.0	2.4	.3	.1	.1	19.1	2.6
2	B1	10-13	.47	.06	8.5	4.0	2.4	.6	.1	.1	11.5	2.0
3	B21t	13-19	.30	.04	6.9	3.7	4.1	1.1	.2	.1	12.9	1.9
4	B22t	19-22	.18	--------	--------	3.1	6.1	2.0	.2	.2	8.4	.4
5	Bx1g	22-37	--------	--------	--------	3.0	6.3	2.1	.2	.2	5.0	<.1
6	IIBx2	37-47	.06	--------	--------	4.1	4.5	1.1	.1	.1	1.6	<.1
7	IIB31	47-57	.18	--------	--------	2.5	[5] 6.0	[5] 2.4	.1	.1	1.8	<.1
8	IIB32	57-62	.17	--------	--------	5.6	[5] 5.6	[5] 1.0	.1	<.1	1.5	<.1
Cookport:												
S66 Pa												
61-2-1	O1	1-½	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2	O2	½-0	47.63	1.73	27.5	--------	--------	--------	--------	--------	--------	--------
3	A1	0-2	18.13	.62	29.2	3.0	1.2	.4	.1	.5	--------	8.9
4	A2	2-6	2.37	.14	16.5	--------	.3	<.1	.1	.2	21.4	3.4
5	B1	6-13	.44	.04	10.1	--------	.2	<.1	.1	.1	9.6	2.2
6	B2t	13-20	.25	--------	--------	--------	.2	<.1	.1	.1	7.8	3.2
7	Bx1g	20-28	.16	--------	--------	--------	.3	<.1	.1	.1	8.7	3.5
8	Bx2g	28-38	.21	--------	--------	--------	.4	<.1	.1	.1	10.6	3.5
9	C	38-60	.32	.03	10.6	--------	.4	<.1	.1	.1	10.4	3.5
Monongahela:												
S66 Pa												
61-10-1	Ap	0-10	2.09	.20	10.7	3.0	.3	.1	.1	.2	20.9	3.4
2	B1	10-14	.51	.07	7.3	5.0	.5	.1	.1	.1	13.0	3.5
3	B2t	14-26	.33	.05	6.0	4.8	2.4	.5	.1	.2	13.5	3.7
4	Bx1	26-38	.14	--------	--------	2.0	2.0	1.0	.1	.2	10.7	3.7
5	Bx2	38-53	.14	--------	--------	1.1	1.3	1.2	.1	.2	9.5	3.5
6	IIB3	53-67	.22	--------	--------	.9	.7	.8	.1	.1	8.9	1.8
7	IIC	67-72	.12	--------	--------	1.0	.3	.3	.1	<.1	5.3	.8

[1] Extractable aluminum is included in total acidity.
[2] Chlorite-illite.
[3] Vermiculite-montmorillonite.

properties of selected soils

determination not made. The symbol < means less than]

Cation exchange capacity (sum)	Base saturation (sum)	Reaction (pH) (1:1 soil solution ratio)			Free iron oxides	Mineral composition of clay fraction (percent of less than 0.002 mm. material)					
		Water	1*N* KCl	0.1*M* $CaCl_2$		Kaolinite	Illite	Vermiculite	Montmorillonite	Chlorite	Interstratified
Meq/100 g. soil	*Pct.*				*Pct. Fe_2O_3*						
28. 6	12. 3	4. 9	3. 7	4. 4	2. 3	25	25	25	5	5	[2,3] 15
17. 5	18. 3	4. 7	3. 9	3. 8	2. 1	15	30	20	10	----------	[2,3] 25
17. 0	19. 4	4. 8	3. 7	3. 4	2. 8	15	35	20	10	----------	[3] 20
17. 8	18. 0	4. 6	3. 7	4. 0	3. 1	15	35	15	15	----------	[2,3] 20
15. 1	21. 2	4. 8	3. 8	4. 1	2. 9	15	55	10	5	----------	[3,4] 15
13. 7	20. 4	4. 7	3. 7	4. 0	2. 3	15	60	10	5	----------	[3,4] 10
14. 0	20. 0	4. 8	3. 9	4. 0	2. 7	15	55	10	5	----------	[3,4] 15
12. 6	20. 6	4. 9	3. 9	4. 1	2. 5	15	60	15	5	----------	[3,4] 5
22. 0	13. 2	5. 0	3. 9	4. 2	2. 0	15	20	40	5	----------	[2] 20
14. 7	21. 8	5. 0	3. 8	4. 3	2. 1	15	20	25	10	----------	[2,3] 30
18. 4	29. 9	5. 3	3. 6	4. 4	3. 3	15	20	25	10	5	[2,3] 25
16. 9	50. 3	5. 3	4. 2	4. 9	3. 4	15	25	15	15	5	[3] 25
13. 8	63. 8	6. 5	4. 9	5. 4	2. 1	10	40	15	15	----------	[3] 20
7. 4	78. 4	6. 2	5. 2	6. 2	1. 9	15	55	15	5	----------	[4] 10
10. 4	82. 7	7. 7	5. 8	6. 5	1. 6	15	60	20	----------	----------	[4] 5
88. 3	81. 9	8. 2	6. 8	7. 0	1. 3	15	60	20	----------	----------	[4] 5
----------	----------	4. 0	3. 5	3. 4	----------	----------	----------	----------	----------	----------	----------
----------	----------	3. 9	3. 1	3. 0	----------	----------	----------	----------	----------	----------	----------
----------	----------	3. 5	3. 1	3. 0	1. 4	30	20	40	----------	----------	[2,4] 10
22. 1	3. 2	4. 4	4. 1	4. 2	2. 1	25	25	30	----------	5	[2,4] 15
10. 1	5. 0	4. 4	4. 0	3. 8	2. 1	35	25	20	5	5	[2,4] 10
8. 3	6. 0	4. 4	3. 3	3. 7	3. 1	45	30	10	5	----------	[2,4] 10
9. 3	6. 5	4. 5	4. 0	3. 4	2. 9	50	35	5	----------	----------	[4] 10
11. 3	6. 2	4. 6	3. 7	4. 1	2. 3	45	40	10	----------	----------	[4] 5
11. 1	6. 3	4. 7	4. 0	4. 1	2. 3	35	45	10	----------	----------	[2] 10
21. 6	3. 2	4. 1	3. 7	3. 9	2. 2	15	25	35	----------	5	[2] 20
13. 8	5. 8	4. 4	3. 8	3. 7	2. 8	15	25	25	10	5	[2,3] 20
16. 7	19. 2	4. 7	3. 7	3. 5	2. 9	15	35	10	15	----------	[2,3] 25
14. 0	23. 6	4. 7	3. 6	3. 6	3. 2	15	35	10	15	----------	[3] 25
12. 3	22. 8	4. 2	3. 3	3. 3	2. 6	20	40	10	10	----------	[3] 20
10. 6	16. 0	5. 2	3. 7	3. 9	2. 5	20	40	10	15	----------	[2,3] 15
6. 1	13. 1	5. 6	3. 8	3. 9	2. 0	25	40	10	10	----------	[3] 15

[4] Vermiculite-illite.
[5] Extracted with BaC12-triethanolamine solution.

TABLE 14.—*Percolation data for selected soils*

[For each soil four holes 36 inches deep and 4 inches in diameter and four holes 36 inches deep and 12 inches in diameter were used]

Soil series	Percolation rate in inches per hour		
	Minimum	Maximum	Median
Alvira	0. 0	1. 2	0. 2
Canfiel	0. 1	5. 3	0. 2
Cookport	0. 1	10. 3	1. 5
Monongahela	0. 0	1. 7	0. 5

Each soil has a particular capacity to hold cations, and the total of extractable cations (bases and acidity) is a measure of the cation exchange capacity of a given soil sample. Base saturation is the percentage of the cation exchange capacity that is satisfied by bases.

Alvira and Canfield soils formed directly in glacial till, and the Monongahela soil formed in outwash material deposited by glacial melt water. According to geologists, this drift was slightly calcareous (containing lime) throughout (*24*, *17*).

As soils form in calcareous material in humid climates, the acids from biologic activity and carbon dioxide act to dissolve the carbonates (lime), which are slowly leached out by percolating water. At this point the cation exchange capacity of the soil material is highly saturated by magnesium, calcium, sodium, and potassium ions. When carbonates are completely leached out, the natural acids, hydrogen and aluminum, begin to displace the bases that are slowly leached away. This entire process starts near the surface and continues in many cases to great depths as time goes on.

The length of time required for such processes can be estimated by referring to findings of glacial geologists. The Canfield soil formed in Kent till (*17*), which is believed to have an age of slightly more than 23,000 years (*24*). Relatively high base saturation and alkaline reaction at a depth of 57 inches indicate that the leaching process is by no means finished. The Alvira soil formed in Titusville till, which may be about 40,000 years old (*24*). In this case the base saturation is low to the bottom of the sampling pit, and the reaction is very strongly acid to extremely acid. Geologists place no specific age estimate on the deposits in which the Monongahela soil formed. The base saturation is low, however, indicating that the material has been in place long enough for extensive leaching of the glacial outwash.

The Cookport soil formed in residuum from sandstone and siltstone beyond the border of any recorded glacial advance. This soil is probably much older than the other soils, and the very low base saturation throughout its depth indicates that it is strongly leached. It should be emphasized that all soils of the area are naturally low in base saturation at the surface, and deviation from this rule is probably due to liming by farmers. Base saturation is an indicator of fertility because the bases are plant nutrients and excessive acidity is detrimental to plant growth.

pH value.—The base saturation and pH value are roughly related. It can be seen that pH is low where base saturation is low and vice versa. The pH in water is most often used in the United States. pH is sometimes measured in salt solutions to help eliminate errors due to seasonal differences in salt concentration. The pH in a salt solution is usually lower than that in water. Measurement of pH can be done quickly and easily on any soil, and it is the most common chemical measurement. The pH is useful for a number of fertility interpretations related to availability and amount of plant nutrients, especially if detailed characterization, such as that in table 13, is available for related soils.

Free iron oxides.—Iron oxide percentages are low in these soils, and the slight variations are of no known practical significance. Iron oxides chemically bound within silicate mineral structures are not measured by the "free iron" method, and total iron values may be much higher.

Clay minerals.—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 many soil parent materials, contains potassium in a form not readily available to plants. When weathered in soils, illite very slowly loses its potassium and is transformed to vermiculite, montmorillonite, or interstratified mixtures of these minerals and chlorite. Large percentages of kaolinite indicate that the soil material is highly weathered.

Montmorillonite and vermiculite have high cation exchange capacities compared to the other minerals and, therefore, enhance the soil's ability to store some plant nutrients in an available form. Excessive amounts of these minerals and high clay content are generally undesirable because they cause shrinking and swelling and may cause unfavorable physical conditions.

The soils listed in table 13, except the Cookport soil, are dominated by illite. The Cookport soil contains slightly more kaolinite than illite, which could be due to its greater degree of weathering or to a parent rock of more kaolinite than illite. In all cases, more vermiculite and less illite are found near the surface than in the subsoil. This is typical of many soils and demonstrates the tendency for illite to lose its potassium and alter to vermiculite near the surface where weathering is strongest. No significant difference in clay mineral weathering can be seen between the Alvira soil (about 40,000 years old) and the Canfield soil (about 23,000 years old). Apparently, a much greater time span in this climate is required to change the present weathering state.

Table 14 shows the percolation rates measured at the sites sampled for characterization. It was stated earlier that all the soils have a fragipan of slow permeability. The percolation rates are generally low because of this. These tests were run in July of a dry year and probably gave higher results than normal. The Cookport site, for instance, gave the best percolation rate of the fragipan soils, but tests on Cookport sites in an adjacent county during a wet summer had water rising in the percolation holes instead of being absorbed.

Percolation rates are widely used to judge suitability of soils for onsite sewage disposal. In general, the soils tested here have severe limitations for this use. The wide range of percolation rates obtained indicates that a detailed study of soil characteristics and landscape position should always accompany percolation testing when evaluating a site for onsite sewage disposal.

General Nature of the County

This section provides general information about the water supply, the geology, and the climate of Venango County. It also tells about the farming and the history and development.

Venango County was formed March 12, 1800 from parts of Allegheny and Lycoming Counties. The name originated from the Indian name for French Creek.

The earliest industry of importance was the iron industry. At one time there were 32 iron furnaces operating in the county, producing 12,000 tons of pig iron per year. With the discovery of iron ore in the Great Lakes region, this industry was abandoned around 1850. The first oil well was drilled in Venango County in 1859 (fig. 15), and oil became the county's main industry. Many oil-oriented industries have been established in the county and moved elsewhere. For many years the world's largest oil refinery was located near Franklin. Although the oil industry has declined, it still is one of the major industries of the county. In 1968 the county was second in the State in number of producing oil wells and third in the State in production of crude oil (*13*).

At present, the manufacture of machinery is the most important industry in the county.

In the past, farming was very important in the county. In 1882, 68 percent of the acreage was farmed. In 1969 only 17 percent, or 71,384 acres, was farmed. The main crops are corn, wheat, and hay, which are fed to livestock on the farms and marketed in the form of dairy products, meat, and poultry.

Water Supply

Venango County lies entirely within the Ohio River drainage basin and is drained mostly by the Allegheny River and its tributaries. Small areas are drained by Wolf Creek and Slippery Rock Creek, which are tributaries of the Beaver River. The Allegheny River, an important feature, winds its way through the county for approximately 60 miles. The steep valley sidewalls are wooded and scenic and make an attractive background for the summer homes on the terraces. There are approximately 20 summer-home communities, of which Kennerdell and President are the largest. Although the Allegheny River is too shallow for motor boating in some areas in summer, there are sizable deep pools at each summer community for water sports and fishing.

Stream pollution from mine drainage and sewage is a major problem in the county. About 162 miles of streams

Figure 15.—Drake oil well, the first drilled oil well in the world. Well is on Atkins silt loam.

are too acid from strip mine pollution for fish to survive. The other 128 miles of polluted streams are polluted from sewage or oil and, while unsafe to drink, are usable for fishing and swimming.

Venango County also has several sites where streams could be dammed to form lakes for water-based recreation. At present only one site, on Two Mile Run in the county park, has been developed.

In general, water supplies for the population of the county are sufficient (*9*). Where municipal water is not available, individual wells are drilled to obtain water, normally 50 to 100 feet deep. Many drilled wells yield "red water." This water is high in content of iron, and its hardness makes it unsatisfactory for use.

Geology

Venango County is underlain by sedimentary rocks that formed from sediments deposited on the floors of ancient seas. The main kinds of rock are sandstone, shale, and siltstone. Lower lying shale formations frequently are covered by sandstone talus.

All the surface rocks formed in either the Mississippian or the Pennsylvanian period. The rocks are divided into three groups, the Pocono group of Mississippian age and the Pottsville and Allegheny groups of Pennsylvanian age.

All the rocks are in nearly level strata. The lowest lying rocks, the Pocono group, are mostly sandstone, conglomerate, and some shale. The next oldest and second lowest formation is the Pottsville, which is mostly sandstone and a small amount of shale. The youngest and highest lying formation is the Allegheny group. This group contains most of the commercially available coal of the county. It is mostly shale and contains some clay and sandstone. In the southern part of the county there is about 15 feet of limestone, the Vanport Limestone. This limestone is not presently being quarried, but has been quarried in the past, both for crushed stone and for agricultural lime. It is the hardest rock in the county and has created problems where it has been encountered in cuts associated with strip mining and road building.

The western and northern half of the county was covered by glacial ice at three different times. The earliest glacier covered the largest part of the county, and the latest glacier covered only a small part at the western edge of the county.

As the glaciers melted, they left the landscape coated with glacial till that was a mixture of former soils and some sandstone, shale, quartzite, and small amounts of granite and limestone. This material ranges from 2 to 200 feet thick in the uplands. The youngest till contains small amounts of granite and limestone and contains more plant nutrients than the older till.

As the glaciers retreated, they left a deposit of gravelly till called an end moraine (fig. 16). This deposit is especially noticeable in Canal Township. Ice in the valleys was thick, and it melted slowly. Melt water running off the ice deposited coarse gravel in the form of small hills or kames along edges of valleys. It carried the finer textured material farther from the ice front and deposited it in nearly level terraces, such as those along Sugar Creek and French Creek.

The glacial ice changed the drainage pattern in the area by filling the drainageways with ice and debris. It reversed the direction of stream flow in some of the valleys, such as French Creek, and caused the streams to find new outlets in others, such as Deep Hollow. This filling of drainageways has resulted in large areas with impeded soil drainage in the glaciated section.

Climate [7]

Venango County is situated in the Northwest Plateau Climatic Division, and the climate is classified as humid continental. Most weather systems that affect this area develop in the Central Plains or the Midwest and are steered eastward by the prevailingly westerly winds. The primary source of cold air is Canada, and the main moisture source is the Gulf of Mexico. Table 15 gives temperature and precipitation data recorded at Franklin for the period 1941–70. Table 16 gives probabilities of the last freezing temperatures in spring and the first in fall at Franklin.

The topography of Venango County is rolling and hilly, and elevations generally range from 1,000 to 1,600 feet, above sea level. Climate varies, sometimes markedly, over short distances because elevations change sharply. Thus, it is difficult to choose any one location as representative of the county. The city of Franklin is centrally located and has therefore been selected as representative. Its location within a valley and its urban nature influence temperature, but these two effects tend to somewhat counterbalance each other, especially at night when cold air drainage from surrounding higher terrain is neutralized by the "heat island" effect of the town proper. It is felt that, all factors considered, the climatological data for Franklin should give a good representation of the climate of Venango County.

The average annual temperature is about 49° F. in the southwestern corner of the county and 48° F. in the northeastern corner. Annual precipitation is approximately 40 inches in the west and 42 inches in the east. Low-lying, north-facing hillsides are cooler than south-facing slopes, as are low-lying areas where cold air tends to pool at night. During daylight hours, these same low-valley areas, if exposed to the sun, heat up more than the surrounding forest-covered hillsides.

Summers are warm and pleasant. Daytime highs average in the low 80's and reach or exceed 90° F. on an average of about 15 days each summer. The record high of 106° F. was set on July 9, 1936. Freezing temperatures are not observed during this season. Cloud cover is at a minimum in summer. This area receives more than 60 percent of available sunshine, and nights are generally clear. The prevailing wind is from the southwest and averages 9 miles per hour. Summer rainfall is usually in the form of thundershowers, which occur on an average of 22 days from June through August.

Cloudiness is prevalent during winter, especially in daylight, as a result of the increased frequency of cold

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

Figure 16.—Typical landscape showing rolling topography on end moraine. The soils are Cranfield gravelly silt loam and Ravenna and Frenchtown silt loams. Ravenna and Frenchtown soils are in the depressions.

TABLE 15.—*Temperature and precipitation data*

[From records at Franklin, Pa., for period 1941–70]

Month	Temperature				Precipitation					
	Average daily maximum	Average daily minimum	Average extreme maximum	Average extreme minimum	Average total	1 year in 10 will have—		Average monthly snowfall	Average number of days with snow cover of—	
						Less than—	More than—		1 inch or more—	6 inches or more—
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches		
January	35	17	56	−3	2.8	1.37	5.36	12.8	19	6
February	37	17	57	−4	2.3	.85	3.62	12.1	16	4
March	46	25	69	8	3.1	1.54	5.05	10.5	7	2
April	60	35	80	20	3.9	2.08	5.89	1.8	1	0
May	70	44	86	30	4.2	2.25	6.45	.0	----------	----------
June	79	54	91	40	3.9	2.13	5.17	.0	----------	----------
July	83	58	91	45	4.4	1.91	6.29	.0	----------	----------
August	81	56	90	43	3.3	1.60	5.94	.0	----------	----------
September	75	49	88	34	3.1	1.54	4.90	.0	----------	----------
October	65	40	81	26	3.2	1.15	5.34	.1	(1)	0
November	50	31	70	15	3.4	1.58	5.23	4.7	2	(1)
December	38	21	58	1	2.6	1.09	4.00	12.4	15	4
Year	60	37	[2] 99	[3] −27	40.2	35.27	45.93	54.4	60	16

[1] Less than 0.5 day.
[2] Maximum in period 1941–70.
[3] Minimum in period 1941–70.

TABLE 16.—*Probabilities of last freezing temperatures in spring and first in fall*

[From records at Franklin, Pa., for period 1941–70]

Probability	Dates for given probability and temperatures				
	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 2	April 15	April 30	May 11	May 23.
2 years in 10 later than	March 30	April 12	April 19	May 5	May 15.
5 years in 10 later than	March 20	April 4	April 12	April 21	May 9.
Fall:					
1 year in 10 earlier than	November 15	November 5	October 24	October 7	September 27.
2 years in 10 earlier than	November 20	November 10	October 31	October 14	September 29.
5 years in 10 earlier than	November 29	November 18	November 11	October 26	October 8.

fronts and low-pressure systems. Considerable instability cloudiness also results, caused by cold-air advection aloft and by the "lake effect" of cold air passing over the relatively warm lake, picking up moisture, and forming clouds to the lee of Lake Erie. Prevailing surface winds are from the west-southwest and average 10 to 15 miles per hour. Daytime highs average in the mid-30's, while nighttime lows range from the mid-teens to the low 20's. Seventy-degree readings have been experienced in the middle of winter, but such occurrences are rare and do not last long. The temperature is below 0 on an average of 6 days each winter. The record low was −30° on January 5, 1904.

The first measurable snowfall usually occurs late in November or in December. Most storms are limited to a total snowfall of less than 10 inches, but a few have exceeded 15 inches. Snow cover is generally persistent during winter, and an inch or more has been observed on an average of 60 days a year. After March the threat of snow diminishes rapidly, although a few light flurries are possible even in May.

Prevailing winds, averaging 10 miles per hour, are from the southwest in spring, and the south in fall. By the middle of May, maximum temperatures average near 70° F. and indicate the shift to the summer season. This average maximum of 70° F. or higher persists into early October. Fall is the driest time of year. Prolonged periods of drought seldom occur; the longest period without measurable rainfall was 25 to 30 days.

The growing season averages about 150 days but has ranged from 111 days, in 1906, to 182 days, in 1964. May 8 is the average date of the last frost in spring, and October 8 is the average date of the first frost in fall. More frost data are available in table 16.

Thunderstorms occur most frequently in summer, but they have been observed at one time or another each month of the year. On the average there are 11 thunderstorm days in spring, 6 in fall, and 1 in winter; these figures combined with the summer statistics give an annual average of 40 thunderstorm days. Damages due to wind and hail accompanying severe thunderstorms are recorded almost every year somewhere in Venango County. Since 1854, when records were first kept on tornadoes, only three such storms have been sighted in the county.

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Glossary

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

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

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.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

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

Bedrock depth. The depth from the soil surface to bedrock. A shallow soil is less than 20 inches to solid bedrock. A moderately deep soil is 20 to 40 inches to solid bedrock. A deep soil is 40 inches or more to solid bedrock.

Bottom land. Low-lying land adjacent to a river, usually rich in alluvial deposits.

Boulder. Stones more than 10 inches in diameter.

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

Cation-exchange capacity. The sum total of exchangeable cations absorbed by a soil, expressed in milliequivalents per 100 grams of soil.

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.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

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

Conglomerate. Rock composed of gravel and rounded stones cemented together by hardened clay, lime, iron oxide, or silica.

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.

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

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Cropland. That part of tillable soils on a farm.

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.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

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). Crossbedded gravel, sand, and silt deposited by melt-water as it flowed from glacial ice.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, and boulders transported and deposited by glacial ice.

Graded stripcropping. Growing of crops in strips that are graded toward a protected waterway.

Grass 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. Soil particles 2.0 millimeters to 3 inches in diameter.

Heaving (of plants). The partial lifting of plants out of the ground, frequently with breaking of roots, that results from material freezing and thawing during winter.

High water table. A zone of saturation in the soil that is within 6 inches of the surface most of the time. It can be the upper surface or normal ground water, or it can be the upper surface of perched water that is separated from underlying ground water by unsaturated material. A high water table is indicated by mottling within 6 inches of the soil surface. It is associated with soils that are poorly drained or very poorly drained.

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 horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to 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.

Inclusion. A generally small area of a soil that is within the soil boundaries of a mapped soil, is not shown on the soil map, but that differs from the mapped soil.

Mapping unit, soil. Any soil or land type that is shown on the soil map.

Mechanical analysis (soils). The percentage of various sizes of individual mineral particles, or separates, in the soil. Also, a laboratory method of determining soil texture.

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.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows:

	Inches/water
Slow	less than 0.2
Moderately slow	0.2–0.6
Moderate	0.6–2.0
Moderately rapid	2.0–6.0
Rapid	more than 6.0

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

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	6.2 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	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Seasonal high water table. A zone of saturation that is within 6 to 36 inches of the soil surface during at least part of the year. It is usually caused by a fluctuating water table generally not associated with the ground water table. It occurs in soils that are somewhat poorly drained or moderately well drained.

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.

Terrace (conservation structure). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow very slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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