Series 1957, No. 10

Issued May 1961

SOIL SURVEY

Cortland County New York

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Cortland County will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, and other structures; aid foresters in managing woodland; and add to the soil scientist's fund of knowledge.

In making this survey soil scientists dug holes and examined surface soils and subsoils; measured slopes with an Abney hand level; noticed differences in the growth of crops, weeds, and grasses; and, in fact, recorded all the things that they thought might affect the suitability of the soils for farming, forestry, engineering, and related uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared the detailed soil map shown in the back of this report. Cultivated fields, roads, streams, and other landmarks are shown on the map.

Locating soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been located, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. The symbol will be inside the area if there is enough room; otherwise, it will be outside the area and a pointer will show where the symbol belongs. Suppose, for example, you find an area on your farm marked with the symbol VbB. The legend for the detailed map shows that this symbol identifies Volusia channery silt loam, 2 to 8 percent slopes. This soil and all others mapped in the county are described in the section, Descriptions of Soil Series and Mapping Units.

In addition to the detailed soil map, this report contains a map of general soil areas, or soil associations. On this generalized map soils that occur next to each other in a characteristic pattern are mapped as a unit. The general soil map furnishes an overall picture or "birdseye view" of the soils and their distribution throughout the county.

Finding information

Few readers will be interested in all parts of the soil survey report, for it has special sections for different groups, as well as some sections of value to all. The section, General Information About the County, points out outstanding features of Cortland County and will be of interest mainly to those not familiar with the area.

Farmers and those who work with farmers will be interested mainly in the section, Descriptions of Soil Series and Mapping Units, and in the section, Use and Management of Soils. Study of these sections will aid them in identifying soils on a farm, in learning ways the soils can be more effectively managed, and in judging what yields can be expected. The guide to mapping units at the back of the report will simplify use of the map and the report. This guide gives the map symbol for each soil, the name of the soil, the page on which the soil is described, the capability unit in which the soil has been placed, and the page where the capability unit is described. The guide also shows the woodland suitability group in which each soil has been placed.

Foresters and others interested in woodlands can refer to the section, Woodland Conservation, and also to the section, Wildlife.

Engineers will want to refer to the section, Engineering Applications. Tables in that section show characteristics of the soils that affect their use in building roads, ponds, and other structures.

Soil scientists will find information about how the soils were formed and how they were classified in the section, Formation and Classification of Soils.

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

* * * * *

The detailed soil survey is part of the technical assistance furnished the Cortland County Soil Conservation District. Fieldwork for the survey was completed in 1957. Unless otherwise specified, all statements in this report refer to conditions in the county at that time.

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SOIL SURVEY OF CORTLAND COUNTY, NEW YORK

SOILS SURVEYED BY BILLY D. SEAY, ROBERT S. LANDRY, AND JOHN A. NEELEY, SOIL CONSERVATION SERVICE, AND CARL S. PEARSON, RICHARD W. ARNOLD, CRAIG K. LOSCHE, RICHARD S. MERRITT, ROGER PENNOCK, AND KLAUS W. FLACH, CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

REPORT BY BILLY D. SEAY, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

CORTLAND COUNTY is in the central part of New York (fig. 1). The county is bounded by Madison and Chenango Counties on the east, by Broome and Tioga Counties on the south, by Tompkins and Cayuga Counties on the west, and by Onondaga County on the north.

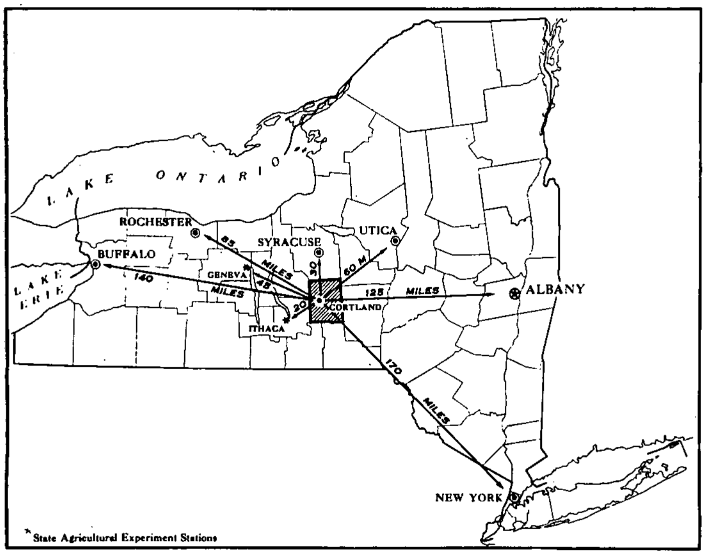

Figure 1.—Location of Cortland County in New York.

In size, the county extends 25 miles from north to south and 20 miles from east to west. It has a total area of 321,280 acres, or 502 square miles. Cortland, the county seat, is about 170 miles northwest of New York City; 125 miles west of Albany, the State capital; 30 miles south of Syracuse; and 20 miles northeast of Ithaca, the home of Cornell University.

Dairying is the predominant kind of agriculture in the county. A large amount of fluid milk is sold. The main crops grown are those used to feed dairy cattle; they include corn grown for silage, oats, and hay. Potatoes and cabbage are grown to some extent, and a few acres are planted to snap beans and dry beans; these crops are grown mostly in valleys north of the city of Cortland.

An estimated 40 percent of the county is covered by forest. The woodlands, though not a major source of income in the county, are used to supplement the income of farmers and other workers. The forests also provide recreational facilities, especially for hunters.

General Soil Map

This section is for persons interested in the soils in areas larger than an average-sized farm. It is designed to give an overall picture of the soils of the county. The information it provides will be helpful in planning general or broad programs of agriculture and in determining locations for schools, hospitals, and roads.

A general soil area, also called a soil association, consists of the soils that occur in a characteristic pattern on the landscape. The most extensive soils in each general area are indicated in the name. A single series of soils may dominate an area; for example, the Howard general area in Cortland County consists mostly of Howard soils and smaller areas of other soils. More commonly, a general area is made up mainly of the soils of two or three series, each of which comprises a significant part of the acreage in that area. An example of such a general area is the Lordstown-Volusia-Mardin.

A map showing the general soil areas in Cortland County is in the back part of this report. Each general area is identified by a different color, as well as by an alphabetic symbol.

In the text that follows, the general soil areas are described in the same order as they are listed on the colored map. Among the things discussed in the description of a general area are the approximate extent of the various soils, the kind of landscape on which the soils occur, and the uses and limitations of the soils of the area. Technical terms used in this section are defined in the glossary in the back part of the report. For a more complete description of the soils described in this section, turn to the sections, Descriptions of Soil Series and Mapping Units, and Use and Management of Soils.

Erie-Volusia-Langford (*EVL*)

The Erie-Volusia-Langford general area is made up mainly of somewhat poorly drained soils that have a fragipan beginning at depths of about 12 inches in the Erie and Volusia soils and 16 inches in the Langford soils. The fragipan is a compact layer that is hard when dry and soft, but firm, when moist. The area occupies about

5 percent of the county. The soils are mainly gently sloping, the slopes extending from the drainageways toward the ridges where the bedrock is near the surface (fig. 2). There are a few distinct valleys formed by tributary streams.

The Erie soils, which are somewhat poorly drained, make up about 45 percent of this general area. The Langford soils, which are moderately well drained and have rolling, convex slopes, comprise about 15 percent of the general area. They lie within areas of Erie soils. Just above the Erie soils, but below the ridges, are somewhat poorly drained Volusia soils, which comprise about 25 percent of the general area. On the ridges are moderately deep to shallow, well-drained Lordstown soils, which occupy nearly 15 percent of the general area. Inextensive soils are the poorly drained Ellery and Chippewa and the very poorly drained Alden soils. These wet soils occur in small depressions and along drainageways.

In most of this area, impeded drainage, resulting from the fragipan, limits the use of the soils for crops. The fragipan restricts the depth to which roots can penetrate. It is slowly permeable to water, and the soils remain wet and cold until late in spring. Unlike the Erie, Volusia, and Langford soils, the Lordstown soils are well drained. They are shallow to moderately deep to bedrock; in places in these soils, roots can penetrate to only shallow depths.

The soils are medium acid to very strongly acid and are low in phosphorus but medium in potassium-supplying power; they are subject to erosion if used continually for intertilled crops. The soils that have a fragipan are difficult to drain, but drainage can be improved through the use of diversion ditches or terraces.

The soils of this general area are slightly better for agriculture than those of the Lordstown-Volusia-Mardin area; the Erie and Langford soils contain more lime than the Volusia and Mardin soils. Corn, alfalfa, oats, and grasses and legumes are grown on the soils of both general areas. Most of the soils in this area are used for dairy farming; only the steep areas are idle or in forest.

Howard (*H*)

The Howard general area occupies less than 1 percent of the county. Nearly level to sloping, well-drained Howard soils make up 80 percent of the acreage. These soils have formed on gravelly outwash terraces deposited in wide valleys. About 15 percent of the acreage consists of moderately well drained Lobdell and poorly drained Wayland soils of the bottom lands. Moderately well drained Phelps and poorly drained Homer soils, which make up about 5 percent of the acreage, are in nearly level areas or in depressions in the outwash plains. Also included in this general area is a small acreage of wet Wallington and Birdsall soils formed in silt or silty clay. These soils occur south of Harford.

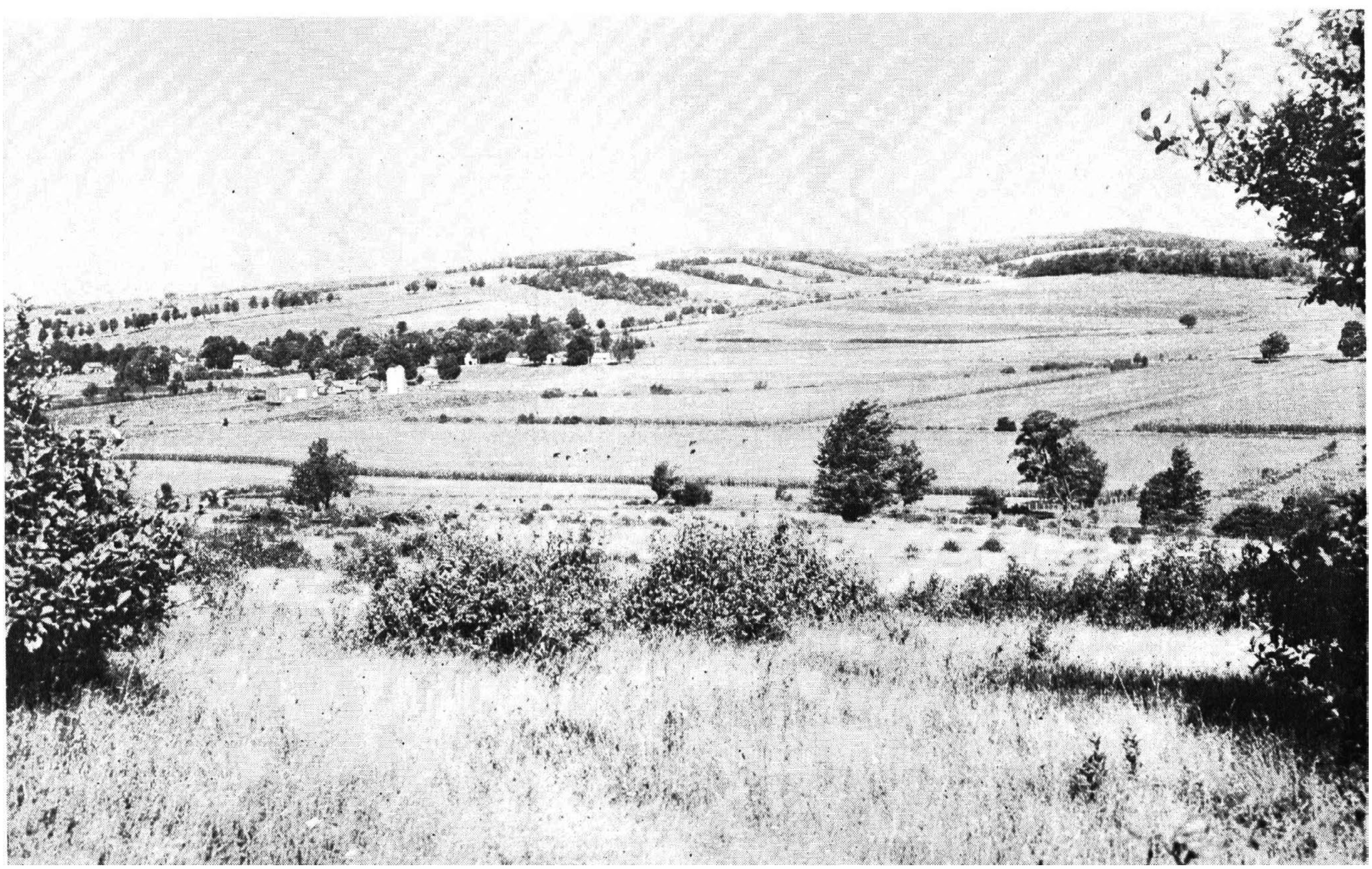

Figure 2.—**Typical landscape of Erie-Volusia-Langford soils near Virgil. Lordstown soils are on the high ridge in the background.**

This general area is among the most favorable for agriculture in the county, and it has several of the best dairy farms. Erosion and drainage are not major problems. Little forest remains on these soils. All the crops common to the county can be grown. The main crops are corn grown for grain or silage, oats, and alfalfa and mixtures of grasses and legumes grown for hay or pasture.

Lobdell-Howard (*LH*)

The Lobdell-Howard general area consists mainly of low-lime soils on bottom lands and on long, narrow outwash terraces that lie between the valley floor and the very steep valley wall. It occupies only about 1.5 percent of the county.

The moderately well drained Lobdell soil makes up about 50 percent of the acreage. This soil, along with well-drained Chagrin and poorly drained Wayland soils, occupies almost all of the valley floor. Adjacent to and just above these soils are the steep, well-drained Howard soils, which have formed on outwash deposits. The Howard soils occupy about 30 percent of the area. Small acreages of Palmyra, Bath, and Chenango soils are also in this general area.

Most of the tilled cropland in this general area is confined to the soils of the bottom lands. The soils have few limitations, but there is danger of the bottom lands being flooded during the growing season. In general, the Howard soils are too steep for cultivation, but they are excellent for hay crops and pasture. Most of the farms are well kept. The principal crops grown are corn for silage and grain, and oats, alfalfa, and mixtures of legumes and grasses grown for hay and pasture. On some farms cabbage and potatoes occupy a few acres. The crops grown on these soils need lime and phosphorus. They respond well to proper management, and good yields of crops are obtained.

Lordstown-Volusia-Mardin (*LVM*)

The Lordstown-Volusia-Mardin general area occupies approximately 60 percent of the county. It is the most extensive of the general areas. It is made up mostly of shallow or moderately deep soils over bedrock and somewhat poorly drained and moderately well drained, gently sloping to sloping soils with a fragipan. A typical landscape consists of a series of ridges partly dissected by tributary drainageways (fig. 3).

Somewhat poorly drained Volusia soils are above the valley floor and extend to the bases of areas of steep, shallow Lordstown soils. The Volusia soils comprise about 35 percent of this general area. Shallow to moderately deep, well-drained Lordstown soils occupy the steep areas and also occur on the level to nearly level ridges; these soils make up 45 percent of the general area. Moderately well drained Mardin soils occupy 15 percent of the area. They occur in rolling areas and have moderately rapid runoff.

Less extensive in this general area are the wet Chippewa, Tuller, and Alden soils that have formed in nearly

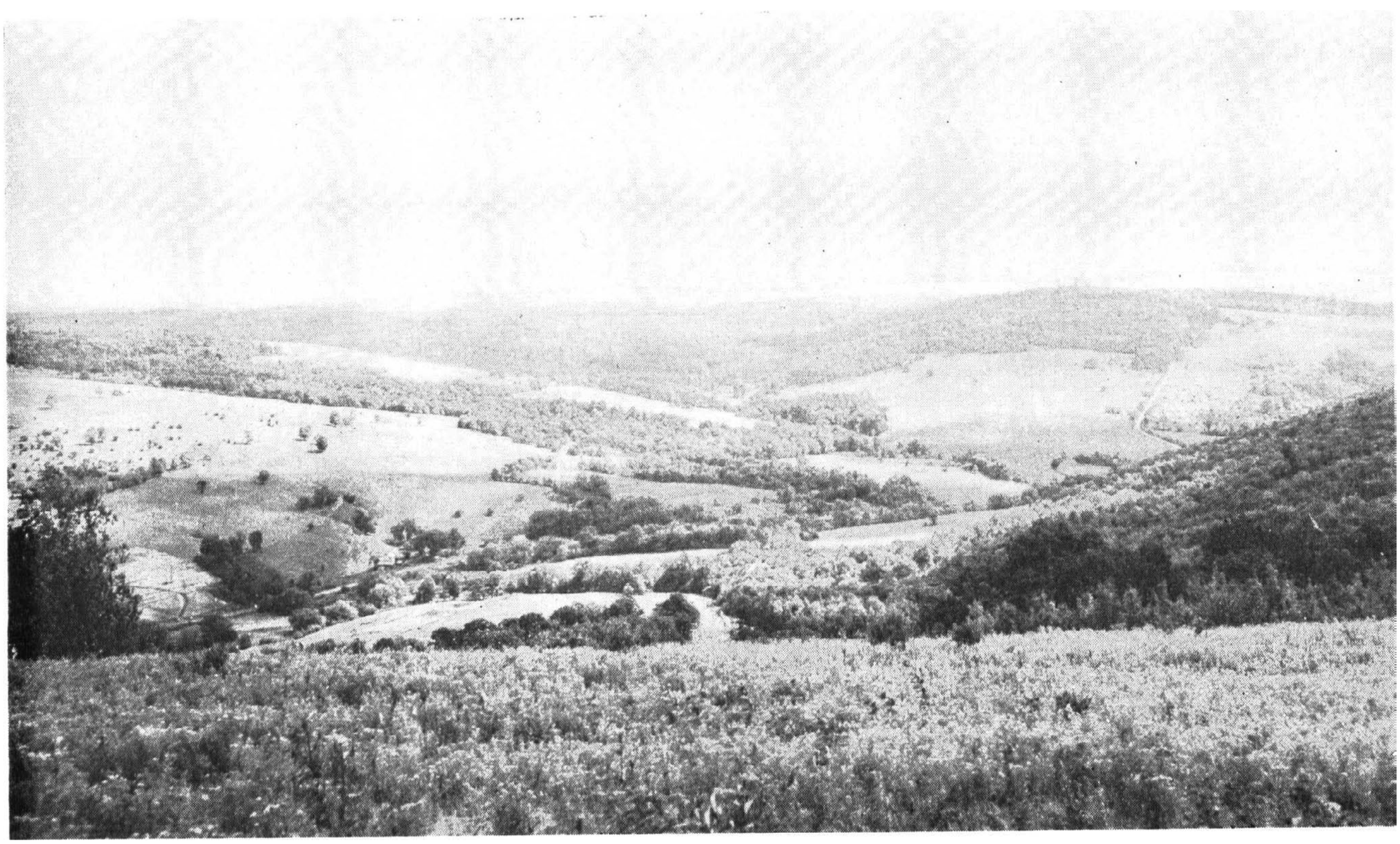

Figure 3.—**A typical landscape on which Lordstown-Volusia-Mardin soils have formed.**

level areas and in depressions. These soils generally make up less than 5 percent of the area. On the valley floor are the predominantly moderately well drained Middlebury soil and well drained Tioga soils; these soils cover about 5 percent of the area. There are also small areas of Chenango soils on outwash terraces and Bath-Chenango soils on moraines with short, steep slopes and on the steep walls of the valleys.

Wetness is a problem on the somewhat poorly drained Volusia soils and in the small areas of Chippewa and Alden soils. Erosion is a hazard on the strongly sloping soils. More land in this general area has been abandoned for crops and reforested than in any of the other general areas. Most areas of Lordstown soils on the steep walls of valleys have remained in native forest.

Farms wholly within this general area must depend mainly on the Lordstown and Volusia soils and, to a limited extent, on the Mardin soils for their cropland. The main crops grown are corn for silage, small grains, hay, and pasture. The Middlebury and Tioga soils have the widest suitability for crops, and yields are higher on these than on other soils. The soils must be limed and fertilized, however, if moderate yields are to be obtained.

Middlebury-Chenango (*MC*)

The Middlebury-Chenango general area is made up mainly of somewhat wet soils on bottom lands and steep, acid, gravelly soils. It covers about 1.5 percent of the county.

The Middlebury soil accounts for 50 percent of the acreage. It has formed in alluvium along the streams. Well-drained Chenango soils, which make up 30 percent of the acreage, lie above the bottom lands but below the steepest parts of the valley wall; they occupy long, narrow, steep areas of gravelly outwash. Locally, the areas of Chenango soils contain small spots of Bath soils.

The less extensive soils of the bottom lands are the well-drained Tioga and the poorly drained Holly. Together, these soils comprise less than 15 percent of the general area. Small areas of Unadilla and Scio soils, covering about 5 percent of the acreage, are on stream terraces above areas flooded by streams. They occur at higher elevations than the Tioga, Middlebury, and Holly soils.

Most of the tilled cropland in this general area is on the alluvial soils of the bottom lands because most areas of Chenango soils are too steep for cultivation. Nevertheless, fairly level areas of Chenango soils are cultivated extensively. Farms entirely within this general area are excellent for dairying. Many of the individual areas, however, are not large. In these places some dairy farms contain a considerable acreage of Lordstown, Volusia, and Mardin soils, which are limited in their suitability for dairying. As a result, these farms are considered only fair for dairying.

Soils of the bottom lands are limited mainly by flooding that occurs early in spring; they seldom are flooded during the growing season. The most extensive soil, the Middlebury, is moderately well drained and becomes warm just after the start of the growing season. Most of the Chenango soils are steep and are likely to erode if they are cultivated. These soils, however, are excellent for hay crops and pasture. All of the soils in this general area are very strongly acid, and the Chenango soils are low in nitrogen and phosphorus. Crops grown on these soils all respond well to lime, commercial fertilizer, and manure.

Corn grown for silage, oats, and alfalfa and other plants grown for hay and pasture are the principal crops. The very steep Chenango soils and the wet, swampy areas of Holly soil are mainly covered by forest.

Palmyra (*P*)

The Palmyra general soil area, which covers about 2.5 percent of the county, consists mostly of nearly level to sloping, well-drained Palmyra soils that are medium to high in lime. These soils occur on outwash terraces (fig. 4), and they make up about 80 percent of the general area. The Lobdell, Wayland, Phelps, and Homer soils comprise most of the rest of the acreage. A large area of Muck, lying east and northeast of Preble, is included in this general area.

The Palmyra soils are gravelly, but they have a clayey subsoil beginning at depths of 12 to 18 inches. The Phelps soils, which are moderately well drained, and the Homer soils, which are poorly drained, also have a clayey subsoil and contain free lime. The Phelps and Homer soils occur in nearly level areas or in slight depressions in the outwash plains and terraces. The poorly drained Wayland and moderately well drained Lobdell soils have formed on alluvium adjacent to the streams.

The best farms in the county are in this general area. Most of the soils are easy to work and have good moisture-holding capacity. High crop yields are obtained if commercial fertilizer and, where needed, lime are added. The soils are used mainly for corn, oats, alfalfa, and mixtures of grasses and legumes grown for hay. In a few places dry beans, snap beans, cabbage, and potatoes are grown extensively. Little of the acreage remains in forest.

Scio-Wallington (*SW*)

The Scio-Wallington general area, covering less than 1 percent of the county, consists mostly of somewhat wet, silty, strongly acid soils underlain by silt and gravel. It is made up mainly of the moderately well drained Scio soil and the poorly drained Wallington soil. These soils, each of which occupies about 40 percent of the acreage, have formed in alluvial deposits in nearly level areas and in depressions in valleys (fig. 5). The Scio soil occurs on stream terraces, and the Wallington soil, on local lacustrine deposits.

The very poorly drained Birdsall soils comprise about 15 percent of the general area. Unadilla soils, on stream terraces, and Tioga soils, on low and high bottoms, are well drained; they constitute only 5 percent of the acreage. Two areas of Muck, one in the valley of Cheningo Creek and the other in the valley of Labrador Creek, are included in this general area.

Farms on which most of the cropland consists of soils of this general area are only fair for dairy farming. If most of a farm is made up of Wallington and Birdsall soils, wetness is a major problem; some fields are difficult to drain artificially because outlets cannot be established sufficiently below the level of the field to be drained. The Scio soil, though nearly level, is subject to erosion. All of the Scio soil is farmed, but a considerable acreage of the Wallington soil is used for pasture and for forests of mixed species. Applications of lime, commercial fertilizer, and manure are necessary for moderate yields of corn grown for silage, oats, hay crops, and permanent pasture.

Valois-Howard-Langford (*VHL*)

The Valois-Howard-Langford general soil area makes up only about 2 percent of the county. It occurs between the uplands and the bottom lands. The area consists mainly of well-drained, mainly steep soils, some that overlie gravel or water-worked till and some with a fragipan. It also includes gently sloping, moderately well drained soils that have a fragipan. The soils have formed in glacial till, outwash, or a mixture of the two.

The Valois soils make up about 30 percent of the acreage. They are well drained and are rolling to steep. The Howard soils, which are well drained and nearly level to steep, comprise about 25 percent of the general area. Near South Cortland, the Valois and Howard soils are on complex topography where the hills are conical in shape.

The Langford soils make up about 25 percent of the acreage. These gently sloping soils lie above the steep slopes that face the bottom lands and below the steep slopes and adjacent steep valley walls that rise to the uplands. They are moderately well drained and have a fragipan beginning at depths of 15 to 18 inches.

Less extensive soils in this general area are well-drained Lansing and moderately well drained Conesus soils. These nearly level to rolling soils occur near the city of Cortland. They make up nearly 10 percent of the acreage. Also included in this general area are somewhat poorly drained Erie soils, which are associated with the Langford soils, and the somewhat poorly drained to poorly drained Kendaia soil, which is associated with the Lansing and Conesus soils. Together, the Erie and Kendaia soils comprise about 10 percent of the general area.

Most of the farms in this general area, especially those on gently sloping Howard soils, are good for dairying. The main limitations in the use of the soils are strong acidity, steepness, and only low to moderate natural fertility; also, the Erie soils are limited by somewhat poor drainage. These limitations can be compensated for by using good management practices. The steep soils can be used for pasture, and the very steep soils, for forest.

Most of the soils are used for growing corn for silage, oats, and grasses and legumes for hay and pasture. Alfalfa is grown to some extent. The soils respond well if lime and fertilizer are applied for the crops commonly grown. They also respond well to management

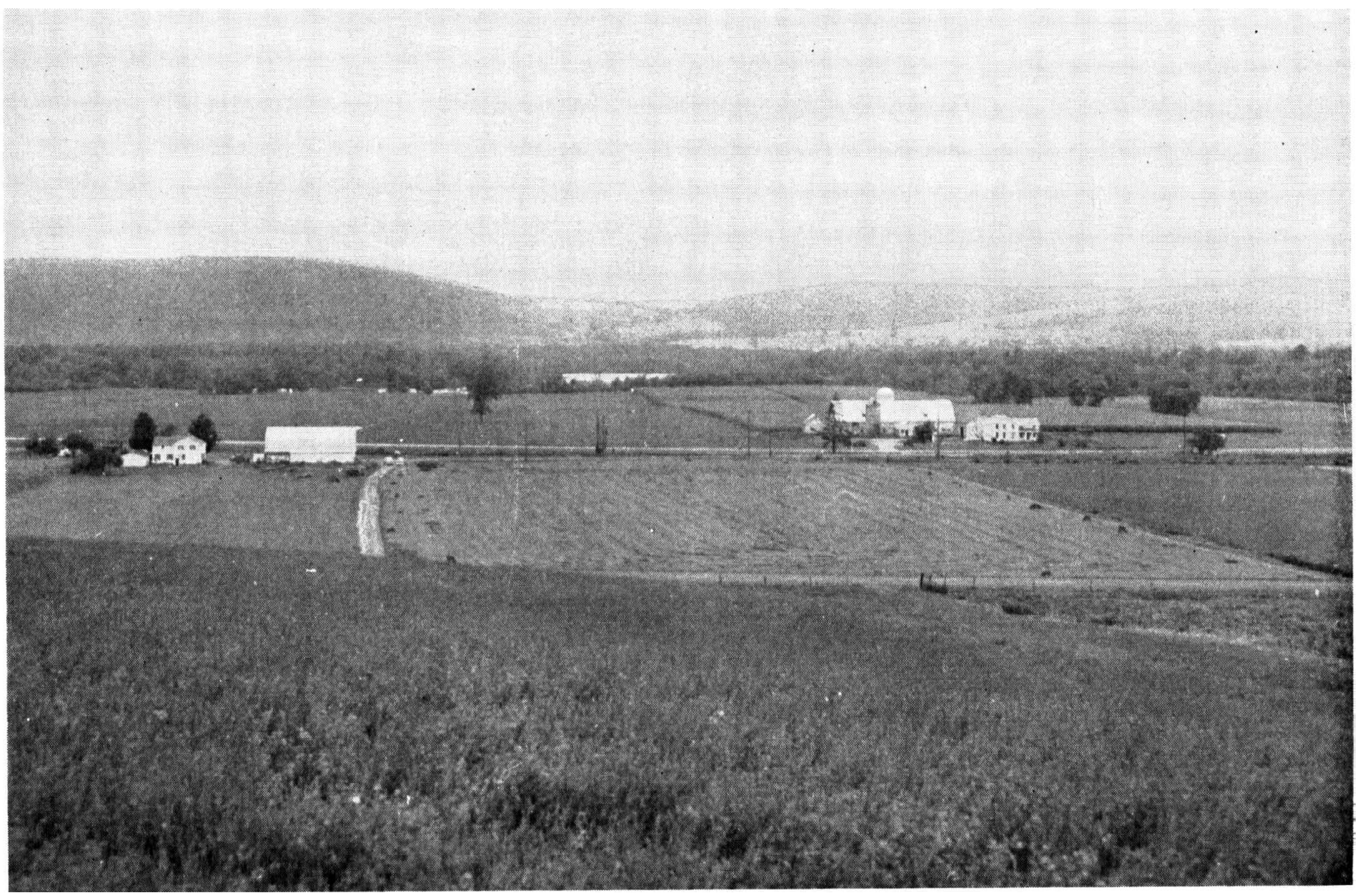

Figure 4.—**Palmyra soils on a gravelly outwash plain north of Preble.**

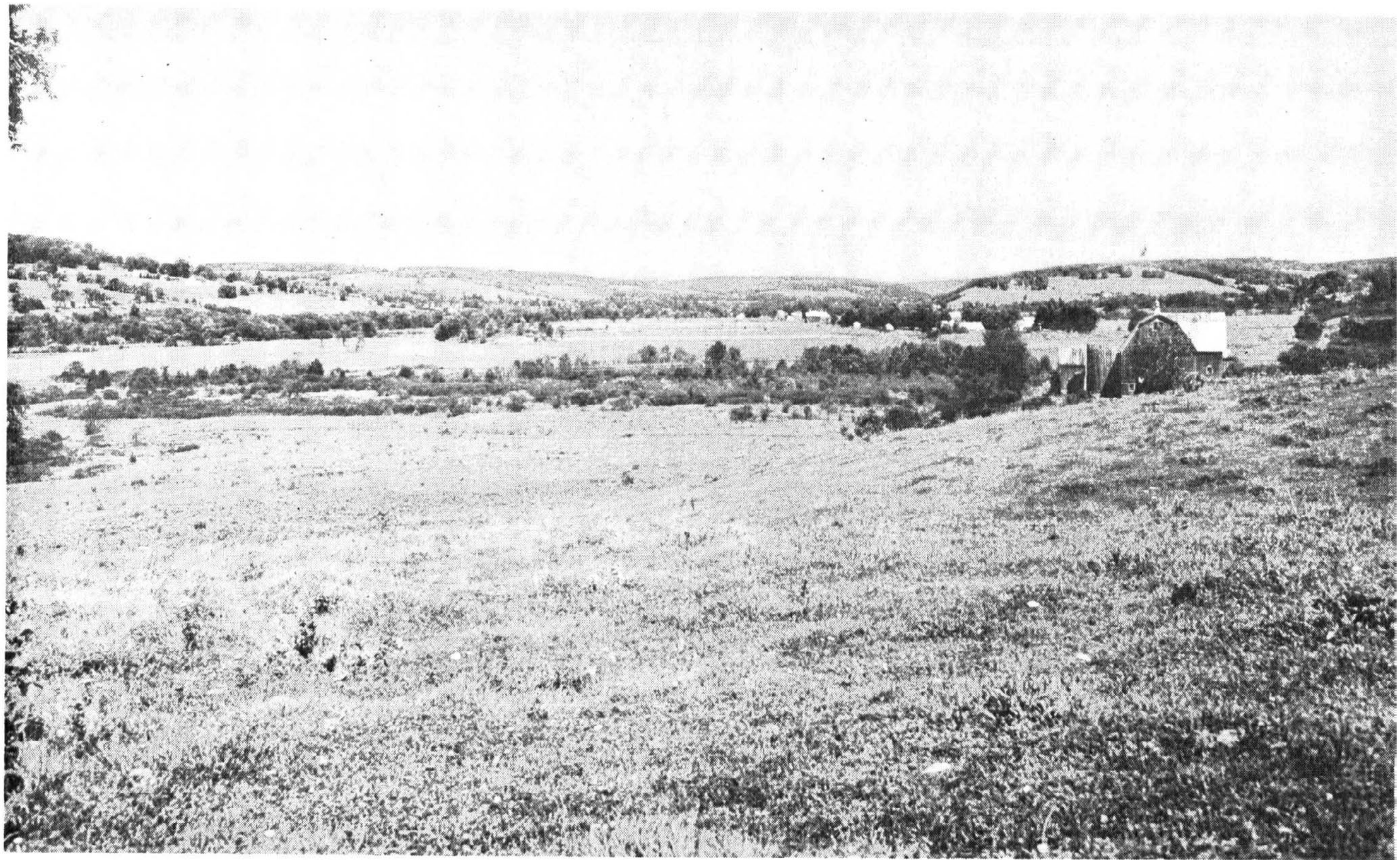

Figure 5.—**Scio-Wallington soils in a valley south of Lower Cincinna tus. Lordstown-Volusia-Mardin soils in uplands in the background.**

practices that increase the supply of readily decayable organic matter.

Valois-Langford-Lansing (*VLL*)

The Valois-Langford-Lansing general soil area, covering only about 1 percent of the county, consists mainly of well drained and moderately well drained, gently sloping to steep soils. Some of the soils have a fragipan. The soils have formed on glacial till containing a low to medium content of lime. A typical landscape in this general area is mostly gently sloping, but there are steep slopes between the low-lying areas and the walls of valleys. In some places short, steep, complex slopes occur between the valleys and the uplands.

Well-drained Valois soils occupy about 60 percent of the general area. In the places where these soils occur, about half the acreage is rolling and the rest is steep. In places where the glacial till contains a considerable amount of gravel, there are inclusions of Howard soils. The Langford soils make up about 25 percent of the acreage. They are moderately well drained and have a slowly permeable fragipan beginning at depths of 16 to 18 inches. These soils are rolling and have moderate runoff. Well-drained Lansing soils, comprising 15 percent of the general area, are on rolling, complex slopes. Most of these soils are south of Skaneateles Lake. Included with them is an area of Rhinebeck soils, which have formed in lacustrine materials. The Rhinebeck soils are erodible and need special care if used for cultivated crops.

Less extensive soils in this general area are somewhat poorly drained Erie soils and a few acres of poorly drained Ellery and very poorly drained Alden soils.

Farms in this general area are good for dairying, though not so highly productive as the farms in the valleys. The main limitations of the soils are strong acidity, low fertility, and steepness. The principal crops are corn grown for silage, oats, and grasses and legumes grown for hay and pasture. A considerable acreage is used for alfalfa. Good yields are obtained if fertilizer is applied and the soils are otherwise well managed. Although most of the soils are used for crops, some forest remains on the steeply sloping Valois soils.

Volusia-Mardin-Lordstown (*VML*)

The Volusia-Mardin-Lordstown general area is the second most extensive in the county, comprising about 27 percent of the total area. It consists of gently sloping to sloping, somewhat poorly drained Volusia soils, moderately well drained Mardin soils, and shallow or moderately deep, well-drained Lordstown soils. The soils are strongly acid and are low in fertility. The Volusia and Mardin soils have a fragipan beginning at depths ranging from 15 to 17 inches.

This general area is like the Lordstown-Volusia-Mardin area in that the same soils are dominant, although in different proportions. It differs from the Lordstown-Volusia-Mardin area in that the landscape is more rolling and the valleys have slightly wider floors.

Nearly 50 percent of the area consists of Volusia soils, which have long, gentle slopes and occur between the floor of the valleys and the steep ridges of exposed bedrock. The Mardin soils have convex, rolling slopes and are alongside and above the Volusia soils. On the highest, nearly level ridges are the Lordstown soils, which occupy about 25 percent of the acreage.

Inextensive soils in this general area are the wet Tuller, Chippewa, and Alden soils. These wet soils, comprising less than 5 percent of the general area, are in depressions and along drainageways where runoff water concentrates. Moderately well drained Middlebury and well drained Tioga soils are on first and second bottoms in the valleys. These alluvial soils constitute about 10 percent of the general area. The Bath and Chenango soils also make up about 10 percent of the acreage. In places they occupy long, narrow areas on the walls of valleys. In some places they have complex topography and occur at drainage divides.

On the whole, the farms within this general area are good because much of the farmland consists of Mardin soils of the uplands and Middlebury and Tioga soils of the bottom lands. Comparatively few farms have been abandoned. Nevertheless, wetness, erosion, strong acidity, and low fertility are major problems on the soils of the uplands. When used for tilled crops, all the soils generally need supporting practices to control runoff.

More corn for silage and more alfalfa are grown on the soils in this general area than on those of the Lordstown-Volusia-Mardin area. Other principal crops are oats and mixtures of grasses and legumes grown for hay and pasture. A few acres are used for potatoes and cabbage. Liberal applications of lime and fertilizer are needed for moderate yields of crops.

Descriptions of Soil Series and Mapping Units

In this section the soil series and mapping units, or individual soils, in the county are described. Table 1 gives the approximate acreage and proportionate extent of each mapping unit.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Map symbol	Soil	Area	Extent
		Acres	*Percent*
AaA	Alden and Birdsall silt loams, 0 to 3 percent slopes	1, 589	0. 5
Ab	Alluvial land	4, 530	1. 4
AcB	Arnot channery silt loam, 2 to 8 percent slopes	3, 897	1. 2
AdA	Atherton silt loam, 0 to 3 percent slopes	222	. 1
BaB	Bath channery silt loam, 3 to 8 percent slopes	3, 129	1. 0
BaC	Bath channery silt loam, 8 to 15 percent slopes	3, 939	1. 2
BaD	Bath channery silt loam, 15 to 25 percent slopes	2, 788	. 9
BbB	Bath-Chenango gravelly loams, 3 to 8 percent slopes	1, 066	. 3
BbC	Bath-Chenango gravelly loams, 8 to 15 percent slopes	1, 976	. 6
BbD	Bath-Chenango gravelly loams, 15 to 25 percent slopes	2, 098	. 7
BbE	Bath-Chenango gravelly loams, 25 to 40 percent slopes	992	. 3
BcE	Bath and Mardin soils, 25 to 40 percent slopes	4, 075	1. 3
BdA	Birdsall silt loam, over gravel, 0 to 1 percent slopes	703	. 2
CbA	Chagrin silt loam, 0 to 2 percent slopes	1, 084	. 3
CcB	Chagrin silt loam, high bottom, 0 to 4 percent slopes	608	. 2
CaB	Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes	677	. 2
CdA	Chenango gravelly loam, 0 to 3 percent slopes	1, 273	. 4
CdB	Chenango gravelly loam, 3 to 8 percent slopes	1, 573	. 5
CdC	Chenango gravelly loam, 8 to 15 percent slopes	486	. 2
CeA	Chippewa channery silt loam, 0 to 3 percent slopes	1, 812	. 6
CeB	Chippewa channery silt loam, 3 to 8 percent slopes	4, 290	1. 3
CfB	Conesus gravelly silt loam, 2 to 8 percent slopes	329	0. 1
CfC	Conesus gravelly silt loam, 8 to 15 percent slopes	310	. 1
DaB	Dunkirk silt loam, over gravel, 0 to 4 percent slopes	409	. 1
DaC	Dunkirk silt loam, over gravel, 8 to 20 percent slopes	59	[1]
EaA	Ellery channery silt loam, 0 to 3 percent slopes	377	. 1
EaB	Ellery channery silt loam, 3 to 8 percent slopes	1, 050	. 3
EbB	Erie channery silt loam, 2 to 8 percent slopes	4, 842	1. 5
EbC	Erie channery silt loam, 8 to 15 percent slopes	2, 796	. 9
HaA	Holly silt loam, 0 to 1 percent slopes	2, 595	. 8
HbA	Homer silt loam, 0 to 2 percent slopes	530	. 2
HdA	Howard gravelly loam, 0 to 3 percent slopes	2, 304	. 7
HdB	Howard gravelly loam, 3 to 8 percent slopes	2, 843	. 9
HdC	Howard gravelly loam, 8 to 15 percent slopes	1, 382	. 4
HdD	Howard gravelly loam, 15 to 25 percent slopes	1, 450	. 5
HcA	Howard cobbly loam, 0 to 3 percent slopes	345	. 1
HcB	Howard cobbly loam, 3 to 8 percent slopes	13	[1]
KaB	Kendaia silt loam, 1 to 6 percent slopes	190	. 1
LaB	Langford channery silt loam, 3 to 8 percent slopes	4, 027	1. 3
LaC	Langford channery silt loam, 8 to 15 percent slopes	4, 070	1. 3
LaD	Langford channery silt loam, 15 to 25 percent slopes	1, 206	. 4
LbB	Lansing gravelly silt loam, 3 to 8 percent slopes	523	. 2

See footnote at end of table.

551289—61——2

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Map symbol	Soil	Area	Extent	Map symbol	Soil	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
LbC	Lansing gravelly silt loam, 8 to 15 percent slopes	896	0.3	RbC	Rhinebeck silt loam, 8 to 15 percent slopes	133	(1)
LbD	Lansing gravelly silt loam, 15 to 25 percent slopes	509	.2	RbD	Rhinebeck silt loam, 15 to 25 percent slopes	102	(1)
LbE	Lansing gravelly silt loam, 25 to 35 slopes	93	(1)	SaB	Scio silt loam, 0 to 4 percent slopes	1,041	0.3
LcA	Lobdell silt loam, 0 to 2 percent slopes	2,174	.7	SbA	Sloan silt loam, 0 to 1 percent slopes	644	.2
LdB	Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes	12,735	4.0	TdA	Tioga silt loam, high bottom, 0 to 3 percent slopes	382	.1
LeB	Lordstown channery silt loam, shallow, 2 to 8 percent slopes	4,457	1.4	TcA	Tioga silt loam, 0 to 2 percent slopes	1,311	.4
LfC	Lordstown channery silt loam, 8 to 15 percent slopes	16,567	5.2	TaB	Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes	2,371	.7
LfD	Lordstown channery silt loam, 15 to 25 percent slopes	22,764	7.1	TbA	Tioga gravelly loam, 0 to 2 percent slopes	438	.1
LgE	Lordstown soils, 25 to 55 percent slopes	22,025	6.9	TeB	Tuller channery silt loam, 2 to 8 percent slopes	1,446	.5
MaB	Mardin channery silt loam, 2 to 8 percent slopes	16,509	5.1	UaB	Unadilla silt loam, 0 to 4 percent slopes	720	.2
MaC	Mardin channery silt loam, 8 to 15 percent slopes	24,651	7.7	VaB	Valois-Howard gravelly loams, 3 to 8 percent slopes	2,799	.9
MaC3	Mardin channery silt loam, 8 to 15 percent slopes, eroded	346	.1	VaC	Valois-Howard gravelly loams, 8 to 15 percent slopes	2,827	.9
MaD	Mardin channery silt loam, 15 to 25 percent slopes	11,165	3.5	VaD	Valois-Howard gravelly loams, 15 to 25 percent slopes	3,018	.9
MbA	Middlebury silt loam, 0 to 2 percent slopes	1,732	.5	VaE	Valois and Howard gravelly loams, 25 to 40 percent slopes	2,383	.7
Mc	Muck	1,442	.4	VbB	Volusia channery silt loam, 2 to 8 percent slopes	36,518	11.4
PbA	Palmyra gravelly silt loam, 0 to 3 percent slopes	6,381	2.0	VbB3	Volusia channery silt loam, 2 to 8 percent slopes, eroded	27	(1)
PbB	Palmyra gravelly silt loam, 3 to 8 percent slopes	1,459	.5	VbC	Volusia channery silt loam, 8 to 15 percent slopes	34,139	10.6
PbC	Palmyra gravelly silt loam, 8 to 15 percent slopes	416	.1	VbC3	Volusia channery silt loam, 8 to 15 percent slopes, eroded	349	.1
PbD	Palmyra gravelly silt loam, 15 to 25 percent slopes	237	.1	VbD	Volusia channery silt loam, 15 to 25 percent slopes	2,607	.8
PaA	Palmyra cobbly loam, 0 to 3 percent slopes	1,393	.4	VbD3	Volusia channery silt loam, 15 to 25 percent slopes, eroded	92	(1)
PcA	Papakating silt loam, 0 to 1 percent slopes	677	.2	WaA	Wallington silt loam, over gravel, 0 to 3 percent slopes	1,095	.3
PdA	Phelps gravelly silt loam, 0 to 3 percent slopes	1,415	.4	WbA	Wayland silt loam, 0 to 1 percent slopes	1,931	.6
RaA	Red Hook silt loam, 0 to 3 percent slopes	259	.1		Mines and pits	43	(1)
RbB	Rhinebeck silt loam, 3 to 8 percent slopes	100	(1)		Made land	5	(1)
					Total land area	321,280	100.0
					Water	640	
					Total	321,920	

[1] Less than 0.1 percent.

In general, the description of a soil series will answer the following questions:

(1) How acid are the soils?
(2) What is their texture?
(3) In what part of the county do the soils occur?
(4) From what kind of parent material did they develop?
(5) What is the drainage class of the series?

The series description also mentions the great soil group to which the particular soil series belongs.[1] This serves as an aid to those interested in soil classification.

For each series, a profile typical of the most extensive soil is described. This is a record of what the soil scientist saw and learned when he dug into the ground. The profile description is followed, as a rule, by a discussion of variations in the characteristics of the soils of the series.

In the profile description the color of the soil is described in words, such as "yellowish brown," and by symbols for hue, value, and chroma, such as "10YR 5/4." These symbols, called Munsell color notations, are used by soil scientists to evaluate soil colors precisely. Other technical terms used in the soil profiles, as well as in other parts of this section, are described in the Glossary in the back of the report.

All the soils of a series have a profile much like that of the soil described as typical. The differences, if any, are mainly in the texture of the surface horizon if there is more than one soil type in the series, or in the thickness of the surface horizon. In Cortland County most of the soil series consist of only one soil type, and, consequently,

[1] See the section, Formation and Classification of Soils, for a discussion of the great soil groups represented in Cortland County.

the soils of these series have similar texture in their surface horizon.

The number of mapping units recognized in a series is based on factors that affect the use and management of the soil. In Cortland County differences in degree of slope is one of the main factors that determines how soils are used. Individual soils, or mapping units, of the same series and type differ mainly in degree of slope, as shown in the name of each unit. Some mapping units are recognized because of the extent of erosion; these are known as eroded phases.

Information given for individual mapping units includes the location, characteristics that affect the use of the soil, and the way in which the soil is used and managed. A map symbol identifies the particular mapping unit described. This symbol, which is in parentheses following the name of the mapping unit, is used to locate areas of this unit on the detailed map in the back part of the report. The symbol PbA, for example, identifies Palmyra gravelly silt loam, 0 to 3 percent slopes, on the map. Also given in the description of each mapping unit is the capability unit to which that mapping unit belongs. Palmyra gravelly silt loam, 0 to 3 percent slopes, is in capability unit I–1. By referring to the description of capability unit I–1 in the section, Use and Management of Soils, you will find additional information about how to use and manage this and similar soils.

Most mapping units consist of a single soil, but in some there are inclusions of other soils in areas too small to map separately. If the inclusions make up more than 15 percent of an area, the mapping unit is named as a complex of different soils rather than as a single soil. Figure 6 shows the detailed pattern of contrasting soils in one 10-acre block of the complex that is named as Valois-Howard gravelly loams, 8 to 15 percent slopes. Valois and Howard soils make up most of the mapping unit, but there are level, wet areas of Alden and Birdsall soils and of Ellery soil and gentle slopes of somewhat poorly drained Erie soil and moderately well drained Langford soil.

Alden Series

The Alden soils occupy nearly level areas or are in slight depressions along drainageways. They are very poorly drained, and, at times, water accumulates on the surface. The soils have formed from glacial till, most of which is medium to low in lime.

The Alden soils are members of the Humic Gley great soil group. They are associated with moderately well drained Langford soils, somewhat poorly drained Erie soils, and poorly drained Ellery soils. In the eastern and southern parts of the county, the Alden soils are adjacent to areas of moderately well drained Mardin soils, somewhat poorly drained Volusia soils, and poorly drained Chippewa soils. They also occur as small seepage spots surrounded by steep Lordstown soils.

In Cortland County the Alden soils have been mapped only in an undifferentiated soil group, Alden and Birdsall silt loams, 0 to 3 percent slopes.

Typical profile (Alden silt loam, 0 to 3 percent slopes; under forest of mixed species):

A_1 0 to 6 inches, black (10R 2/1) silt loam with many, fine, distinct mottles of dark reddish brown along old root channels; moderate, coarse, granular structure; friable; fine roots abundant; pH 6.6; 4 to 8 inches thick; clear, wavy lower boundary.

A_2G 6 to 14 inches, gray (5Y 5/1) silt loam with many, medium and fine mottles of yellowish brown (10YR 5/4); weak, fine, subangular blocky structure; slightly firm; a few medium-sized roots; pH 6.4; 5 to 12 inches thick; clear, wavy lower boundary.

BG 14 to 30 inches, dark-gray (5Y 4/1) silt loam to silty clay loam with common, large, prominent mottles of olive brown (2.5Y 4/4); massive (structureless) within extremely weak prisms that are 12 to 15 inches across; firm when moist, sticky when wet; a few large roots are on outside of prisms; contains a few pebbles and cobblestones; neutral, pH 6.8 to 7.3; 9 to 20 inches thick; gradual lower boundary.

C_g 30 to 36 inches, dark-gray (5Y 4/1) silt loam with few, coarse, distinct mottles of light olive brown (2.5Y 5/4); massive (structureless); firm in place; free of roots; neutral to weakly calcareous.

In these soils the thickness and texture of the soil material above the BG horizon vary. In some areas, especially in areas that have received deposits of local alluvium, the texture of the soil ranges from silt or silt loam to silty clay loam. Here, the soil profile is similar to that described for the Birdsall series. In local depressions the

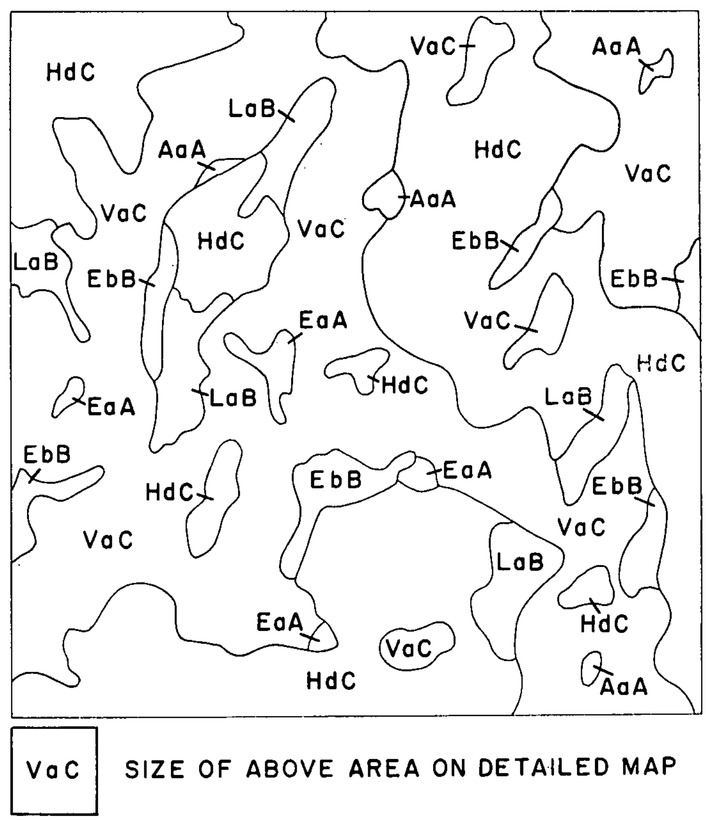

Figure 6.—Large scale map of approximately 10 acres showing the pattern of soils in a mapping unit that is a complex. This mapping unit is named for the dominant soils, Valois-Howard gravelly loams, 8 to 15 percent slopes. The map shows that the complex consists of these 2 dominant soils and 5 minor soils in the following mapping units: Alden and Birdsall silt loams, 0 to 3 percent slopes (AaA); Ellery channery silt loam, 0 to 3 percent slopes (EaA); Erie channery silt loam, 2 to 8 percent slopes (EbB); Howard gravelly loam, 8 to 15 percent slopes (HdC); Langford channery silt loam, 3 to 8 percent slopes (LaB).

surface layer in many places is 12 to 14 inches thick and is peaty or mucky. In the eastern and southern parts of the county, the reaction of the soils is nearly pH 5.5 to a depth of 2 feet. Where these soils lie next to areas of Lordstown, Arnot, or Tuller soils, they have flaggy fragments on the surface and mixed with the soil material.

In their natural state the Alden soils are high in organic matter and lime, medium in potassium, and low in phosphorus. Because of their very poor drainage, however, they are low in productivity. Unless drained artificially, they are too wet during the growing season to be used for cultivated crops. Only in the places where they are medium acid do they need lime for successful production of suitable crops.

These soils provide some pasture during the latter part of the growing season when the pastures on other soils of the uplands become dry. They need fertilizer if they are drained and used intensively for 4 or more years.

Alden and Birdsall silt loams, 0 to 3 percent slopes (AaA).—The Alden and Birdsall soils have similar characteristics, and in this county they have been mapped together as an undifferentiated soil group. The profile of the Alden soil is the same as the profile described for the Alden series. The profile of the Birdsall soil is similar to that described for the Birdsall series.

Both of these soils are cold and wet during most of the growing season. Unless artificially drained, they can seldom be cultivated. This mapping unit is in capability unit IVw-1.

Alluvial Land

Alluvial land (Ab).—This miscellaneous land type is made up of soils that were so intermingled it was not feasible to map them separately. It is on low, level to nearly level terraces and on bottom lands adjacent to streams. The areas occur in all parts of the county. Where they occur on the present flood plains of streams, they include areas of riverwash.

The soils making up this land type are well drained to very poorly drained. Some areas are flooded frequently during the year. The soil has a good supply of plant nutrients, and the content of lime ranges from low to high. Some areas have not been damaged through erosion; others have been damaged severely.

In the valleys where the soil materials washed from strongly acid soils of the uplands, this land type consists mainly of moderately well drained Middlebury and poorly drained Holly soils. In the valleys where the soil materials washed from soils that have a medium content of lime, it consists predominantly of moderately well drained Lobdell and poorly drained Wayland soils.

Because of the frequent flooding, this land type has only a limited use for agriculture. It is used mainly for pasture, but many fairly large areas are used for meadow. In many areas lime is needed for fair yields of grass. This land type is in capability unit VIw-1.

Arnot Series

The Arnot series consists of strongly acid, moderately well drained soils of the uplands. The soils are nearly level to gently sloping. They have formed in acid, medium-textured glacial till that is olive gray to dark grayish brown. The till contains rocks that have been fractured by frost. Depth to bedrock ranges from 10 to 24 inches. From a depth of 16 inches down to the bedrock, permeability of the soil to water is moderately slow to slow.

The Arnot soils are members of the Sols Bruns Acides great soil group. They are associated with well-drained Lordstown soils and poorly drained Tuller soils. The Arnot soils differ from the Mardin soils in that bedrock occurs at shallow depths and their fragipans are only weakly expressed or lacking.

Only one member of the Arnot series, Arnot channery silt loam, 2 to 8 precent slopes, has been mapped in Cortland County.

Typical profile (Arnot channery silt loam, 2 to 8 percent slopes; observed in a cultivated field 1.5 miles east of Little York):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine to medium, granular structure; friable; pH 4.5; 9 inches thick; abrupt, smooth lower boundary.

B_2 9 to 13 inches, yellowish-brown (10YR 5/4) to dark yellowish-brown (10YR 4/4) channery silt loam; compound structure—weak, fine, crumb and weak, fine, subangular blocky; friable; few, fine to medium, prominent mottles of grayish brown (2.5Y 5/2) in the lower 3 inches; fine roots plentiful; pH 4.9; 3 to 6 inches thick; wavy, clear lower boundary.

B_{3g} 13 to 16 inches, light olive-brown (2.5Y 5/4) to grayish-brown (2.5Y 5/3) channery silt loam with common, fine, prominent mottles of olive brown (2.5Y 4/4) and yellowish brown (10YR 5/6); compound structure—very weak, fine, subangular blocky and very weak to weak, medium, platy; friable to firm when moist, slightly hard when dry; fine roots plentiful; pH 4.8; 1 to 4 inches thick; wavy, gradual lower boundary.

C_g 16 to 24 inches, mottled light olive-brown (2.5Y 5/4) to olive-brown (2.5Y 4/4) channery silt loam; inside of peds coated gray (5Y 6/1 to 6/2); weak, fine to medium, subangular blocky structure; peds form prisms that are 2 to 5 centimeters across; firm when moist, hard when dry; contains a few flagstones; a few coarse roots; pH 5.0; 3 to 12 inches thick; abrupt, smooth lower boundary.

D_r 24 inches +, dark grayish-brown (2.5Y 4/2 to 3/2) fractured sandstone and siltstone that has mottled gray and olive, acid silt loam in the joints.

In most places bedrock is at depths between 18 and 22 inches in these soils; in a few areas it is at a depth of 10 inches. In some places the soil is somewhat poorly drained instead of moderately well drained and is mottled at depths of less than 10 inches.

Arnot channery silt loam, 2 to 8 percent slopes (AcB).—This soil is in the uplands. Most of the areas are nearly level. Runoff is slow to medium, and erosion is not a serious problem. On the complex slopes, some areas of Mardin soils are included with this soil; as much as 15 percent of the acreage mapped as Arnot soil consists of Mardin soils.

This soil is low in lime and phosphorus and is low to medium in potassium because of shallow depth to bedrock. It remains cold and wet longer than the Lordstown soils. Farm machinery can be used easily.

This soil was once used intensively to grow potatoes. It is now used mainly for hay crops, pasture, and corn grown for silage, although potatoes and cabbage are grown to some extent. A large acreage has been replanted to trees. If this soil is used for crops, it needs large amounts of lime, manure, and commercial fertilizer. It is in capability unit IIe-2.

Atherton Series

The Atherton series consists of strongly acid, medium-textured soils that are very poorly drained. The soils occupy nearly level areas or occur in slight depressions of the stream terraces and outwash plains. The soils have formed in materials derived mainly from olive-gray to dark grayish-brown siltstone, sandstone, and shale of the uplands. This material is mixed with gravel that was carried into the county by glaciers. Drainage is restricted by a high water table and by a firm, silty layer that is only slightly pervious. The firm to very firm layer begins at depths between 12 and 15 inches.

The Atherton soils belong to the Humic Gley great soil group. They are associated with somewhat poorly drained to poorly drained Red Hook soils and with well-drained Chenango soils.

Only one member of the Atherton series, Atherton silt loam, 0 to 3 percent slopes, has been mapped in Cortland County.

Typical profile (Atherton silt loam, 0 to 3 percent slopes, under a cover of sedge and alder):

A_1 0 to 6 inches, very dark gray (10YR 3/1) silt loam with many, fine and medium, distinct mottles of yellowish red (5YR 4/6) and dark reddish brown (2.5YR 3/4) along old root channels; weak to moderate, coarse, crumb structure; friable; fine roots plentiful; pH 5.8; 2 to 5 inches thick; clear, smooth lower boundary.

G 6 to 15 inches, gray to dark-gray (5Y 5/1) silt loam with many, very fine, black (5YR 2/1) concretions and a few, fine mottles of light reddish brown (5YR 6/4) along old root channels; very weak, fine to medium, blocky structure with aggregates crudely arranged in prisms or blocks; prisms or blocks are 6 to 12 inches across and have very dark gray (5Y 3/1 or 10 YR 3/1) coatings of organic matter on uppermost 1 or 2 inches; slightly firm or nonplastic when removed, but firm in place; few medium-sized roots; contains a few pebbles and cobblestones; pH 5.6; 5 to 12 inches thick; abrupt, wavy lower boundary.

BG 15 to 32 inches, mottled gray and olive-brown (5Y 5/1 to 2.5Y 4/4) silt loam to heavy silt loam; weak, coarse, blocky structure or massive (structureless); nonplastic when removed, firm to very firm in place; free of roots; contains some pebbles and cobblestones; pH 5.5; 10 to 20 inches thick; gradual lower boundary.

C_1G 32 to 40 inches, similar to horizon immediately above but less firm in place and more variable in texture; essentially structureless; nonplastic; pH 5.5; 5 to 13 inches thick; clear, wavy lower boundary.

C_2G 40 to 46 inches, dark-gray (N 4/) gravelly sandy loam; structureless; loose; pH 5.5.

The texture of the B and C horizons ranges from sandy loam to silty clay loam. In places the C_2G horizon is several feet thick. The reaction of the soil varies considerably; in a few acres near Little York and Homer, the surface layer is neutral instead of medium acid.

Atherton silt loam, 0 to 3 percent slopes (AdA).—This soil occupies small areas, principally in the valley of the Otselic River. A few small areas occur in other valleys.

This soil is not important for agriculture. It is wet and cold, except during the dry midsummer, and the areas are difficult to drain. Pastures are poor. In forested areas the stand consists only of alder and willow. This soil is in capability unit IIIw-2.

Bath Series

The Bath series consists of strongly acid, medium-textured soils that are well drained. The soils have a hard, compact fragipan that generally begins at depths between 20 and 30 inches. The fragipan, however, is deep enough, so that drainage is not adversely affected. These soils have formed from glacial till. The till consists of firm channery silt loam derived from slightly acid, olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale. The soils occur on rolling areas of the uplands.

The Bath soils are members of the Sols Bruns Acides great soil group. They are associated with moderately well drained Mardin soils, somewhat poorly drained Volusia soils, and poorly drained Chippewa soils. They also occur with well-drained Chenango soils in areas where the glacial till was reworked by water at the time it was deposited.

Typical profile (Bath channery silt loam, 8 to 15 percent slopes; cultivated):

A_p 0 to 6 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, medium, crumb structure; friable; fine roots abundant; pH 6.2, limed; abrupt lower boundary.

B_{21} 6 to 12 inches, yellowish-brown (10YR 5/4) channery silt loam; weak, fine, crumb structure; friable; fine roots abundant; pH 5.0; 5 to 10 inches thick; gradual lower boundary.

B_{22} 12 to 18 inches, weak yellowish-brown (10YR 5/4) channery silt loam; compound structure—very weak, fine, subangular blocky and weak, fine crumb; friable; a few medium-sized roots; pH 5.1; 4 to 12 inches thick; gradual, wavy lower boundary.

A'_2 18 to 21 inches, light olive-brown (2.5Y 5/4) channery silt loam; weak, fine, subangular blocky structure; friable, but slightly firm in place; a few medium-sized roots; pH 5.1; 1 to 5 inches thick; clear, wavy lower boundary.

B'_2 21 to 35 inches, dark grayish-brown (2.5Y 4/2) to olive-brown (2.5Y 4/4) channery silt loam with a few, medium, faint mottles of yellowish brown (10R 5/4) and olive gray (5Y 5/3); weak, fine and medium, subangular blocky structure; hard, firm in place; a very few medium and coarse roots; pH 5.4; 10 to 20 inches thick; diffuse lower boundary.

B'_3 35 to 54 inches, very dark grayish-brown (2.5Y 3/2) to dark grayish-brown (2.5Y 4/2) channery silt loam; very weak, coarse, blocky structure; fewer yellowish-colored mottles than in B'_2 horizon, but the aggregate faces are light olive gray (5Y 6/2); very hard if removed, firm in place; contains a few flaggy fragments; pH 5.8; diffuse lower boundary.

C 54 to 64 inches, dark grayish-brown (2.5Y 4/2) channery silt loam; very weak, very thick, platy structure or massive (structureless); pH 6.0 at a depth of 60 inches.

In some of the gently sloping areas, the depth to the fragipan is only 18 inches. Channery fragments are common in these soils. In areas where these soils grade to Lordstown soils, flaggy fragments are common on the surface and throughout the profile. In places the C horizon is several feet thick.

The soils are well aerated and have a fairly deep root zone. Their moisture-holding capacity is good. They are naturally low in lime and phosphorus but are medium in potassium. The soils respond well to good management. If they have been cultivated for many years, they are generally low in readily decayable organic matter.

These soils are used principally for oats and to grow corn for silage. They are used to some extent to grow alfalfa, clover, and grass for hay. In addition, a few acres near Scott are used to grow dry beans and potatoes.

Bath channery silt loam, 3 to 8 percent slopes (BaB).—The profile of this soil resembles the profile described for the series. This soil more commonly occurs with the Mardin and Volusia soils than with the strongly sloping Bath soils. In places, where the fragipan begins at a depth of about 18 inches, small areas of moderately well drained Mardin soils are included with this soil.

Runoff is slow on this soil, and erosion is not a problem. The soil is permeable to water and air, and roots can penetrate easily. It is deep and has good moisture-holding capacity.

This soil is suitable for intensive cultivation. Farm machinery can be used easily. In most areas the soil is low in lime, phosphorus, and organic matter. Nevertheless, if it is properly limed and fertilized ,good yields of crops can be obtained. This soil is in capability unit IIe-1.

Bath channery silt loam, 8 to 15 percent slopes (BaC).—The profile of this soil is like the profile described for the Bath series. This soil is on the rolling parts of the uplands. In the strongly sloping areas, it occurs with other Bath soils. On the milder slopes it lies next to Mardin and Volusia soils.

This soil has faster runoff and is more erodible than the gently sloping Bath soils. In most places it is moderately eroded, but a small acreage is severely eroded. In the severely eroded areas, almost all of the original surface layer has been removed.

This soil is permeable to water and air and has good moisture-holding capacity. Roots can penetrate easily. In fields that have been cultivated for several years, but have not received applications of lime, manure, or commercial fertilizer, the soil is low in lime, phosphorus, and organic matter. Farm machinery is more difficult to use than on the gently sloping Bath soils.

Oats, corn grown for silage, and grass and clover grown for hay are the main crops. Alfalfa, dry beans, and potatoes are grown to a limited extent. The soil cannot be used so intensively for cultivated crops as the gently sloping Bath soils. If it is used for crops, good response is received when fertilizer is added and other good management practices are used. This soil is in capability unit IIIe-1.

Bath channery silt loam, 15 to 25 percent slopes (BaD).—This soil has strong slopes, but its profile is essentially like the profile described for the series. Most of it occurs in the uplands next to other Bath soils.

This soil has rapid runoff, and, therefore, it is somewhat droughty. Erosion is a problem in places where row crops are grown too often. In a few places severe erosion has removed all of the original surface layer.

This soil has about the same requirements for lime, phosphate, and potash as the other Bath soils. In the areas in which legumes have not been grown recently, it is generally low in nitrogen.

Most of the areas are pastured or are used to grow hay crops. Some corn is grown in a few places. The soil responds well to good management. It is in capability unit IVe-1.

Bath-Chenango gravelly loams, 3 to 8 percent slopes (BbB).—This soil complex consists of small areas of two deep, well-drained, strongly acid soils. The soils are so intermingled that it was not feasible to map them separately. The Bath soil has a profile similar to the profile described for the Bath series. The Chenango soil has a profile like that described for the Chenango series.

The soils occur mainly on long, narrow, low slopes in the valleys of the principal streams and the large tributary streams in the county. In many places the slopes are short and vary in steepness; here, the parent material was deposited in the form of small, conical hills.

These soils generally occur next to moderately well drained Mardin, somewhat poorly drained Volusia, and poorly drained Chippewa soils.

The soils are easy to work. They are permeable to water and air and are deep enough to have good moisture-holding capacity. Roots penetrate easily. The soils are naturally low in fertility. Crops and pastures respond well if large amounts of lime and fertilizer are added.

Oats, corn grown for silage, and grass and legumes grown for hay or pasture are the main crops. Minor crops are alfalfa and potatoes. This mapping unit is in capability unit IIIe-1.

Bath-Chenango gravelly loams, 8 to 15 percent slopes (BbC).—This soil complex consists of small areas of two well-drained, strongly acid soils. The soils are so intermingled that it was not feasible to map them separately. The profile of the Bath soil is similar to the profile described for the Bath series. The profile of the Chenango soil is like the one described for the Chenango series.

In many places these soils have short, moderately steep slopes. Here, the parent material was deposited in the form of small conical hills. In some places the soils occur near soils of the other Bath-Chenango complexes. Generally, the more strongly sloping areas occur in association with small areas of Mardin, Chippewa, or Volusia soils.

A few small areas of these soils are severely eroded. These areas are indicated on the detailed soil map by a symbol for erosion. Included in this mapping unit are a few areas of stony soil that occur in the valley of the Otselic River.

The soils of this complex are low in natural fertility. Roots penetrate deeply, and permeability is moderately rapid to rapid. Nevertheless, in the areas where the slopes are moderately steep, runoff is moderately rapid and only a limited amount of water infiltrates into the soil. As a result, these soils are more droughty than Bath-Chenango gravelly loams, 3 to 8 percent slopes.

The same kinds of crops are grown on these soils as are grown on the soils of the Bath-Chenango complexes with milder slopes. Like the less sloping Bath-Chenango soils, these soils require liberal applications of lime, commercial fertilizer, and manure. This mapping unit is in capability unit IIIe-1.

Bath-Chenango gravelly loams, 15 to 25 percent slopes (BbD).—This soil complex is made up of a mixture of strongly sloping Bath and Chenango soils. The soils occur near soils of the less strongly sloping Bath-Chenango complexes.

These soils have rapid runoff and are slightly droughty. In general, erosion has not been severe, but in a few small areas all of the original surface layer has been lost. The strong slopes make the soils difficult to work.

The soils are used mainly for pasture or to grow hay crops. On some farms, where they are the only well-drained soils, they are used to some extent to grow alfalfa or to grow corn for silage. The soils require lime, commercial fertilizer, and manure if moderate to high yields are to be obtained. This mapping unit is in capability unit IVe-1.

Bath-Chenango gravelly loams, 25 to 40 percent slopes (BbE).—These strongly sloping soils have very rapid runoff and are erodible and droughty. Their profiles are thinner than the profiles described for the Bath and Chenango series, respectively, but are similar otherwise.

These soils are used mainly for pasture, but a large acreage is in forest. When used for pasture, they need liberal applications of lime, phosphate, and nitrogen fertilizer to increase yields. Nevertheless, the strong slopes make lime and fertilizer difficult to apply. Therefore, it is more economical to use this soil for grazing and to apply the fertilizer and lime to soils that have more favorable relief. This mapping unit is in capability unit VIe-1.

Bath and Mardin soils, 25 to 40 percent slopes (BcE).—This mapping unit consists of a mixture of Bath and Mardin soils. The Bath soil has a profile similar to the profile described for the Bath series; the Mardin soil has a profile like that described for the Mardin series. These soils are in the uplands and have steep to very steep slopes. They occur mainly on the steep parts of the banks of tributary drainageways. They are associated with the less sloping Mardin, Bath, and Volusia soils.

Both soils are steep. They have about the same use and need about the same management. Consequently, they have been mapped as a single unit.

The Bath soil is naturally low in lime and phosphorus, but it is medium in potassium. The Mardin soil is low in lime, nitrogen, and phosphorus and is medium in potassium. It has a medium to low content of organic matter. A fragipan in the Mardin soil limits the depth to which roots can penetrate.

These soils are used mostly for pasture and forest. The pastures, however, consist mostly of weeds. This mapping unit is in capability unit VIe-1.

Birdsall Series

The Birdsall soils are medium textured to moderately fine textured and are strongly acid and very poorly drained. They occur in local basins or flats. These soils have formed in acid materials derived from sandstone, siltstone, and coarse-textured shale. Because of the high water table, they remain wet throughout the growing season.

The Birdsall soils are members of the Humic Gley great soil group. They are associated with the Wallington soils, which are poorly drained. In some places they are associated with moderately well drained Scio soils.

Only one member of the Birdsall series, Birdsall silt loam, over gravel, 0 to 1 percent slopes, has been mapped separately in Cortland County. The Birdsall soil also has been mapped with the Alden soil in the undifferentiated soil group, Alden and Birdsall silt loams, 0 to 3 percent slopes.

Typical profile (Birdsall silt loam, over gravel, 0 to 1 percent slopes; under a cover of sedges):

A_1 0 to 7 inches, very dark gray (5Y 3/1) silt loam with many, fine, distinct mottles of dark reddish brown (5YR 3/3) along old root channels; moderate, coarse, granular structure; friable when moist, slightly sticky when wet; many fine roots; pH 5.6; 5 to 9 inches thick; clear, smooth lower boundary.

G 7 to 13 inches, gray (5Y 5/1) silty clay loam with many, medium, distinct mottles of yellowish brown (10YR 4/4) along old root channels; compound structure—very weak, medium plates that break to peds having very weak, fine, angular blocky structure; slightly sticky; a few medium-sized roots; pH 5.7; 4 to 8 inches thick; clear, gradual lower boundary.

B_g 13 to 26 inches, gray (5Y 5/1) silty clay loam; prisms, 4 to 9 inches across, stained black (5Y 2/1) on top and on the uppermost 2 inches of the sides: essentially structureless; sticky; a few large roots between prisms; pH 5.8; 8 to 15 inches thick; abrupt, wavy lower boundary.

D_g 26 to 34 inches, dark-gray (N 4/) gravelly silt loam, loam, or fine sandy loam; structureless; loose to slightly firm; pH 6.0.

Depth to the underlying gravel varies; generally, gravel is at a depth of 30 inches, but, in parts of the valley of Labrador Creek, it begins at depths of 4 to 5 feet. In that valley the soil is commonly slightly acid instead of medium acid to strongly acid like the typical Birdsall soil. In places the D_g horizon is several feet thick.

Birdsall silt loam, over gravel, 0 to 1 percent slopes (BdA).—This soil occurs in valleys along the Otselic River and the Labrador and Cheningo Creeks. It also occurs near Harford. In some areas, less than 100 acres in total extent, the soil contains more clay than the typical soil. These areas are in the extreme northeastern and northwestern parts of the county.

Very poor drainage limits the use of this soil. The soil is wet during the entire growing season. Unless it is drained, most of it is seldom used for crops. Some areas, however, provide pasture late in summer and early in fall when pastures in the uplands are drying up.

Usually, improving the drainage of this soil is difficult because most areas lack suitable outlets. Nevertheless, if the soil is drained adequately, it responds well to proper management; good yields of crops, especially of hay crops and pasture, can be obtained. This soil is in capability unit IIIw-2.

Chagrin Series

The Chagrin series is made up of well-drained, medium-textured soils formed in alluvium. The soils are in the level to nearly level parts of valleys, mainly north and northwest of the city of Cortland. They also occur north of Marathon in the valley of the Tioughnioga River. Most of the parent material was washed from the acid soils of the uplands. This acid material was mixed with sediments washed from soils high in lime. As a result, these soils are only medium acid.

The Chagrin soils are in the Alluvial great soil group. They are associated with moderately well drained Lobdell soils, poorly drained Wayland soils, and very poorly drained Sloan soils, all of which have formed in parent material similar to that of the Chagrin soils. The Chagrin soils and the soils associated with them occur mainly just below the well-drained Howard and Palmyra soils, which are on outwash terraces. The Chagrin soils are similar to the Tioga soils, but the parent material of the Tioga soils does not contain lime.

Typical profile (Chagrin silt loam, 0 to 2 percent slopes; cultivated):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, crumb structure; friable; many fine roots; pH 5.8; abrupt, smooth lower boundary.

C_1 8 to 21 inches, olive-brown (2.5Y 4/4) to light olive-brown (2.5Y 5/4) silt loam; compound structure—very weak, fine, subangular blocky but breaks to moderate, coarse, crumb; friable; many fine and medium-sized roots; pH 5.7; 9 to 16 inches thick; gradual lower boundary.

C_2 21 to 34 inches, olive-brown (2.5Y 4/4) silt loam with few, medium, prominent mottles of dark yellowish brown (10YR 4/4) in the lower 7 or 8 inches; massive, but appears to have very weak, fine, subangular blocky structure; slightly firm; a few large roots; pH 5.9 in upper part, but 6.2 at a depth of 30 inches; 8 to 15 inches thick; abrupt, wavy lower boundary.

D 34 to 50 inches, dark grayish-brown (2.5Y 4/2) gravelly silt loam or gravelly fine sandy loam with a few, coarse, distinct mottles of gray (5Y 5/1) and dark brown (10YR 4/3); structureless; loose to slightly firm in place; a few large roots; pH 6.5 at a depth of 50 inches.

The C_2 horizon is lacking in the areas where gravel occurs at a depth of only about 20 inches. These soils are generally moderately acid to a depth of about 26 inches, but in the valleys north and northwest of Cortland they are only slightly acid. In a few places the surface layer is neutral. In places the D horizon is several feet thick.

These soils absorb water rapidly but retain enough moisture for plants to use. They are permeable to air, and plant roots penetrate easily. The soils are easy to work and have good tilth. The areas on first bottoms are flooded frequently.

The soils are extremely important for agriculture. They are well suited to most of the crops grown in the county. These soils are especially valuable on farms in the uplands that consist mostly of somewhat poorly drained and moderately well drained soils. On many of these farms, a large part of the income is derived from crops grown on Chagrin soils.

Chagrin silt loam, 0 to 2 percent slopes (CbA).—The profile of this soil is like the one described for the Chagrin series. The soil has formed on nearly level first bottoms adjacent to streams. The areas are flooded frequently in spring but are seldom flooded during the growing season. Although flooding is the main limitation, gouging and undercutting of streambanks also limit the use of the soil.

Permeability of the soil to water is moderate to moderately slow. Roots penetrate easily. The moisture-holding capacity is good.

This soil is highly productive and is suitable for intensive use. Oats, corn grown for grain and silage, and clover, alfalfa, and grasses grown for hay are the main crops. For continuous good yields, the soil needs lime, manure, and phosphate; in addition, it commonly requires potash. This soil is in capability unit IIw-1.

Chagrin silt loam, high bottom, 0 to 4 percent slopes (CcB).—This soil has a profile similar to that described for the series. It occurs in valleys but occupies level to nearly level areas on high bottoms, 4 to 10 feet above the soils on first bottoms. As a result, the soil is not flooded so often nor is it damaged so much by gouging and undercutting of streambanks as the lower lying soils.

This soil has rapid permeability to water; roots penetrate easily, and the moisture-holding capacity is good. Farm machinery is easy to use. There is little risk of erosion except for the undercutting of streambanks in a few places.

The soil is highly productive and is suitable for intensive use. It is used for the same crops as the other Chagrin soils, but a greater acreage is used to grow alfalfa.

Like the other Chagrin soils, this soil needs lime, phosphate, and potash if high yields are to be maintained over a long period of time. It is in capability unit I-1.

Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes (CaB).—The profile of this soil resembles the profile described for the series. This soil, however, contains many channery fragments. Because of those fragments, the structure of the soil is weak. Commonly, the color of the C_1 horizon is more nearly yellowish brown than that of the C_1 horizon in the profile described for the series.

This soil is on nearly level to gently sloping alluvial fans in the valleys north and northwest of the city of Cortland. Small areas also occur near Harford Mills and Virgil.

The soil is slightly droughty if rainfall is below normal during the growing season. There is a slight risk of erosion, but the soil is seldom damaged seriously by erosion. Fragments of stone on the surface interfere with cultivation of crops to some extent but do little damage to farm machinery. This soil is flooded less frequently than the soils on low bottoms. Nevertheless, about once in 10 to 20 years, it may be flooded as the result of ice jams or flash floods.

Oats, clover, alfalfa, corn grown for grain or silage, and grasses grown for hay are the principal crops. If the soil is well managed, good yields are obtained. Lime and manure, phosphate, and potash are necessary for continuous high yields. This soil is in capability unit IIe-1.

Chenango Series

The Chenango soils are strongly acid, medium textured, and well drained. They have formed on nearly level outwash terraces in the valley of the Otselic River and on a few alluvial fans in the valleys of tributary streams. The soils also commonly occur on valley walls and in drainage divides in places where the glacial till was reworked by water.

The outwash from which the soils formed consists of material derived from acid, olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale of the uplands. It also contains many cobblestones and pebbles derived from quartzite and granite carried into the area by glaciers. The outwash material is rapidly permeable to water and is well drained.

The Chenango soils belong to the Sols Bruns Acides great soil group. They are associated with somewhat poorly drained to poorly drained Red Hook soils and very poorly drained Atherton soils. In areas where the glacial till was reworked by water at the time it was deposited, the Chenango soils are also associated with well-drained Bath soils.

Typical profile (Chenango gravelly loam, 0 to 3 percent slopes; cultivated):

A_p 0 to 8 inches, dark-brown (10YR 4/3) gravelly loam; weak, fine, crumb structure; friable; fine roots plentiful; pH 4.7; abrupt, smooth lower boundary.

B_{21} 8 to 13 inches, yellowish-brown (10YR 5/8) gravelly loam; very weak, fine, subangular blocky structure that breaks to weak, medium, crumb; very friable, loose in place; fine and medium-sized roots plentiful; pH 4.5; 3 to 7 inches thick; gradual, wavy lower boundary.

B_{22} 13 to 20 inches, yellowish-brown (10YR 5/4) gravelly loam; weak to very weak, fine, crumb structure; very friable; a few coarse roots; contains a few cobblestones; pH 4.5; 3 to 10 inches thick; gradual, wavy lower boundary.

C_1 20 to 34 inches, dark grayish-brown (10YR 4/2) to olive-brown (2.5Y 4/4) very gravelly loam; essentially structureless; loose; a few coarse roots; contains a few cobblestones; pH 4.9; 4 to 16 inches thick; gradual, wavy lower boundary.

C_2 34 to 70 inches +, dark grayish-brown (2.5Y 4/2) very gravelly loam to sandy loam; structureless; loose; not so many cobblestones as in the horizon just above; pH 5.2 in upper part of horizon, but near 6.0 at depths between 66 and 70 inches, and 6.6 to 7.3 (neutral) at depths between 96 and 108 inches.

In a few small areas south of Cincinnatus, the surface layer of these soils is gravelly fine sandy loam. In areas where the soils formed on alluvial fans, they contain more channery fragments than gravel. In some places the B_{22} horizon is essentially structureless and the soil is loose in place. Near Taylor, there are some areas of these soils that are neutral to weakly calcareous at a depth of 72 inches, although the Chenango soils are generally strongly acid at depths between 48 and 60 inches. In these places the horizon at depths between 42 and 60 inches contains more clay than the horizons immediately above and below it. This clayey layer occurs in places where the Chenango soils grade to Howard soils; here, not only is the soil more clayey than the typical Chenango soil, but it also contains more lime. The soils are rapidly permeable to water and air. Roots penetrate easily. Normally, the moisture-holding capacity is good, but the soils may be slightly droughty during years when precipitation is below normal.

These soils are extremely important for agriculture. They are well suited to the crops commonly grown, and in most areas they can be cultivated intensively. Although low in phosphorus and lime and medium in potassium, they are productive soils if they are managed properly.

Chenango gravelly loam, 0 to 3 percent slopes (CdA).—The profile of this soil is like the typical profile described for the series. The soil is on nearly level terraces where farm machinery is easy to use. It absorbs water readily, and erosion is not a problem.

This soil can be cultivated intensively and is suited to all the crops commonly grown in the county. Yields are only fair on fields that have not been limed or fertilized. But where liberal amounts of lime and manure have been added and phosphate and potash applied, the yields are nearly as high as those obtained on the most productive soils in the county. This mapping unit is in capability unit I–1.

Chenango gravelly loam, 3 to 8 percent slopes (CdB).—The profile of this soil is similar to the profile described as typical of the Chenango series. The soil occurs on short, steep slopes that are irregular and hummocky. It also is on alluvial fans in the valleys of tributary streams. This soil is associated with other Chenango soils and with the somewhat poorly drained to poorly drained Red Hook soil.

The soil is rapidly permeable to water, and roots penetrate easily. Runoff is medium; because the soil absorbs water readily, erosion is not a serious problem. This soil is easy to work.

Oats, hay, and corn, which is grown for silage and grain, are the principal crops. In addition, alfalfa is grown on a large acreage. The soil is strongly acid and needs liberal applications of lime. Also, because it is low in natural fertility, it needs phosphate, nitrogen, and potash for moderate to high yields. This soil, like the other Chenango soils, responds well to good management. It is in capability unit IIe–1.

Chenango gravelly loam, 8 to 15 percent slopes (CdC).—This soil is moderately steep, but its profile is essentially like the typical profile described for the series. The soil occurs in the same general areas as other members of the Chenango series. It has both simple and complex slopes. In places it is on terrace scarps. On the complex slopes the outwash material from which the soil formed was deposited in the form of conical hills. In areas that have simple slopes, this soil is commonly associated with the somewhat poorly drained to poorly drained Red Hook soil and with the very poorly drained Atherton soil. A few, small areas of Red Hook soil, shown on the detailed map by a symbol for wetness, are included with this soil.

Chenango gravelly loam, 8 to 15 percent slopes, has rapid runoff and is somewhat droughty. Where it has irregular slopes, it is not easy to work. If used intensively, it needs protection from erosion.

This soil is used more extensively for hay crops and pasture than the less strongly sloping Chenango soils. It is in capability unit IIIe–1.

Chippewa Series

These strongly acid, medium-textured soils are poorly drained and have a fragipan that begins at depths between 8 and 12 inches. They occur in nearly level areas and in slight depressions in the uplands. They have formed from slightly acid glacial till. The till was derived from dark grayish-brown to olive-gray siltstone, sandstone, and coarse-textured shale. Surface water accumulates in the depressions. The fragipan restricts drainage.

The Chippewa soils are members of the Low-Humic Gley great soil group. They are associated with moderately well drained Mardin soils, somewhat poorly drained Volusia soils, and very poorly drained Alden soils. In the upper part of the profile, the Chippewa soils are similar to the Tuller soils; the Chippewa soils, however, have a more strongly expressed fragipan, and bedrock is at greater depths, or at depths of more than 24 inches.

Typical profile (Chippewa channery silt loam, 0 to 3 percent slopes; in an excavation in a forested area 3.5 miles east of Marathon):

A_1 0 to 3 inches, very dark grayish-brown (10YR 3/2) channery silt loam; moderate, medium to coarse, granular structure; friable; a few, fine, distinct mottles of reddish brown (5YR 4/4); roots plentiful; pH

5.0; 1 to 5 inches thick; clear, smooth lower boundary.

A_{21g} 3 to 9 inches, dark grayish-brown to dark-gray (2.5Y 4/2 to 4/1) channery silt loam with fine, distinct mottles of yellowish brown (10YR 5/6 to 5/8); weak, fine to medium, subangular blocky structure; friable, slightly hard; a few roots; pH 5.2; 2 to 8 inches thick; clear, wavy lower boundary.

A_{22g} 9 to 11 inches, olive-gray to gray (5Y 5/2 to 5/1) channery silt loam with many, medium to coarse, prominent mottles of yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4); very weak, medium, platy structure that breaks to weak, fine, subangular blocky; firm, slightly hard; essentially no roots; pH 5.2; 2 to 4 inches thick; clear, wavy lower boundary.

B_{2g} 11 to 20 inches, light olive-brown (2.5Y 5/4) to olive-brown (2.5Y 4.4) channery silt loam; weak, fine to medium, subangular blocky peds prominently mottled with yellowish brown (10YR 5/6 to 5/8) in the upper 2 to 6 inches of horizon; peds are within prisms 2 to 5 inches across; prisms are separated by narrow cracks coated with olive gray or gray (5Y 5/2 to 5/1) silt; beneath coating is a yellowish-brown band 1/16 inch wide that surrounds the prism; firm, hard; contains a few flagstones; no roots; pH 5.6; 5 to 13 inches thick; gradual lower boundary.

B_{3g} 20 to 33 inches, olive-brown (2.5Y 4/4) channery silt loam with common, medium, distinct mottles of yellowish brown (10YR 5/6) and olive gray (5Y 5/2); massive (structureless) to very weak, medium to coarse, subangular blocky structure; firm, but less firm than material in the horizon just above; contains a few flagstones; pH 5.6; 7 to 14 inches thick; diffuse lower boundary.

C_{1g} 33 to 38 inches +, dark grayish-brown (2.5Y 4/2) to olive (5Y 5/3) silt loam till; massive (structureless) to weak, coarse, blocky or very thick, platy structure; firm, hard; medium acid, pH 5.8.

Locally, the texture of these soils is flaggy silt loam. In depressions, especially in depressions where water sometimes accumulates, the texture ranges from silt to silty clay loam. In areas of these soils associated with soils of the Bath-Chenango complexes, there is a large amount of gravel in the B_{3g} and C_{1g} horizons. In places, where the Chippewa soils grade to the Ellery soils, the B_{2g} horizon is slightly acid.

The Chippewa soils are not very productive. They are high in organic matter but are low in lime and in available plant nutrients. Because the lower horizons are waterlogged for long periods, the soils have shallow root zones. They are used principally for grass meadows and pasture, but a large acreage is idle or in forest.

Chippewa channery silt loam, 0 to 3 percent slopes (CeA).—The profile of this soil is like the profile described for the series. The soil occurs throughout the uplands in nearly level areas or in slight depressions. In places small areas of silts and silty clay loams are included. The nearly level areas of Chippewa channery silt loam, 0 to 3 percent slopes, are associated with the Volusia channery silt loams and the Mardin channery silt loams.

This soil remains cold and wet during most of the growing season. It is strongly acid and low in available plant nutrients.

Most of the areas are idle or in forest. The soil needs to be drained and well managed otherwise, if it is to be used for cultivated crops. It is in capability unit IVw–2.

Chippewa channery silt loam, 3 to 8 percent slopes (CeB).—This soil has stronger slopes than the soil described for the series, but its profile is similar. It occurs in drainageways and in narrow belts between areas of Volusia soils and the less sloping Chippewa soil. Small wet spots of very poorly drained Alden soil, shown on the detailed map by a symbol for wetness, are included with this soil.

Chippewa channery silt loam, 3 to 8 percent slopes, is low in lime and available plant nutrients and is low in productivity. It is used more for hay and pasture than the less sloping Chippewa soil. In a few places, where drainage is practical, good yields of oats and of corn grown for silage can be obtained if the soil is properly managed. This soil is in capability unit IVw–2.

Conesus Series

These moderately well drained, medium-textured soils have a clayey subsoil. They are medium in lime. The soils have formed in medium-textured, calcareous glacial till derived from sandstone, siltstone, shale, and limestone. They are nearly level to gently sloping. Most of the acreage is in the valleys between Scott and Cuyler, but a small acreage is near South Cortland. The soils lie about halfway between the soils of the uplands and the soils of the valleys.

The Conesus soils are members of the Gray-Brown Podzolic great soil group. They are associated with somewhat poorly drained to poorly drained Kendaia soils and well-drained Lansing soils.

Typical profile (Conesus gravelly silt loam, 2 to 8 percent slopes; cultivated):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; moderate, medium, crumb structure; friable; fine and medium-sized roots plentiful; pH 6.0, limed; abrupt, smooth lower boundary.

A_2 10 to 14 inches, grayish-brown (2.5Y 5/2) gravelly silt loam with a few, medium, prominent mottles of light olive brown (2.5Y 5/4) and dark yellowish brown (10YR 4/4); compound structure—weak, coarse, crumb to very weak, fine, subangular blocky; friable; fine and medium-sized roots are plentiful; pH 5.6; 2 to 8 inches thick; clear, wavy lower boundary.

B_{21} 14 to 22 inches, dark yellowish-brown (10YR 4/4) gravelly silt loam; moderate, fine, subangular blocky peds that have a few, medium, distinct mottles of grayish brown (2.5Y 5/2); exteriors of peds contain clean grains of sand or silt that give them a frosty appearance; friable when moist, slightly hard when dry; a few medium-sized roots; pH 6.0; 5 to 12 inches thick; gradual, wavy lower boundary.

B_{22} 22 to 38 inches, olive-brown (2.5Y 4/4) to dark grayish-brown (2.5Y 4/2) silty clay loam; moderate, medium, subangular blocky structure; firm, slightly sticky, firm in place; a few large roots; pH 6.6 to a depth of 30 inches but neutral, pH 6.6 to 7.3, at a depth of 36 inches; gradual lower boundary.

C 38 to 59 inches, dark grayish-brown (2.5Y 4/2) to dark olive-gray (5Y 3/2) gravelly silt loam; massive; slightly firm in place; free of roots at a depth of 48 inches; calcareous at a depth of 42 inches.

In the northeastern corner of the county and near Cuyler, the clayey subsoil begins at depths between 12 and 15 inches and the depth to free lime ranges from 20 to 25 inches. Near South Cortland, free lime is at a depth of about 54 inches.

These soils are moderately permeable, but they have a compact horizon in the subsoil that slows down the movement of water. The soils are slightly wet early in spring, but during the rest of the growing season, they have moderately good drainage.

On the farms on which they occur, these soils are important for agriculture, even though their total acreage is not large. They are well suited to oats, wheat, corn grown for silage, and hay and pasture crops, and they are also suited to some varieties of alfalfa. The crops respond well if lime and fertilizer are applied. The soils are easy to work and are productive if they are well managed. Their use is not seriously restricted by impeded drainage.

Conesus gravelly silt loam, 2 to 8 percent slopes (CfB).—This soil lies next to areas of Kendaia and Lansing soils. Its profile is like the profile described for the series.

This soil is easy to work. Runoff is slow to medium, and erosion is seldom a problem. The soil is limited somewhat by restricted internal drainage. It needs lime, phosphate, and nitrogen if good yields are to be obtained. This soil is in capability unit IIe–3.

Conesus gravelly silt loam, 8 to 15 percent slopes (CfC).—This soil has stronger slopes than the soil described as typical of the series, but it has a similar profile. In places it is associated with the Lansing soils and with the nearly level Kendaia soil. Small areas of a Kendaia soil, which has slopes of 8 to 15 percent, are mapped with this soil.

If it is cultivated, Conesus gravelly silt loam, 8 to 15 percent slopes, needs protection from erosion. It has faster runoff than Conesus gravelly silt loam, 2 to 8 percent slopes, and is more likely to be droughty. It dries out sooner in spring.

The soil is used principally to grow oats and hay crops. A few acres are used for alfalfa or to grow corn for silage. This soil is in capability unit IIIe–3.

Dunkirk Series

These strongly acid soils are medium textured and well drained. They have formed from silt deposited in shallow lakes on outwash plains and in old, abandoned stream channels. Most of the areas are near Scott, but a few are near Cortland. In areas in the uplands, the silt was derived from glacial till, and, in areas in the valleys, it was derived from outwash material. Gravel begins at depths between 25 and 40 inches; therefore, water moves readily downward through these soils.

The Dunkirk soils are members of the Gray-Brown Podzolic great soil group. In most places they are associated with well drained Palmyra soils, but in some places they adjoin moderately well drained Phelps or Rhinebeck soils.

Typical profile (Dunkirk silt loam, over gravel, 0 to 4 percent slopes; cultivated):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, crumb structure; friable; fine roots plentiful; pH 6.3, limed; abrupt, smooth lower boundary.

A_3 9 to 12 inches, brown (10YR 5/3) silt loam; weak, fine, subangular blocky structure; friable; fine and medium-sized roots plentiful; pH 5.2; 2 to 4 inches thick; clear, smooth lower boundary.

B_{21} 12 to 16 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, subangular blocky peds; exteriors of peds have small spots of brown (10YR 5/3) material similar to that in the horizon just above; friable, slightly firm in place; fine and medium-sized roots plentiful; pH 5.4; 3 to 7 inches thick; gradual, wavy lower boundary.

B_{22} 16 to 28 inches, dark grayish-brown (2.5Y 4/2) to very dark grayish-brown (2.5Y 3/2) silt loam to silty clay loam with a few, fine, distinct mottles of yellowish brown (10YR 5/4) at a depth of 23 inches; moderate, coarse, subangular blocky structure with distinct clayflow on surfaces; slightly firm when removed or in place; a few, medium- and large-sized roots; pH 5.5; 6 to 15 inches thick; abrupt, wavy lower boundary.

D 28 to 42 inches, dark grayish-brown (2.5Y 4/2) gravelly silt loam to very fine sandy loam; massive; friable to slightly firm; a few large roots; neutral to calcareous at a depth of 36 inches.

Depth to gravel and free lime varies considerably in these soils. In the areas north of Cortland, gravel, which is generally neutral or calcareous, occurs at a depth of about 30 inches. In the areas just east of Cortland, gravel occurs at a depth of 42 inches and free lime begins at a depth of 51 inches.

Dunkirk silt loam, over gravel, 0 to 4 percent slopes (DaB).—The profile of this soil is like the profile described for the series. In an area near Skaneateles Lake, however, the surface layer is fine sandy loam to a depth of about 3 or 4 inches. When the soil is cultivated, this material is mixed with the underlying silty material and the entire plow layer is then fine sandy loam.

Dunkirk silt loam, over gravel, 0 to 4 percent slopes, is easy to work. A good seedbed is more difficult to prepare in it, however, than in soils that contain less silt. This soil has good moisture-holding capacity and moderately rapid permeability to water down to the B_{22} horizon. Roots penetrate fairly easily to this horizon. In most places erosion is not a serious problem, but, in a few places, where the slopes are more than 5 percent, intensive practices are required to control erosion. The soil needs lime and phosphate. If used continuously for row crops, it will become low in organic matter.

The principal crop on this soil is corn grown for silage or grain. Oats, wheat, and alfalfa are grown on a small acreage, and, near Preble, potatoes and cabbage are grown to some extent. This soil responds well to good management. It is in capability unit I–1.

Dunkirk silt loam, over gravel, 8 to 20 percent slopes (DaC).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. Most of the slopes are short and complex. As a result, farm machinery is difficult to use. The soil erodes easily.

This soil is used mostly for hay and pasture. If row crops are grown, practices are needed to control erosion. Because of the complex slopes, stripcropping and contour farming are not too practical. Soil and water can best be conserved through cross-slope cultivation or by keeping the soil in permanent sod.

The soil needs lime and phosphate for good yields. Good response is received if fertilizer is applied and other good management practices are used. This soil is in capability unit IIIe–1.

Ellery Series

These nearly level to gently sloping soils occur in the uplands and are poorly drained. They have concave slopes in which water accumulates. The soils are acid at the surface but are nearly neutral at depths of 10 to 12 inches. They have formed in medium-textured glacial till. The till was derived from dark grayish-brown to olive-gray siltstone, sandstone, and coarse-textured shale mixed with enough limestone to make the soils neutral to slightly calcerous at depths of 24 to 36 inches. These soils are mostly in the extreme western part of the county. A few areas are on valley slopes north, northwest, and northeast of the city of Cortland.

The Ellery soils are members of the Low-Humic Gley great soil group. They are associated with moderately well drained Langford, somewhat poorly drained Erie, and very poorly drained Alden soils. The Ellery soils are similar to the Chippewa soils, but they are higher in lime and have more clay in the subsoil.

Typical profile (Ellery channery silt loam, 0 to 3 percent slopes; cultivated and area partly drained):

A_p 0 to 8 inches, very dark gray (10YR 3/1) channery silt loam; weak, fine to medium, crumb structure; friable; fine roots plentiful; pH 6.0; abrupt, smooth lower boundary.

AG 8 to 14 inches, gray to dark-gray (10YR 5/1 to 4/1) silt loam with common, fine, distinct mottles of dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4); weak to moderate, fine, subangular blocky structure; friable, slightly firm in place; a few fine roots; pH 6.5; 4 to 8 inches thick; gradual lower boundary.

B_{2g} 14 to 26 inches, mottled gray (10YR 5/1), yellowish-brown (10YR 5/6), and olive-brown (2.5Y 4/4) silt loam to silty clay loam; weak, fine to medium, subangular blocky peds within very weak prisms; slightly firm when removed or in place; a few medium-sized roots; pH 6.6; 10 to 14 inches thick; diffuse lower boundary.

C_g 26 to 37 inches, mottled dark olive-gray (5Y 3/2) and olive-brown (2.5Y 4/4) silt loam; massive; slightly firm; free of roots; in places the texture approaches loam; upper part pH 6.6, but weakly calcareous at a depth of 36 inches.

In areas where these soils have formed in till that was sorted to some extent by water, the surface layer is gravelly loam. Locally, in potholes the texture is commonly more silty than that of the typical profile. In areas where the soils integrade to the strongly acid Chippewa soils, these soils are moderately acid.

Poor drainage limits the use and productivity of these soils. Pastures make good yields, however, especially in areas that have been artificially drained. On farms where these soils predominate, pasture and clover and grasses grown together for hay are the principal crops.

Ellery channery silt loam, 0 to 3 percent slopes (EaA).—The profile of this soil is like the profile described as typical for the series. Water accumulates on the concave slopes during rainstorms and after rain has fallen. Surface runoff is slow, and internal drainage is medium to slow. As a result, the soil is cold and wet during most of the growing season. Roots can penetrate only to depths of 8 to 10 inches.

This soil is used principally for pasture. A few acres are in forest or idle. This soil is in capability unit IVw–2.

Ellery channery silt loam, 3 to 8 percent slopes (EaB).—The profile of this soil is similar to that of the soil described as typical of the series. This soil has stronger slopes, however, and is less wet. In general, it occurs between areas of moderately well drained Langford soils and nearly level, somewhat poorly drained Erie soils.

This soil is used principally for pasture, but it is better suited to the growing of hay crops. In the few areas that have been drained adequately, corn can be grown for grain and silage, and grasses and legumes can be grown together for hay. This soil is in capability unit IVw–2.

Erie Series

These soils are moderately acid and are medium textured. They have a firm, slowly permeable fragipan at depths of 8 to 13 inches. As a result, they are dominantly somewhat poorly drained. The soils have formed in uplands from medium-textured glacial till that is medium in lime. The till was derived principally from dark grayish-brown to olive-gray siltstone, sandstone, and coarse-textured shale, mixed with enough limestone to make the till slightly acid to weakly calcareous.

The Erie soils, along with the Volusia soils, occupy a large part of the uplands. They have formed on smooth slopes and are gently sloping to sloping. They are mainly in the extreme western part of the county. Small areas occur on the walls of valleys north, northeast, and northwest of the city of Cortland.

The Erie soils are members of the Sols Bruns Acides great soil group. They are associated with well drained Valois, moderately well drained Langford, poorly drained Ellery, and very poorly drained Alden soils. In some areas, mainly near Virgil, Cortland, and Homer, these soils occur at the bases of slopes below areas of well-drained Lordstown soils. These soils resemble the Volusia soils to some extent. They are less acid and their fragipan contains more clay.

Typical profile (Erie channery silt loam, 2 to 8 percent slopes; cultivated):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine, crumb structure; friable; fine roots abundant; pH 5.4; abrupt, smooth lower boundary.

A_{2g} 8 to 11 inches, light olive-brown (2.5Y 5/4) to grayish-brown (2.5Y 5/2) channery silt loam with common, fine, prominent mottles of yellowish brown (10YR 5/6); compound structure—weak, fine to medium, crumb to very weak, thin, platy; friable, slightly firm in place; fine roots plentiful; pH 5.7; 1 to 5 inches thick; abrupt, wavy lower boundary.

B'_{2g} 11 to 26 inches, olive-brown (2.5Y 4/4) channery silt loam or light clay loam; weak, fine, subangular blocky peds that form prisms 8 to 13 inches across; the peds and prisms are very firm and are firm in place; the prisms are separated by very narrow cracks filled with grayish material like that in horizon just above; interiors of the peds have a few, medium, prominent mottles of yellowish brown (10YR 5/6); a few medium-sized roots occur between prisms; pH 6.0 in upper part of horizon, but near 6.4 at a depth of 20 inches; 10 to 18 inches thick; diffuse lower boundary.

B'_{3g} 26 to 50 inches, channery light clay loam; somewhat similar to material in horizon just above, but gray streaks are less strongly expressed; weak, fine, subangular blocky peds are dark yellowish brown (10YR 4/3), and surfaces are coated with clay; slightly sticky when wet, firm when moist; less firm in place than soil in horizon just above; no roots; neutral (pH 6.6 to 7.3) throughout horizon; 15 to 25 inches thick; diffuse lower boundary.

C 50 to 58 inches, dark grayish-brown (2.5Y 4/2) to olive-gray (5Y 4/2) channery silt loam with a few, large, faint mottles of brown (2.5Y 4/4); massive (structureless) to very weak, very thick, platy structure; firm; weakly calcareous at a depth of 56 inches.

In some places these soils grade to Volusia soils, and here the pH in the upper part of the fragipan is about 5.8. In areas where the fragipan is more acid, it is generally more strongly expressed and contains less clay than in areas where the pH is 5.8. In some places, where the Erie soils are associated with soils of the Valois-Howard complexes, the profile contains more gravel than that of the typical soil and the texture of the surface layer is loam.

These soils are cold and wet until late in spring. Because of the fragipan, roots can penetrate effectively to depths of only 8 to 11 inches. The crops grown on these soils need applications of ground limestone, even though the soils formed in till that is medium in lime.

The principal crops grown on these soils are pasture grasses and grass-legume hay crops. Because Erie and Volusia soils make up most of the acreage in many fields in the uplands, the crops and cropping systems chosen need to be those that will be suitable for these soils.

Erie channery silt loam, 2 to 8 percent slopes (EbB).—The profile of this soil is like the profile described for the series. The soil is associated with poorly drained Ellery soils and with the more strongly sloping Erie soil. In some places small areas of poorly drained Ellery soils have been mapped with this soil; in only a few of these do the Ellery soils make up more than 5 percent of the area.

This soil has slow to medium surface runoff, and movement of water through the profile is very slow. In the places where drainage has not been improved, the soil is wet and cold for long periods. As a result, yields of oats and of corn grown for silage are low. Erosion is not a serious problem. This soil is in capability unit IIIw-1.

Erie channery silt loam, 8 to 15 percent slopes (EbC).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. In many areas it occurs just below areas of well drained Lordstown and moderately well drained Langford soils.

This soil has rapid runoff, and erosion is a hazard. Like Erie channery silt loam, 2 to 8 percent slopes, this soil is used mainly to grow hay crops and pasture. More of it, however, is used to grow corn for silage. Though it is limited in productivity, this soil responds well to good management. It is in capability unit IIIe-5.

Holly Series

These strongly acid, medium-textured soils are poorly drained. They have formed in alluvium that was deposited along streams in the valleys. The alluvium consists of sediments washed from soils formed on glacial till in the uplands. The till was derived from slightly acid, olive-gray sandstone, siltstone, and coarse-textured shale.

The Holly soils are members of the Low-Humic Gley great soil group. They are associated with moderately well drained Middlebury and very poorly drained Papakating soils.

Only one member of the Holly series, Holly silt loam, 0 to 1 percent slopes, has been mapped in Cortland County.

Typical profile (Holly silt loam, 0 to 1 percent slopes; under a cover of sedges):

A_1 0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam with many, fine, distinct mottles of strong brown (7.5YR 5/7) and yellowish red (5YR 5/7) along old root channels; moderate, medium, crumb structure; friable; fine roots abundant; pH 5.5; 3 to 6 inches thick; clear, smooth lower boundary.

C_{1g} 4 to 16 inches, dark grayish-brown (2.5Y 4/2) silt loam with many, fine and medium, distinct mottles of strong brown (7.5YR 5/7) and gray (5Y 5/1); massive; friable, slightly firm in place; a few medium-sized roots; pH 5.4; 10 to 18 inches thick; gradual, lower boundary.

C_{2g} 16 to 34 inches +, mottled olive-gray (5Y 5/2), dark grayish-brown (2.5Y 4/2), and yellowish-brown (10YR 5/6) silt loam to fine sandy loam; massive; friable, slightly firm in place, but looser as the amount of gravel increases; a few large roots at a depth of 20 inches; pH 5.4.

In abandoned oxbow channels of streams on the flood plains, the texture of the soil commonly ranges from clay loam to silty clay. In places gravel occurs on the surface and within the soil profile. In some places the pH is 6.0 at depths between 18 and 20 inches. The texture of the C_{2g} horizon and the amount of gravel in that horizon vary according to the degree of stratification. Near the present stream channel, the thickness of this C_{2g} horizon varies within short distances.

Holly silt loam, 0 to 1 percent slopes (HaA).—This soil occurs in nearly level areas and in depressions on the flood plains of streams. It is in the valleys south, east, and northeast of Cortland. A few areas are at the bases of outwash terrace scarps occupied by the Chenango soils.

This soil has a high water table and is cold and wet during most of the year. Consequently, it is not suitable for cultivated crops, although it is high in organic matter and plant nutrients.

In summer fair yields are obtained from pastures on this soil when pastures on other soils of the uplands are dry. Areas that can be drained can be made productive of crops other than pasture. This soil is in capability unit IIIw-3.

Homer Series

These soils are predominantly poorly drained and have a high water table. They are mainly slightly acid to neutral but are weakly calcareous below depths of 18 to 20 inches. The soils are medium textured to a depth of about 8 inches. They have formed on glacial outwash that was deposited in the valleys. The gravelly outwash was derived from acid, olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale mixed with dark-gray limestone.

The Homer soils are members of the Low-Humic Gley great soil group. They are associated with moderately well drained Phelps soils. Homer soils are also associated with very poorly drained Westland soils, which are not mapped separately in this county.

Only one member of the Homer series, Homer silt loam, 0 to 2 percent slopes, has been mapped in Cortland County.

Typical profile (Homer silt loam, 0 to 2 percent slopes; cultivated):

A_p 0 to 6 inches, dark-gray (10YR 4/1) to very dark grayish-brown (10YR 3/2) silt loam; moderate, coarse, crumb structure; friable; fine roots abundant; pH 6.7; abrupt, smooth boundary.

B_{21g} 6 to 12 inches, dark grayish-brown (10YR 4/2) gravelly silty clay loam with many, fine, prominent mottles of yellowish brown (10YR 5/4) and light brownish gray (10YR 6/2); weak, fine, and medium, subangular blocky structure; friable and slightly sticky, slightly firm in place; a few fine and medium-sized roots; pH 6.6; 4 to 9 inches thick; gradual, smooth lower boundary.

$B_{22g}D_1$ 12 to 19 inches, dark gray (10YR 4/1) to very dark gray (10YR 3/1) gravelly fine sandy loam with many, coarse, prominent mottles of light olive brown (2.5Y 5/4) and light yellowish brown

(10YR 6/4); very weak, coarse, blocky structure but breaks to very weak, medium plates; friable, slightly firm in place; a few fine roots; contains a few cobblestones; pH 6.6; 6 to 12 inches thick; clear, smooth lower boundary.

C_gD_2 19 to 36 inches, dark-gray (10YR 4/1) gravelly fine sandy loam to sandy loam with a few, coarse, prominent mottles of olive gray (5YR 5/2); structureless; loose; contains a few cobblestones and other stones; weakly calcareous.

These soils are predominantly poorly drained, but in some places they are somewhat poorly drained. Below depths of 12 to 15 inches, the texture of the soil varies because of differences in the degree of stratification. In places the B_{21g} and $B_{22g}D_1$ horizons differ from those of the typical profile in being more silty, firmer in place, and essentially free of gravel.

Homer silt loam, 0 to 2 percent slopes (HbA).—This soil occurs in nearly level areas or in slight depressions in the valleys near Cortland, Preble, Scott, and Harford. It has a high water table; below the surface layer, the soil has moderately slow permeability. Surface runoff is very slow, and internal drainage is moderately slow.

These soils are fertile, but, because they are wet and cold until midsummer, they are not productive of most farm crops. Unimproved areas are used mostly for hay crops and pasture. On a few acres, where this soil is somewhat poorly drained, corn is grown for silage. In places, where artificial drainage is practical, the soil will respond well to good management. This soil is in capability unit IIIw-2.

Howard Series

This series consists of well-drained soils that are strongly acid and medium textured to depths of 18 to 22 inches. At greater depths, the soils are finer textured. The soils are moderately acid to slightly acid at depths between 18 and 30 inches. They range from nearly level to strongly sloping.

The soils have formed in slightly acid to neutral glacial outwash. The outwash was derived mostly from acid, olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale mixed with some dark-gray limestone. The rapid to moderate permeability of the outwash material helps make the soils well drained.

These soils occur mainly on nearly level terraces in the valleys near South Cortland and Harford Mills and south of Scott (fig. 7), but some areas are near Truxton. In some of the areas near South Cortland, the soils have developed in outwash material deposited by glaciers in the form of a series of rounded hills. In the valley near Truxton, long, narrow areas of these soils lie between soils of the bottom lands and those of the uplands.

The Howard soils are Gray-Brown Podzolic-Sols Bruns Acides intergrades. They are associated with moderately well drained to somewhat poorly drained Phelps soils, somewhat poorly drained to poorly drained Homer soils, and very poorly drained Westland soils (not mapped separately in Cortland County).

Typical profile (Howard gravelly loam, 0 to 3 percent slopes; cultivated):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) gravelly loam; weak, fine to medium, crumb structure; friable; pH 6.1, limed; smooth, abrupt lower boundary.

A_2 9 to 23 inches, dark yellowish-brown (10YR 4/4) gravelly loam; weak to very weak, fine, subangular blocky structure; the lower 3 to 4 inches of horizon may be lighter in color and brown (10YR 5/3) and have thin, platy aggregates that represent remnants of an A_{22} horizon; friable; fine and medium-sized roots abundant; pH 5.2; 9 to 18 inches thick; clear, wavy lower boundary.

B_{22} 23 to 30 inches, dark-brown (10YR 3/3) gravelly loam to clay loam that contains a few dark reddish-brown (5YR 3/3) remnants of weathered limestone gravel; weak to moderate, fine and medium, subangular blocky structure; slightly firm in place; maximum zone of clay accumulation; medium-sized roots plentiful; contains a few cobblestones; pH 6.5 at a depth of 28 inches; 6 to 12 inches thick; abrupt, irregular lower boundary, but parts of this horizon extend downward, in the form of V-shaped tongues, 12 to 36 inches into the C horizons.

C_1 30 to 52 inches, dark grayish-brown to grayish-brown (10YR 4/2 to 5/2) very gravelly loam that contains fewer pebbles of weathered limestone than the horizon just above; very weak, fine, crumb structure; a few large roots; pH 6.8; 22 to 36 inches thick; gradual lower boundary.

C_2 52 to 65 inches, grayish-brown (10YR 5/2) gravelly and cobbly loam that is essentially free of weathered limestone gravel; structureless; loose; a few coarse roots; calcareous at a depth of 60 inches.

In places near the city of Cortland, these soils grade to the Palmyra soils. Here, they are slightly calcareous at a depth of 45 inches and the somewhat clayey B_{22} horizon is at depths 2 to 6 inches closer to the surface. In some areas, where the outwash material contains but little limestone, these soils grade to the Chenango soils. In these areas they are strongly acid to depths between 36 and 50 inches and have a weakly expressed clayey horizon at depths between 40 and 60 inches.

The Howard soils have formed in open, porous material and are, therefore, not likely to be damaged severely through erosion. They are well drained, well aerated, and have good moisture-holding capacity; consequently, they are well suited to the growth of plants. The upper horizons of the profile, however, are low in lime and plant nutrients.

These soils are important for agriculture, but they also provide ideal sites for public housing and industrial devel-

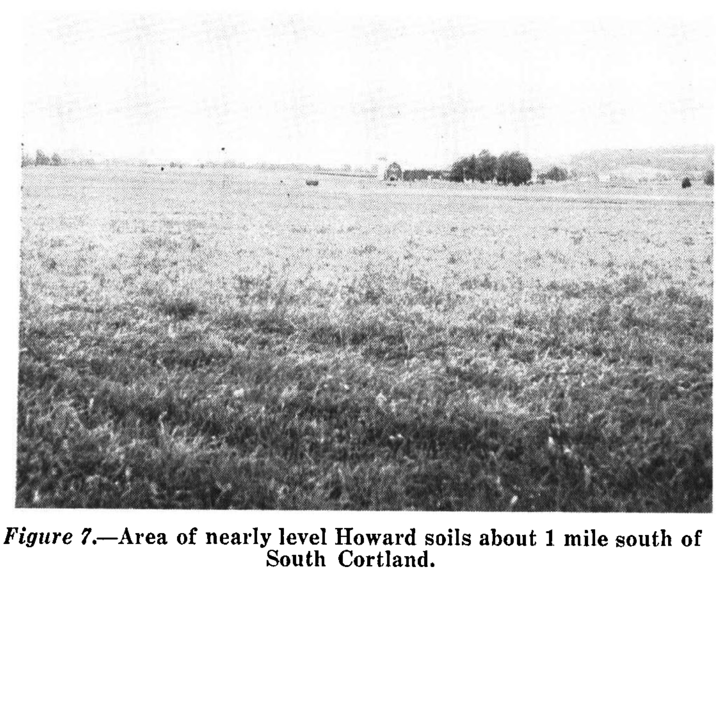

Figure 7.—**Area of nearly level Howard soils about 1 mile south of South Cortland.**

opment. High-grade gravel for use in construction is obtained from the deeper horizons and in the layers below the soil profile.

The soils are well suited to the principal crops grown in the county—oats, corn grown for silage and grain, and grass-legume hay crops (especially grass-alfalfa mixtures) and pasture. Farm machinery is easy to use on the nearly level soils.

Howard gravelly loam, 0 to 3 percent slopes (HdA).—The profile of this soil is like the typical profile described for the series. The soil is on level terraces and in very gently sloping areas. Mapped with it are some areas in which the soil is free of gravel to depths between 14 and 20 inches. These areas, which total about 50 acres, are near Harford.

This soil has good drainage and good moisture-holding capacity. It is well aerated and roots penetrate deeply. As a result, it is ideally suited to the crops commonly grown. The soil must be well managed, however, if it is cropped continuously. It is in capability unit I–1.

Howard gravelly loam, 3 to 8 percent slopes (HdB).—This soil has stronger slopes than the soil described for the series, but its profile is similar. In a few areas it has complex slopes. The soil is associated with Howard gravelly loam, 0 to 3 percent slopes. In a few small areas, each about 5 acres in size, it is severely eroded. These areas are indicated on the detailed soil map by a symbol for erosion.

This soil is well drained and has good moisture-holding capacity. Roots can penetrate deeply. The soil is well suited to all the crops commonly grown, and farm machinery can be used on it easily. Crops respond well if lime and fertilizer are added and other good management practices are used. This soil is in capability unit IIe–1.

Howard gravelly loam, 8 to 15 percent slopes (HdC).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. In most places the slopes are complex, but in places there are short, single slopes. Small areas of a Phelps soil, most of which are less than 3 acres in size, are mapped with this soil.

Runoff is more rapid on this soil than on the less sloping Howard gravelly loams. Consequently, this soil is more droughty and erodible, and it is used less extensively for row crops. The crops respond well if lime and fertilizer are added and other good management practices are used. This soil is in capability unit IIIe–1.

Howard gravelly loam, 15 to 25 percent slopes (HdD).—This soil occurs in association with other Howard soils. It is moderately steep, but its profile is similar to the profile described as typical of the series. This soil has both single and complex slopes. Most of it is on conical hills where runoff is very rapid. It also occurs on short slopes on the scarps of outwash terraces.

This soil is droughty and is subject to severe erosion. Severely eroded areas that are 5 acres or more in size are indicated on the detailed soil map by a symbol for erosion.

Most of this soil is used for hay crops or pasture, but corn is grown occasionally. Good crop response is received if lime and fertilizer are added and other good management is used. This soil is in capability unit IVe–1.

Howard cobbly loam, 0 to 3 percent slopes (HcA).—The surface layer of this soil differs from that of the soil described for the series, but the profile is otherwise similar. Many rounded, subangular cobblestones are scattered over the surface and mixed with the soil material. The cobblestones consist of granite and sandstone and range from 3 to 10 inches in diameter. This soil is associated with the Howard gravelly loams. The largest areas are near South Cortland.

This soil is used and managed like Howard gravelly loam, 0 to 3 percent slopes. The cobblestones make it more difficult to cultivate, however, and cause farm machinery to receive more wear. This soil is in capability unit I–1.

Howard cobbly loam, 3 to 8 percent slopes (HcB).—This soil has stronger slopes than the soil described as typical of the series, and the texture of its surface layer differs. The profile is similar otherwise, and this soil occurs in the same general areas.

The soil is rapidly permeable to water, and roots can penetrate easily. It is used in about the same way as Howard gravelly loam, 3 to 8 percent slopes, and its management is about the same. It is in capability unit IIe–1.

Kendaia Series

These medium-lime soils are somewhat poorly drained to poorly drained and are medium textured. They have formed in glacial till that was derived from siltstone, sandstone, shale, and limestone. The till is high in lime.

The Kendaia soils are members of the Gray-Brown Podzolic great soil group. They are generally associated with moderately well drained Conesus and very poorly drained Alden soils.

Only one member of the Kendaia series, Kendaia silt loam, 1 to 6 percent slopes, has been mapped in Cortland County.

Typical profile (Kendaia silt loam, 1 to 6 percent slopes; in a meadow):

A_p 0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; strong, coarse, granular structure; friable; fine roots abundant; pH 6.4; abrupt, smooth lower boundary.

A_{2g} 9 to 15 inches, grayish-brown (2.5Y 5/2) silt loam with many, medium, distinct mottles of dark yellowish brown (10YR 4/4) and strong brown (7.5YR 5/6); moderate, fine, subangular blocky structure; friable to slightly firm; a few medium-sized and fine roots; pH 6.7; 3 to 10 inches thick; clear, wavy lower boundary.

B_g 15 to 26 inches, dark grayish-brown (2.5Y 4/2) silty clay loam with many, medium and coarse, distinct mottles of gray (5Y 5/1) and yellowish brown (10YR 5/4); moderate, fine and medium, subangular blocky structure; slightly firm, slightly sticky; a few large roots; contains a few pebbles and channery fragments; pH 6.8 in upper part of horizon, but weakly calcareous at a depth of 24 inches; 8 to 15 inches thick, gradual, wavy lower boundary.

C_g 26 to 39 inches, dark olive-gray (5Y 3/2) silt loam; a few, very coarse, prominent mottles of olive brown (2.5Y 4/4) and gray (5Y 5/1); massive (structureless) or weak, thick, platy structure; slightly firm, firm in place; free of roots; calcareous.

In areas where these soils are in depressions, the depth to the B_g horizon varies considerably. In some places, where the depth to the B_g horizon is 24 inches, the surface soil is nearly black. These soils do not have gravel and stones on the surface, but there are some pebbles and channery fragments in the lower horizons.

Kendaia silt loam, 1 to 6 percent slopes (KaB).—This soil occurs near Scott and Cuyler. It lies on land forms about halfway between the soils in the uplands and the soils in the valleys. The slopes are very gentle to slightly concave. As a result, water accumulates on the surface.

This soil is cold and wet for long periods during the early part of the growing season. Even though it is high in organic matter and lime, cultivated crops grown on it do not make good yields except where artificial drainage has been installed and phosphate fertilizer added. Nevertheless, good yields of hay crops and pasture are obtained during periods when the pastures on better drained soils dry out. If this soil is drained artificially, it is suited to about the same crops as the gently sloping Lansing and Conesus soils and high yields can be obtained. It is in capability unit IIIw–2.

Langford Series

These moderately well drained soils are medium textured and moderately acid. They have a fragipan that begins at depths ranging from 15 to 18 inches. The soils have formed in glacial till. The till was derived from dark grayish-brown to olive-gray siltstone, sandstone, and coarse-textured shale mixed with enough limestone to make the soil slightly acid to neutral.

The Langford soils are sloping to rolling. They are in the uplands, mainly between Harford and Homer in the western part of the county. They also occur on some of the lower walls of valleys northeast of the city of Cortland and northwest of Homer.

The Langford soils belong to the Sols Bruns Acides great soil group. They occur in association with the well-drained soils of the Valois-Howard complexes. They are also associated with somewhat poorly drained Erie, poorly drained Ellery, and very poorly drained Alden soils. The Langford soils resemble the Mardin soils, but they have formed in till that was less acid and their B'_{2g} horizon contains more clay.

Typical profile (Langford channery silt loam, 8 to 15 percent slopes; cultivated):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine, crumb structure; friable; fine roots abundant; pH 5.4; abrupt, smooth lower boundary.

B_2 9 to 16 inches, yellowish-brown (10YR 5/6) channery silt loam; yellowish brown (10YR 5/4) at a depth of 12 inches; common, fine, prominent mottles of gray (10YR 5/1) and grayish brown (2.5Y 5/2) in the lower 3 or 4 inches of this horizon; fine and medium-sized roots plentiful; pH 5.2; 10 to 18 inches thick; clear, smooth lower boundary.

A'_{2g} 16 to 18 inches, olive (5Y 4.5/3) channery silt loam with a few, fine, prominent mottles of dark yellowish brown (10YR 4/4) and gray (5Y 5/1); weak, fine, subangular blocky structure, but breaks to very weak, thin, platy; friable, slightly firm in place; a few medium-sized roots; pH 5.2; 1 to 5 inches thick; abrupt, wavy lower boundary.

B'_{2gm} 18 to 36 inches, olive-brown (2.5Y 4/4) channery silt loam to light clay loam; firm; very weak, medium, subangular blocky aggregates form prisms that are 8 inches across; the prisms have thin, yellowish-brown (10YR 5/6) borders separated by gray (5Y 5/1) streaks consisting of material comparable to that in horizon just above; very firm in place; pH 6.5; 12 to 20 inches thick; diffuse lower boundary.

B'_{3gm} 36 to 56 inches, light olive-brown (2.5Y 5/4) channery silt loam; very weak, medium, subangular blocky structure to massive (structureless); hard, firm in place; a few gray streaks divide this horizon into coarse prisms similar to those in horizon just above; pH 6.6; 12 to 30 inches thick; diffuse lower boundary.

C 56 to 76 inches, olive-gray (5Y 4/2) channery silt loam; massive (structureless) to very weak, very thick, platy structure; firm when removed or in place; a few, large mottles of gray (N 5/) on outside of plates; neutral, but becomes weakly calcareous at a depth of 76 inches.

In many small areas adjacent to soils of the Valois-Howard complexes, the texture is gravelly silt loam. In these places the B'_{2g} and C horizons contain more gravel than comparable horizons in the typical profile.

Above the fragipan, the soils are strongly acid. They may be low in organic matter and phosphorus and medium in potassium. The fragipan restricts drainage and makes the soils cold and wet in spring; roots can penetrate only to depths of 14 to 18 inches.

These soils make up much of the agricultural land in the parts of the county in which they are mapped. They are used principally for oats, corn grown for silage and grain, and grass-legume hay crops and pasture. Some varieties of alfalfa can be grown. Crops respond well if lime and commercial fertilizer are added and other good management practices are used.

Langford channery silt loam, 3 to 8 percent slopes (LaB).—This soil has a profile similar to the soil described for the series, but it has milder slopes. The areas in which slopes are 5 to 6 percent occur in association with the somewhat poorly drained Erie soils; the areas on which slopes are 2 to 3 percent lie next to the poorly drained Ellery soils. Small areas of both Erie and Ellery soils are included with this mapping unit. In only a few places does their total acreage constitute more than 8 percent of an individual area shown as this soil on the detailed map.

This soil is suited to the principal crops grown in the county—corn, oats, and grasses and legumes grown for hay. Some varieties of alfalfa can be grown. Farm machinery is easy to use on this soil, and the risk of erosion from excessive runoff is not great. For good yields of crops, lime, phosphate, and manure are needed. This soil is in capability unit IIe–2.

Langford channery silt loam, 8 to 15 percent slopes (LaC).—The profile of this soil is like the one described as typical of the series. This soil occurs in rolling, slightly convex areas in the uplands, along with areas of less strongly sloping Erie soils. In places it has lost most of the original surface layer through erosion. These spots are indicated on the detailed map by an erosion symbol. In some places, where the slopes are the strongest, as much as 8 percent of an individual area, shown as this soil on the detailed map, may consist of Valois soils.

This soil, the most extensive of the Langford series, is suited to most crops grown on dairy farms. The slopes are not too steep for the use of farm machinery; runoff is rapid, however, and the soil is likely to become severely eroded if it is not protected. Because the upper part of the profile is strongly acid, the soil needs lime and fertilizer for high yields. This soil is in capability unit IIIe–2.

Langford channery silt loam, 15 to 25 percent slopes (LaD).—This soil is moderately steep, but its profile is like that of the typical soil described for the series. This soil occurs in the uplands, most commonly along the walls of drainageways and on the parts of valley walls that are adjacent to bottom lands. As much as 10 percent of an individual area, shown as this soil on the detailed map, may consist of Valois soils.

Runoff is rapid to very rapid on this soil, and only a limited amount of moisture infiltrates into the soil; consequently, erosion is a hazard. The soil is acid and has only a moderate amount of available plant nutrients. It is used principally for pasture and for crops grown for forage. Corn is grown occasionally. This soil is in capability unit IVe–3.

Lansing Series

These medium-textured, well-drained soils have a subsoil of silty clay loam that begins at depths between 25 and 34 inches. The soils have formed in medium-lime glacial till derived from sandstone, shale, and limestone. They are mainly on gently sloping to undulating plains between Scott and Cuyler, but small areas are near South Cortland. The soils lie about halfway between the soils in the uplands and the soils in the valleys. Near Scott and northwest of Preble, the till was deposited in moraines that have distinct undulating topography.

The Lansing soils belong to the Gray-Brown Podzolic great soil group but intergrade to Sols Bruns Acides. They have a thick A_2 horizon that, in the upper part, has weakly developed characteristics like the B_2 horizon of the typical soils in the Sols Bruns Acides great soil group. The Lansing soils are associated with moderately well drained Conesus soils, somewhat poorly drained to poorly drained Kendaia soils, and very poorly drained Alden soils.

Typical profile (Lansing gravelly silt loam, 8 to 15 percent slopes; cultivated):

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam; moderate, medium, crumb structure; friable; fine roots abundant; pH 6.4, limed; abrupt, smooth lower boundary.

A_{21} 7 to 14 inches, yellowish-brown (10YR 5/4) gravelly silt loam; weak, fine crumb structure; friable; fine and medium-sized roots abundant; pH 5.3; 4 to 9 inches thick; gradual, smooth lower boundary.

A_{22} 14 to 19 inches, brown (10YR 5/3) gravelly silt loam; weak, fine, crumb structure; friable; medium-sized roots plentiful; pH 5.3; 3 to 8 inches thick; clear, smooth lower boundary.

B_{21} 19 to 27 inches, dark-brown (10YR 4/3) gravelly silt loam; moderate, fine, subangular blocky structure; exteriors of peds have clear grains of sand or silt giving them a frosty appearance; slightly hard, slightly firm in place; pH 5.5; 6 to 12 inches thick; gradual, wavy lower boundary.

B_{22} 27 to 40 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) gravelly silty clay loam; moderate, medium, subangular blocky structure; slightly hard when dry, sticky when wet, firm in place; a few large roots; pH 5.8; 10 to 16 inches thick; clear, wavy lower boundary.

C 40 to 56 inches, dark grayish-brown (2.5Y 4/2) gravelly silt loam; massive (structureless) or very weak, thick, platy structure; firm, slightly firm in place; a few large roots; pH 6.8 to a depth of 43 inches, but calcareous at a depth of 50 inches.

In these soils depth to the layer of silty clay loam and to the calcareous material varies. Northeast of Preble near the county line and in the northeastern corner of the county near De Ruyter in Madison County, these soils have a layer of silty clay loam beginning at depths between 10 and 16 inches; here, the reaction of the surface soil is neutral and the soil is calcareous at a depth of 26 inches. Near South Cortland, however, the soil has free lime beginning at a depth of 5 feet.

These soils have enough slope so that excessive water runs off, and they are permeable to water. As a result, they are well drained. Roots penetrate the soil easily. Because the lower part of the subsoil is clayey, the soils have good moisture-holding capacity and are high in potassium-supplying power. Except for the steep areas, they are easy to work. The soils that have strong slopes are subject to serious erosion. The surface layer of these soils is low in lime. The soils are low in phosphorus but high in ability to supply potassium.

The Lansing soils are suitable for most crops grown in the county. They are highly productive if managed well.

Lansing gravelly silt loam, 3 to 8 percent slopes (LbB).—The profile of this soil is essentially the same as the one described as typical of the series. In general, the slopes are mild and runoff is not rapid. In places, principally near Scott, the soil has short, gentle, complex slopes. Most of this soil occurs next to other Lansing soils and near moderately well drained Conesus and somewhat poorly drained to poorly drained Kendaia soils.

This soil is excellent for most crops commonly grown in the area, and it responds well to good management. It is easy to work, and erosion is not a serious problem. The soil needs lime and liberal applications of fertilizer for continuous high yields. It is in capability unit IIe–1.

Lansing gravelly silt loam, 8 to 15 percent slopes (LbC).—The profile of this soil is like the profile described as typical of the series. In general, this soil has simple slopes, but near Scott it has short, moderately steep slopes. Severely eroded spots that are a few acres in size are indicated on the detailed map by the symbol for erosion.

This soil has more rapid runoff and is more erodible than Lansing gravelly silt loam, 3 to 8 percent slopes. Also, it absorbs less water, is slightly more droughty, and is not so easy to work.

The soil is well suited to the crops commonly grown, but it needs protection from excessive runoff and erosion. It needs lime and a fertilizer high in phosphorus and nitrogen if continuous high yields are to be obtained. This soil is in capability unit IIIe–1.

Lansing gravelly silt loam, 15 to 25 percent slopes (LbD).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. It occurs in the same general areas as other Lansing soils. Runoff is rapid to very rapid, and the soil is subject to severe erosion if it is not managed properly. In a small acreage this soil has been severely eroded.

Most of this soil is used to grow hay crops and pasture, but corn is grown for silage on a few acres. Lime and fertilizer are needed in areas that are cropped. This soil is in capability unit IVe–1.

Lansing gravelly silt loam, 25 to 35 percent slopes (LbE).—This strongly sloping soil has a profile similar to the one described as typical of the series. It occurs along drainageways and on the faces of till deposits.

The soil has rapid runoff and is droughty. It is poorly suited to field crops. Although suitable for pasture, the soil requires careful management to control erosion. If it is managed properly, fair yields of pasture grasses are obtained. This soil is in capability unit VIe-1.

Lobdell Series

These medium-textured, moderately well drained soils occur on flats and in slight depressions on low, first bottoms adjacent to streams. They have formed from alluvium consisting of both acid sediments washed from soils in the uplands and alkaline sediments washed in from high-lime soils to the north. Consequently, the Lobdell soils are less acid than if they had formed entirely from acid parent material. They are slightly acid to moderately acid.

The Lobdell soils belong to the Alluvial great soil group. They are associated with well-drained Chagrin soils, poorly drained Wayland soils, and very poorly drained Sloan soils. The Lobdell soils are similar to the Middlebury soils, but the Middlebury soils are strongly acid.

Only one Lobdell soil, Lobdell silt loam, 0 to 2 percent slopes, has been mapped in Cortland County.

Typical profile (Lobdell silt loam, 0 to 2 percent slopes; cultivated):

A_p 0 to 10 inches, grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; fine roots abundant; pH 6.4, limed; abrupt, smooth lower boundary.

C_1 10 to 19 inches, olive-brown (2.5Y 4/4) silt loam; a few, fine, prominent mottles of light brownish gray (2.5Y 6/2) at a depth of 16 inches; compound structure—moderate, medium, granular to very weak, fine, subangular blocky; friable to slightly firm; fine and medium-sized roots abundant; pH 5.8 but near 6.0 at a depth of 18 inches; 6 to 12 inches thick; clear, wavy lower boundary.

C_{2g} 19 to 26 inches, olive-brown (2.5Y 4/4) to dark grayish-brown (2.5Y 4/2) gravelly silt loam to fine sandy loam with many, medium to large, distinct mottles of dark reddish brown (5YR 3/4) and gray (10YR 5/1); massive but breaks to very weak, fine, subangular blocky; slightly firm when removed or in place; a few large roots; pH 6.3.

D_g 26 to 38 inches, dark grayish-brown (2.5Y 4/2) gravelly alluvium of variable texture; structureless; loose to slightly firm in place; a few large roots; pH 6.6.

In areas near Homer, Preble, and Scott, the surface layer of this soil is neutral instead of moderately acid or slightly acid. In some areas the soil is mottled at a depth of about 12 inches. In places the D_g horizon is several feet thick.

Lobdell silt loam, 0 to 2 percent slopes (LcA).—This soil occurs along streams in the valleys north and northwest of the city of Cortland. It is also near Marathon in the valley of the Tioughnioga River. A few scattered areas are in valleys in other parts of the county. In spring the soil is flooded frequently. Some erosion results from scouring by floodwaters, but the damage is seldom serious. Most of this soil is on low bottoms, but small areas are on high bottoms.

In this soil the water table is at a depth of about 12 inches early in spring, but it drops to depths of 24 to 36 inches by the time crops are planted. The uppermost 18 to 20 inches of soil is moderately permeable to water and is penetrated easily by roots.

This soil is productive of the crops commonly grown in the county. Most of the Lobdell soil is used to grow oats, corn for silage, and grass-legume hay crops. It is suitable for intensive cultivation; if row crops are grown continuously, they will need lime, phosphate, and manure to produce high yields. This soil is in capability unit IIw-2.

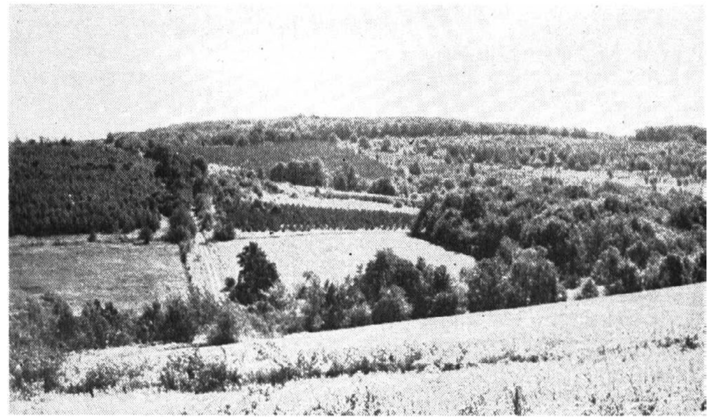

Figure 8.—**Lordstown channery silt loams are on the high ridges in the background. Volusia channery silt loams are at the bases of the ridges.**

Lordstown Series

These medium-textured, strongly acid soils are on the highest ridges in the uplands (fig. 8) and on the steep walls of the valleys. The soils are well drained. They have formed in thin glacial till derived from olive-gray to dark grayish-brown sandstone, siltstone, and coarse-textured shale.

The Lordstown soils are members of the Sols Bruns Acides great soil group. They occur in association with moderately well drained Mardin and Arnot soils, somewhat poorly drained Volusia soils, and poorly drained Tuller soils.

Typical profile (Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes; cultivated):

A_p 0 to 8 inches, dark yellowish-brown (10YR 4/3) channery silt loam; weak, fine, crumb structure; friable; fine roots abundant; pH 4.8; abrupt, smooth lower boundary.

B_{21} 8 to 15 inches, yellowish-brown (10YR 5/8) to strong-brown (7.5YR 5/6) channery silt loam; compound structure—very weak, fine, subangular blocky and weak, medium, crumb; friable; fine and medium-sized roots plentiful; pH 4.8; 6 to 10 inches thick; clear, smooth lower boundary.

B_{22} 15 to 23 inches, yellowish-brown (10YR 5/4) channery silt loam; compound structure—very weak, fine, subangular blocky and weak, coarse, crumb; friable, slightly firm in place; medium-sized roots plentiful; pH 5.0; 5 to 12 inches thick; gradual, smooth lower boundary.

B_3 23 to 30 inches, light olive-brown (2.5Y 5/4) to yellowish-brown (10YR 5.5/4) channery silt loam; compound structure—very weak, fine, subangular blocky and weak, coarse, crumb; friable to slightly firm, but firmer in place than material in horizon just above; a few large and medium-sized roots; contains a few fragments of flagstone; pH 5.2; 6 to 14 inches thick; gradual, smooth lower boundary.

C_g 30 to 36 inches, olive-brown (2.5Y 4/4) channery silt loam with a few, large, distinct mottles of yellowish brown (10YR 5/6); compound structure—very weak, coarse, blocky to very weak, thick, platy; firm to hard, firm in place; outsides of peds have grayish-brown (10YR 5/2) coating of silt; a few large roots; fragments of flagstone common; pH 5.4; 6 to 20 inches thick; abrupt, smooth lower boundary.

D 36 inches +, fractured, olive-gray to dark grayish-brown siltstone and sandstone with material like that in the horizon just above in the joints and bedding planes; a few large roots; pH 5.8.

Depth to bedrock ranges from 10 to 40 inches, but it is generally between 30 and 36 inches. In places the bedrock outcrops. In some areas of shallow soil, fragments of flagstone, as much as 8 to 10 inches in diameter, are in the soil material and scattered over the surface.

These soils have good drainage and are permeable to water.

Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes (LdB).—The profile of this soil is like the one described as typical of the series. The soil occurs on the highest ridges of the uplands. It is associated with Mardin, Volusia, and Tuller soils. Commonly, small, wet spots of Tuller and Alden soils, shown on the detailed map by a symbol for wet spots, are mapped with this soil.

This strongly acid, well-drained soil is moderately permeable to water, and roots penetrate easily. Surface runoff is slow to medium, and erosion is not serious. Farm machinery is easy to use. The soil is low in natural fertility but responds to appropriate management. At the high elevations where this and the other Lordstown soils occur, the temperatures are slightly lower than in other parts of the county. As a result, the growing season is 1 to 2 weeks shorter than in other parts of the county.

The principal crops are oats, corn grown for silage, and grass-legume hay crops and pasture. Potatoes and cabbage are grown in a few areas. This Lordstown soil is excellent for alfalfa-grass mixtures grown for hay. Fast-growing early varieties of alfalfa utilize soil moisture most effectively in the early part of the growing season. This soil is in capability unit IIe–1.

Lordstown channery silt loam, shallow, 2 to 8 percent slopes (LeB).—This soil has a shallower profile than the soil described as typical of the series. Depth to bedrock is only 10 to 24 inches. The soil is associated with Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes. It also occurs in the same general areas as the moderately well drained Arnot and poorly drained Tuller soils.

In this soil shallowness to bedrock limits the penetration of roots to depths of less than 20 inches and restricts the moisture-holding capacity and supply of plant nutrients. Runoff is medium, and erosion is not serious. Farm machinery is easy to use, except in small areas where bedrock is at the surface.

This soil is used principally to grow grass-legume hay crops and pasture. Potatoes are grown on a few acres. Even though the soil is low in fertility, strongly acid, and somewhat droughty, the crops make fair yields if the soil is well managed. This soil is in capability unit IIIs–1.

Lordstown channery silt loam, 8 to 15 percent slopes (LfC).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. It occurs in the same general areas as other Lordstown soils. It is also associated with moderately well drained Mardin and Arnot soils and with somewhat poorly drained Volusia soils.

In the more strongly sloping areas, as much as 5 percent of an individual area, shown as this soil on the detailed map, may consist of Lordstown channery silt loam, shallow, 2 to 8 percent slopes. Small, seepage spots of Tuller and Alden soils, indicated on the detailed map by a symbol for wetness, are included with this soil. In areas where most of the original surface soil has been lost through erosion, the present plow layer consists mainly of subsoil material. These eroded areas are indicated on the map by an erosion symbol.

This soil is productive if it is limed and fertilized. It is used to grow the same kinds of crops as are grown on less sloping Lordstown soils. This soil is in capability unit IIIe–1.

Lordstown channery silt loam, 15 to 25 percent slopes (LfD).—The profile of this soil is similar to the typical profile described for the series. The soil occurs in the uplands with other Lordstown soils. Most of it is on the slopes of ridges that have Volusia soils at their bases. Small, wet areas of Tuller and Alden soils are mapped with this soil. The wet spots are indicated on the detailed map by a symbol for wetness.

Moderately steep slopes and the risk of erosion limit the use of this soil for crops. The soil is used mainly for hay crops and pasture. Good yields are obtained if lime and fertilizer are added. Occasionally, corn for silage and oats are grown. This soil is in capability unit IVe–1.

Lordstown soils, 25 to 55 percent slopes (LgE).—These steep soils have a shallower profile than the soil described as typical of the series. They occur on the walls of narrow valleys in all parts of the county.

Runoff is very rapid on these soils. As a result, the soils are droughty and are highly susceptible to severe erosion. Although for most plants the root zone is shallow, the roots of trees penetrate the joints and fractured spaces in the bedrock.

These soils are low in fertility. If used for pasture, they need liberal applications of fertilizer and lime. A large acreage, once used for crops or pasture, has been reforested. Most areas, especially those on slopes of more than 35 percent, should be kept in forest. This mapping unit is in capability unit VIe–1.

Mardin Series

These medium-textured soils are strongly acid and are moderately well drained. They have a hard, compact fragipan that begins at depths between 15 and 20 inches. The soils are on sloping to rolling areas of the uplands. They have formed in glacial till of firm channery silt loam. The till was derived from slightly acid, olive-gray to grayish-brown siltstone, sandstone, and coarse-textured shale.

The Mardin soils are members of the Sols Bruns Acides great soil group. They are associated with well-drained Bath and Lordstown, somewhat poorly drained Volusia (fig. 9), poorly drained Chippewa, and very poorly drained Alden soils. The Mardin soils resemble the Langford soils, but their parent material is less acid and their B'_{2gm} horizon contains less clay.

Typical profile (Mardin channery silt loam, 8 to 15 percent slopes; cultivated):

A_3 0 to 9 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine, crumb structure; friable; pH 4.8, unlimed; abrupt, smooth lower boundary.

B_2 9 to 14 inches, yellowish-brown (10YR 5/4) channery silt loam with a few, faint mottles of grayish brown (10YR 5/2) in the lowest 3 inches; very weak, fine, subangular blocky structure, but breaks to weak, medium, crumb; friable; fine and medium-sized roots plentiful; pH 5.1; 8 to 15 inches thick; clear, smooth lower boundary.

A'_{2g} 14 to 17 inches, light olive-brown to grayish-brown (2.5Y 5/4 to 5/2) channery silt loam with common, distinct, mottles of yellowish brown (10YR 5/6); weak to moderate, medium, platy structure; friable; a few fine roots; pH 4.9; 2 to 4 inches thick; abrupt, wavy lower boundary.

B'_{2gm} 17 to 38 inches, olive-brown to dark yellowish-brown (2.5Y 4/4 to 10YR 4/4) channery silt loam with common, coarse, distinct mottles of grayish brown (2.5Y 5/2); very weak, medium, blocky peds that are very firm to extremely hard form weak, coarse, blocky peds that have gray (10YR 5/1) exteriors; the coarse peds form prisms that are 6 to 24 inches across; the prisms are separated by cracks ¾ to 1½ inches wide; the cracks are filled with grayish-brown (2.5Y 5/2) silt loam, comparable to that in the A'_{2g} horizon, and they have yellowish-brown (10YR 5/6 to 5/8) borders; a few large roots are in the cracks; pH 5.0 in upper part of horizon, but increases to 6.0 at a depth of 32 inches; 14 to 24 inches thick; gradual, wavy lower boundary.

B'_{3gm} 38 to 60 inches, olive-brown to olive (2.5Y 4/4 to 5Y 5/3) channery silt loam; very weak, medium, blocky structure grading to massive (structureless) or very weak, thick, platy in the lowest 4 to 6 inches; very firm, very hard; the blocks and plates are within prisms coated with grayish brown (2.5Y 5/2); the prisms are 20 to 40 inches across and are separated by cracks, which are extensions of the vertical cracks between prisms in the horizon just above; essentially free of roots; pH 6.0 but increases to 6.5 at a depth of 60 inches; 18 to 30 inches thick; diffuse lower boundary.

C 60 inches +, olive to olive-gray (5Y 4/4 to 4/2) channery silt loam; very weak, very thick, platy structure and massive (structureless); firm, hard; a complicated pattern of thin, irregular, discontinuous gray streaks gives this horizon a faintly mottled appearance; pH 6.5 to 6.8 at a depth of 70 inches; the till is commonly calcareous at depths greater than 70 inches.

In places, where these soils occur among Bath-Chenango soils, the fragipan is not so strongly expressed as it is in the typical profile and the B'_{3gm} and C horizons contain more gravel. In some of these places, the texture of the surface soil is loam.

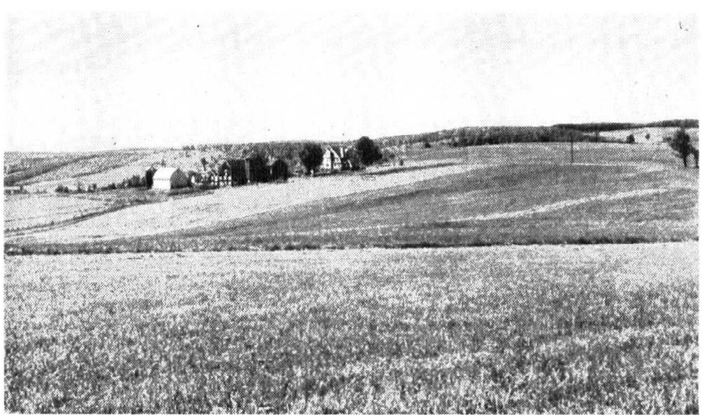

Figure 9.—**Mardin channery silt loam occupies the rolling, convex slopes in the background, and Volusia channery silt loam, the nearly level area in the foreground. These soils are on a typical farmstead about 1 mile east of Marathon.**

The fragipan, which somewhat restricts internal drainage, makes the soil cold and wet in spring and limits the depth to which roots can penetrate. The Mardin soils are medium in organic matter. They are strongly acid. They are low in available nitrogen and phosphorus and medium in ability to supply potassium. These soils are responsive to good management.

These extensive soils, along with the Volusia and Lordstown soils, constitute most of the agricultural land in the county. The Mardin soils are used principally for oats, corn grown for silage, and grass-legume hay crops and pasture. In a few areas potatoes and cabbage are grown.

Mardin channery silt loam, 2 to 8 percent slopes (MaB).—This soil is more nearly level than the soil described as typical of the series, but its profile is similar. Its fragipan, however, begins 2 or 3 inches nearer the surface. The soil occurs on low-lying, convex ridges in the uplands in association with Volusia soils. In places, where the soil is nearly level, as much as 10 percent of an individual area, shown on the detailed map as this soil, may consist of Volusia channery silt loam, 2 to 8 percent slopes. In places, where the slopes are stronger, as much as 10 percent of an individual area of this soil may consist of Arnot channery silt loam, 2 to 8 percent slopes.

Farm machinery is easy to use on this soil, and the danger of erosion is not great. The soil is limited mainly by its low fertility, by the low content of lime, and by slight wetness in spring. It responds well to appropriate combinations of management practices. Good crop yields are obtained if lime and fertilizer are added and if a cropping system is used that will help to increase the content of readily decayable organic matter. This soil is in capability unit IIe–2.

Mardin channery silt loam, 8 to 15 percent slopes (MaC).—The profile of this soil is like the profile described as typical of the series. Most of this soil occurs on sloping and rolling parts of the uplands.

Runoff is rapid. Even though the soil has a fragipan, it dries out sooner in spring than the Volusia soils. The fragipan limits the depth to which roots can penetrate. Roots are largely dependent on the water and plant nutrients in the soil material above the fragipan. Farm machinery is easy to use on this soil.

This soil is used mainly to grow corn, oats, and hay crops. It is used more extensively to grow corn for silage than the more gently sloping Mardin soils. Cabbage and potatoes are grown in a few areas but are minor crops. Though this soil is naturally low in fertility, good crop response is received if lime and fertilizer are added and erosion-control practices, as stripcropping and contour cultivation, are used. This soil is in capability unit IIIe–2.

Mardin channery silt loam, 8 to 15 percent slopes, eroded (MaC3).—The profile of this soil is similar to the one described for the series. In this soil, however, the fragipan begins at a depth of 10 inches. Consequently, the effective root zone is shallower. Also, because of the effects of erosion, the present plow layer consists mostly of former subsoil material. The present plow layer has poorly defined structure and is strongly acid and low in organic matter.

This soil is used to grow about the same kinds of crops as are grown on Mardin channery silt loam, 8 to 15 percent slopes. Unless it is managed properly, the soil is likely to be damaged further through erosion. Erosion can be controlled by stripcropping, by contour cultivation, and, in some places, by the use of diversion terraces. Good crop yields can be obtained on this soil by proper liming and fertilizing and through the use of other good management practices. This soil is in capability unit IVe–2.

Mardin channery silt loam, 15 to 25 percent slopes (MaD).—This soil is somewhat similar to the soil described as typical of the series. It has steeper slopes, and the fragipan is 2 to 4 inches nearer the surface. In a few places where the slopes are the strongest, as much as 5 percent of an individual area, shown on the detailed map as this soil, may consist of Bath channery silt loam, 15 to 25 percent slopes. Small areas of Mardin channery silt loam, 8 to 15 percent slopes, eroded, have been mapped with this soil; these areas are indicated on the detailed map by a symbol for erosion.

Only light farm machinery can be used on this soil. The shallow depth to the fragipan causes the soil to be low in moisture-holding capacity. There is a serious hazard of erosion, and small gullies are common.

Most of this soil is used for meadow and pasture, but, occasionally corn is grown for silage. Because of steep slopes, the soil must be managed carefully to reduce the erosion hazard if it is used for crops. The crops will need lime and fertilizer if good yields are to be obtained. This soil is in capability unit IVe–3.

Middlebury Series

These soils are medium textured and are dominantly moderately well drained. They are on low first bottoms and on high bottoms adjacent to streams. The soils have formed in alluvium washed from soils in adjacent uplands. The alluvial sediments were derived from slightly acid, olive-gray to grayish-brown sandstone, siltstone, and coarse-textured shale.

The Middlebury soils belong to the Alluvial great soil group. They occur with well-drained Tioga, poorly drained Holly, and very poorly drained Papakating soils. The Middlebury soils are strongly acid, but, otherwise, they are somewhat similar to the Lobdell soils, which are slightly acid.

Only one member of the Middlebury series, Middlebury silt loam, 0 to 2 percent slopes, has been mapped in Cortland County.

Typical profile (Middlebury silt loam, 0 to 2 percent slopes; cultivated):

A 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, crumb structure; friable; fine roots abundant; pH 5.4; abrupt, smooth lower boundary.

C 8 to 16 inches, olive-brown (2.5Y 4/4) silt loam; compound structure—very weak, subangular blocky and moderate, coarse, crumb; friable; fine roots plentiful; pH 5.2; 7 to 14 inches thick; gradual, wavy lower boundary.

C 16 to 30 inches, dark grayish-brown (10 YR 4/2) silt loam with common, fine to medium, prominent mottles of yellowish brown (10YR 5/4) and olive gray (5Y 5/2); very weak, subangular blocky structure to massive (structureless); friable, slightly firm in place; a few medium-sized roots; pH 5.2; 12 to 24 inches thick; abrupt, wavy lower boundary.

C 30 to 45 inches +, dark grayish-brown (2.5Y 4/2) gravelly silt loam with many, medium and large, distinct mottles of yellowish brown (10YR 5/6) and olive gray (5Y 5/2); essentially massive; slightly firm to loose; a few large roots; pH 5.5.

In some places drainage is somewhat poor in these soils and mottling is within 12 inches of the surface. Where these soils grade to Lobdell soils, they have a pH of 6.0 at a depth of 30 inches. In the lowest horizon the texture and the amount of gravel vary because of differences in stratification. In places this horizon is several feet thick.

Middlebury silt loam, 0 to 2 percent slopes (MbA).—This soil lies along streams in the valleys northeast, east, and southeast of the city of Cortland. It is mainly on first bottoms, but it also occurs at the bases of alluvial fans. In these places channery fragments are on the surface and mixed with the soil. Small areas of poorly drained Holly soil are included with this soil; these areas are indicated on the detailed map by a symbol for wet spots.

The permanent water table is at depths of 30 to 40 inches, and, as a result, this soil is moderately well drained. During the early part of the growing season, however, the soil is flooded frequently. The floodwaters sometimes cause scouring. The undercutting of streambanks is also a problem.

The soil is easy to work. Roots penetrate effectively to a depth of about 16 inches.

This soil is extremely important for agriculture. The principal crops are oats, corn grown for silage, hay crops, and pasture. Moderate to high yields are common. The soil requires liberal amounts of lime, phosphate, and potash for high crop yields. It is in capability unit IIw–2.

Muck

Muck (Mc).—This very wet organic soil has formed from decomposed woody materials, sedges, reeds, cattails, and rushes. Most of the areas are near Tully Lake and along the Labrador and Cheningo Creeks. A few areas, mostly no larger than 1 to 2 acres, are in the uplands. Muck is associated with poorly drained and very poorly drained mineral soils of the valleys and uplands.

Typical profile:

1. 0 to 24 inches, black (10YR 2/1) to very dark gray (10YR 3/1) decomposed organic material; moderate, coarse and medium, crumb structure; friable; many fine roots in the uppermost 8 inches; pH 5.8; 16 to 24 inches thick; gradual lower boundary.
2. 24 to 50 inches, dark reddish-brown (5YR 3/2), partly decomposed remains of plants; massive (structureless); loose in place; very few large roots; pH 6.2 at a depth of 30 inches, weakly calcareous at a depth of 50 inches.

In some places the muck is shallow—extending only to depths of about 18 inches—and overlies 12 to 36 inches of marl. Areas of this shallow muck occur near Tully Lake and along Labrador Creek. They border areas of deep muck, which is described in the typical profile. In other places in the uplands the layer of muck is 12 to 36 inches thick and is underlain by silt or by silty clay loam. The muck is low in lime; in most places it has a pH of 5.4.

Most of this organic soil is in forest. None of it has been improved by drainage. Draining the soil is difficult because most of it is in depressions where the water table is seldom below a depth of 24 inches. Muck is in capability unit VIIw–1.

Palmyra Series

These medium-textured soils have an accumulation of clay beginning at depths between 12 and 18 inches. Even though the surface soil is medium to slightly acid, free lime commonly begins at depths between 26 and 40 inches. The soils are mainly on nearly level to gently sloping outwash plains in the valleys north of the city of Cortland and near Cuyler. They have formed in deep, gravelly outwash derived from siltstone, sandstone, shale, and dark-gray limestone. Because the underlying outwash material is moderately to rapidly permeable to water, the soils are well drained.

The Palmyra soils belong to the Gray-Brown Podzolic great soil group. Most commonly they are associated with moderately well drained Phelps and poorly drained Homer soils.

Typical profile (Palmyra gravelly silt loam, 0 to 3 percent slopes; cultivated):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; weak, fine to medium, crumb structure; friable; fine roots abundant; pH 6.6, limed; abrupt, smooth lower boundary.

A_2 8 to 12 inches, brown (10YR 5/3) to yellowish-brown (10YR 5/4) gravelly silt loam; compound structure—weak, fine, crumb and very weak, thin, platy; friable; fine roots abundant; pH 5.7; 2 to 5 inches thick; clear, smooth lower boundary.

B_{21} 12 to 18 inches, dark-brown (10YR 4/3) to dark yellowish-brown (10YR 4/4) gravelly silt loam; weak, fine, blocky structure; friable, slightly hard; fine to medium-sized roots plentiful; pH 6.4; 5 to 12 inches thick; clear, wavy lower boundary.

B_{22} 18 to 29 inches, dark-brown (10YR 4/3) to very dark grayish-brown (10YR 3/2) gravelly clay loam with many very dark gray (N 3/) and dark reddish-brown (5YR 3/2) pebbles of weathered limestone; weak to moderate, fine, subangular blocky structure; friable when moist, slightly sticky when wet, slightly hard when dry; firmer in place than horizons just above or below; a few medium-sized to large roots; contains a few cobblestones and other stones; pH 6.8; 8 to 18 inches thick; clear, irregular lower boundary.

C_1 29 to 40 inches, dark grayish-brown (10YR 4/2) very gravelly loam or sandy loam that has fewer pebbles of weathered limestone than material in the horizon just above; essentially structureless; loose; a few large and medium-sized roots; weakly calcareous; cobblestones and other stones are common, and many of them have a thin coating of carbonates; 8 to 20 inches thick; gradual, wavy lower boundary.

C_2 40 to 60 inches +, dark grayish-brown (10YR 4/2) gravelly, cobbly, and stony loam to sandy loam outwash material; structureless; loose; a few large roots; calcareous.

In some places near Preble, carbonates are at a depth of only 16 inches in these soils. They begin at depths of as much as 40 inches in places near Cortland where the Palmyra soils grade to the Howard soils. The thickness of the clayey B_{22} horizon varies: In many places tonguelike projections extend downward from the B_{22} horizon into the C_1 horizon; in other places, just a few feet away, the B_{22} horizon begins a little below the plow (A_p) layer. In places the C_2 horizon is several feet thick.

These soils are permeable to air and water, and roots penetrate easily. The gravelly silt loams do not contain enough gravel to interfere seriously with cultivation. The cobbly loam, however, contains enough cobblestones to make cultivation difficult.

These are among the most productive and highly responsive soils in the county. They have medium texture and a high content of lime. When fertilized with potash and phosphate, all crops grown in the area are suitable. The crops most commonly grown are corn for silage and grain, oats, wheat, alfalfa, and grass-legume hay crops and pasture. A small acreage is used to grow potatoes, dry beans, snap beans, cabbage, and peas.

The outwash deposits in which these soils formed are an important source of gravel for highway and building construction. Because the gravelly outwash is permeable to water, these soils are excellent sites for industrial development.

Palmyra gravelly silt loam, 0 to 3 percent slopes (PbA).—A profile of this soil is described as typical of the series. A few acres of gravel-free silt loam were included in mapping. The soil that is free of gravel is more acid at depths between 26 and 30 inches than the typical soil. Most of it is in an area 1½ miles northeast of Preble. Included with this soil are a few acres near Homer where the surface layer consists of gravelly sandy loam.

Palmyra gravelly silt loam, 0 to 3 percent slopes, is high in lime, has good moisture-holding capacity, and is easy to work. The soil absorbs water readily, and erosion is not a problem.

This soil is suited to intensive cultivation. It can be used for all of the crops commonly grown in the county, and yields are high. For continuous high yields, the supply of available forms of nitrogen, phosphorus, and potassium should be supplemented to the extent necessary. This soil is in capability unit I–1.

Palmyra gravelly silt loam, 3 to 8 percent slopes (PbB).—This soil has a profile like that of the soil described as typical of the series, but it has stronger slopes. In a small acreage the relief is undulating and the slopes are short and broken. Included with this soil are a few acres near Homer where the surface layer consists of gravelly sandy loam.

This productive soil is high in lime, absorbs water readily, and is easy to work. It is well suited to intensive cultivation and can be used for all the crops commonly grown in the county. The soil requires about the same general management as the less strongly sloping Palmyra soils. If used for continuous row crops, however, it needs protection from erosion. This soil is in capability unit IIe–1.

Palmyra gravelly silt loam, 8 to 15 percent slopes (PbC).—This soil resembles the soil described for the series, but most of it has short, steep slopes that are complex. In a small acreage it has simple slopes.

Runoff is rapid and the soil is somewhat droughty. The soil is more likely to erode than the less strongly sloping Palmyra soils and is not so easy to work. Nevertheless, it is productive and can be used for all the crops commonly grown in the county. Long-lived varieties of alfalfa, mixed with smooth bromegrass and grown for hay, are especially well suited to this Palmyra soil because of the ability of the alfalfa to extract moisture from depths of 3 to 4 feet in the soil profile. This soil is in capability unit IIIe–1.

Palmyra gravelly silt loam, 15 to 25 percent slopes (PbD).—This soil has a profile similar to that of the soil described as typical of the series. In general, however, the depth to the clayey horizon (B_{22} horizon in the typical profile) and to carbonates is 6 to 10 inches less. This soil is associated with the less strongly sloping Palmyra soils. Most of it is on the faces of terraces. A small acreage of this soil has short, steep, irregular slopes.

Runoff is rapid to very rapid on this soil, and there is a serious risk of erosion. The soil is droughty and has only moderate moisture-holding capacity. Farm machinery is somewhat difficult to use.

This soil is used mostly for hay crops and pasture. Areas on the sides of terraces, however, are commonly used to grow corn, oats, and wheat; cabbage and beans are grown to some extent, and a few acres are used to grow alfalfa.

For high yields of crops, the supply of available forms of nitrogen, phosphorus, and potassium must be supplemented. This soil is in capability unit IVe–1.

Palmyra cobbly loam, 0 to 3 percent slopes (PaA).—This soil has a profile like the one described as typical of the series, but its surface layer consists of cobbly loam. Many cobblestones, 3 to 10 inches in diameter, are scattered over the surface and mixed with the soil material. The cobblestones were derived from granite and sandstone. This soil occurs south and north of Preble. It is associated with the other Palmyra soils.

Because of the cobblestones, this soil is more difficult to cultivate and is harder on farm machinery than the Palmyra gravelly silt loams. Nevertheless, it is productive if it is used and managed like the other mildly sloping Palmyra soils. It is in capability unit I–1.

Papakating Series

Very poorly drained, strongly acid soils on flood plains make up this series. The soils are medium textured. They have formed in alluvium consisting of sediments washed from soils on the adjacent uplands. The alluvial sediments were derived from slightly acid, olive-gray sandstone, siltstone, and coarse-textured shale.

The Papakating soils belong to the Humic Gley great soil group. They are associated with dominantly poorly drained Holly soils and with moderately well drained Middlebury soils.

Only one member of the Papakating series, Papakating silt loam, 0 to 1 percent slopes, has been mapped in Cortland County.

Typical profile (Papakating silt loam, 0 to 1 percent slopes; under mixed forest):

A_1 0 to 10 inches, very dark gray to black (10YR 3/1 to 2/1) mucky silt loam with many, fine, distinct mottles of yellowish brown (10YR 5/4) and gray (10YR 5/1); moderate to strong, coarse, crumb structure; friable; fine to medium-sized roots plentiful in the uppermost 4 inches; pH 5.7; 8 to 12 inches thick; clear, smooth lower boundary.

CG 10 to 30 inches, gray (10YR 5/1) silt loam to silty clay loam with a few coarse mottles of olive brown (2.5Y 4/4) and yellowish brown (10YR 5/4); massive (structureless) but contains very weak prisms; firm to slightly firm in place; an occasional large root; pH 5.5; 16 to 25 inches thick; abrupt lower boundary.

DG 30 to 40 inches, olive-gray (5Y 4/2) gravelly loam to sandy loam with yellowish-brown (10YR 5/4) horizontal mottles along bedding planes; structureless; loose; free of roots; pH 5.8.

In areas where these soils have been pastured, the A_1 horizon is only 2 to 3 inches thick and the CG horizon contains material that has been pushed down from the A_1 horizon as the result of trampling by cattle. In areas where the soils are flooded frequently, the texture of the surface soil is commonly sandy loam. In some places the DG horizon is several feet thick.

Papakating silt loam, 0 to 1 percent slopes (PcA).—This soil is on the flood plains of streams in the eastern, northeastern, and southeastern parts of the county. The permanent water table is at or near the surface. Consequently, this soil remains wet and cold throughout the entire year.

In general, this inextensive soil is not well suited to crops. If it is cleared and drained adequately, however, good yields of corn, small grains, and grasses grown for hay or pasture are obtained. This soil is in capability unit VIw–1.

Phelps Series

These soils are dominantly moderately well drained. They are moderately acid to depths between 8 and 10 inches, neutral at depths between 10 and 24 inches, and calcareous beginning at depths of 24 to 30 inches. The upper horizons are medium textured, but, in places, the soil has a texture of silty clay loam at depths between 12 and 20 inches.

These soils are on nearly level to slightly convex ridges on the glacial outwash plains and terraces. The gravelly outwash in which they formed was derived mainly from acid, olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale and partly from dark-gray limestone.

The soils belong to the Gray-Brown Podzolic great soil group. They are associated with well-drained Palmyra and Howard soils and with poorly drained Homer soils.

Only one soil of the Phelps series, Phelps gravelly silt loam, 0 to 3 percent slopes, has been mapped in Cortland County.

Typical profile (Phelps gravelly silt loam, 0 to 3 percent slopes; cultivated):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; weak, fine to medium, crumb structure; friable; fine roots abundant; pH 5.8; abrupt, smooth lower boundary.

B_{21g} 9 to 15 inches, dark-brown (10YR 4/3) gravelly loam to silty clay loam; the uppermost 1 to 2 inches in places contains discontinuous parts of an A_2 horizon that has not been mixed in the plow layer; weak to moderate, fine, subangular blocky structure; peds coated with clay; friable and slightly sticky; common to many, prominent mottles of yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) at depths of 12 to 14 inches; fine roots plentiful; pH 6.6; 4 to 10 inches thick; clear, wavy lower boundary.

B_{22g} 15 to 21 inches, dark grayish-brown (10YR 4/2) to very dark grayish-brown (10YR 3/2) gravelly silty clay loam with many, fine and medium, prominent mottles of yellowish brown (10YR 5/4) and light brownish gray (10YR 6/2); weak to moderate, fine, subangular blocky structure; surfaces and interiors of peds exhibit clayflow; friable to slightly firm and slightly sticky when wet; a few fine and medium-sized roots; contains a few dark reddish-brown (5YR 3/3) pebbles of weathered limestone in the lowest 3 inches; pH 7.0; 4 to 12 inches thick; clear, wavy lower boundary.

C_g 21 to 36 inches, dark-gray (10YR 4/1) to dark grayish-brown (2.5Y 4/2) outwash of gravelly loam to sandy loam; structureless; loose; a few large roots; contains a few cobblestones; calcareous.

Although normally moderately well drained, these soils are somewhat poorly drained in some places.

Phelps gravelly silt loam, 0 to 3 percent slopes (PdA).—This soil occurs near Cortland, Preble, Scott, and Harford. In some places a few spots of a poorly drained Homer soil were included with it in mapping. These wet areas are indicated on the map by a symbol for wet spots.

Phelps gravelly silt loam, 0 to 3 percent slopes, absorbs water rapidly and has good moisture-holding capacity. Runoff is slow, and erosion is not a problem.

The soil can be used for most of the crops commonly grown in the county. The principal crops are corn, oats, wheat, and some varieties of alfalfa, but cabbage and beans are grown near Preble. High yields can be obtained under good management that includes use of a complete fertilizer. This soil is in capability unit IIw-2.

Red Hook Series

This series consists of strongly acid, poorly drained to somewhat poorly drained soils formed from glacial outwash. Most of the outwash was derived from uplands where the bedrock is olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale. The soils are on level to nearly level terraces and in slight depressions in stream terraces and outwash plains.

The Red Hook soils are members of the Low-Humic Gley great soil group. They are associated with well-drained Chenango and with very poorly drained Atherton soils.

Only one member of the Red Hook series, Red Hook silt loam, 0 to 3 percent slopes, has been mapped in Cortland County.

Typical profile (Red Hook silt loam, 0 to 3 percent slopes; meadow):

A_p 0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, coarse, granular structure; friable; fine roots abundant; pH 6.1, limed; abrupt, smooth lower boundary.

A_{2g} 7 to 11 inches, grayish-brown (10YR 5/2) silt loam with a few, coarse, prominent mottles of yellowish brown (10YR 5/4) and olive brown (2.5Y 4/4); very weak, fine, subangular blocky structure; friable, slightly firm in place; medium-sized roots plentiful; pH 5.8 (influenced by lime); 3 to 6 inches thick; abrupt, smooth lower boundary.

B_{2gm} 11 to 23 inches, mottled light olive-brown (2.5Y 5/4) and light brownish-gray (10YR 6/2) silt loam that contains a considerable amount of gravel; massive (structureless) or very weak, fine to medium, subangular blocky structure; slightly firm, firm in place; a very few large roots; pH 4.9; 8 to 18 inches thick; abrupt, wavy lower boundary.

C_gD 23 to 30 inches +, dark-gray (5Y 4/1) very gravelly loam to sandy loam in stratified layers; structureless; slightly firm in place, but below a depth of 30 inches becomes loose in place; free of roots; pH 5.5.

The texture of the B_{2gm} horizon is extremely variable; in some areas the material is like the loam or fine sandy loam of the C_gD horizon. In places the C_gD horizon is several feet thick.

Red Hook silt loam, 0 to 3 percent slopes (RaA).—Most of this soil is in the valley of the Otselic River, but small areas are in the tributary valleys. The soil formed in outwash material that is generally permeable to water. Nevertheless, it has a somewhat slowly permeable horizon, beginning at depths of 10 to 12 inches, that restricts drainage to a certain degree. The soil remains cold and wet until late in spring and through the early part of summer. It is strongly acid and low in plant nutrients.

This soil is used mostly for hay crops and pasture, but when artificial drainage is provided, corn is frequently grown for silage. The depth to which roots penetrate effectively is limited to the part of the profile above the panlike B_{2gm} horizon. Consequently, unless the soil is drained, the crops do not respond well if fertilizer is added. This soil is in capability unit IIIw-2.

Rhinebeck Series

This series consists of slightly acid, fine-textured soils that are moderately well drained to somewhat poorly drained. The soils have formed from lacustrine clays. They occur south of Skaneateles Lake and in the extreme northeastern part of the county. Free lime occurs below a depth of 26 inches. The silty and clayey material in the lower part of the profile is slowly permeable.

The Rhinebeck soils are members of the Gray-Brown Podzolic great soil group. Near Skaneateles Lake they occur in association with well-drained Lansing and Dunkirk soils. In the extreme northeastern corner of the county, they are associated with poorly drained Wallington and very poorly drained Birdsall soils.

Typical profile (Rhinebeck silt loam, 3 to 8 percent slopes; meadow):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, crumb structure; friable; small roots abundant; pH 6.2; clear, smooth lower boundary.

A_2 10 to 13 inches, grayish-brown (2.5Y 5/2) silty clay loam with a few, fine to medium, prominent mottles of dark brown (10YR 4/3); weak, fine, subangular blocky structure; friable, slightly firm in place; fine and medium-sized roots plentiful; pH 6.1; 1 to 3 inches thick; clear, smooth lower boundary.

B_2 13 to 22 inches, dark-brown (10YR 4/3) silty clay; strong, coarse, subangular blocky peds; exteriors of peds coated with abundant deposits of dark grayish-brown (10YR 4/2) clay; firm and sticky, firm in place; a few medium-sized roots; common, fine and medium-sized, prominent mottles of yellowish brown (10YR 5/4) along old root channels; pH 6.8; gradual lower boundary; 6 to 12 inches thick.

C 22 to 32 inches, dark grayish-brown (2.5Y 4/2) silty clay; strong, blocky or moderate, very thick, platy structure; firm and sticky, firm in place; a few large roots; outsides of peds are gray (10YR 5/1), and the interiors have a few mottles of dark brown (10YR 4/3) and grayish brown (2.5Y 5/2); calcareous at a depth of 26 inches.

The profiles of the soils in this series do not vary greatly from the profile just described. In places erosion has removed part of the original surface layer and the present surface layer is only 4 to 5 inches thick. The eroded areas were too small to be shown separately on the detailed map.

Areas of these soils that are farmed are used mainly for hay crops or pasture. The soils are not extensive, and most of the areas are so strongly sloping that the use of farm machinery is difficult. Successful crop production on these soils requires maintenance of an adequate pH level in the plow layer and fertilization with appropriate quantities of nitrogen, phosphate, and potash for the crops to be grown.

Rhinebeck silt loam, 3 to 8 percent slopes (RbB).—The profile of this soil is like the profile described as typical of the series. The soil is nearly level to gently sloping and is dominantly moderately well drained to somewhat poorly drained. It occurs in association with the more strongly sloping Rhinebeck soils. It is also associated with poorly drained Wallington and very poorly drained Birdsall soils, both of which are in very gently sloping, slightly concave areas.

This soil, because of its mild slopes, has moderate to slow surface runoff. Farm machinery is easy to use. Roots can penetrate only the part of the profile above the clayey B_2 horizon. The soil remains cold and wet longer in spring than soils formed in less fine-textured materials. The surface soil, which consists mostly of silt, erodes easily; consequently, erosion can become a problem after the soil has been farmed for a short period.

The soil is used principally for hay crops and pasture, but corn is grown for silage in some areas. If the soil is managed properly, good yields of suitable crops are obtained. The soil is in capability unit IIe–4.

Rhinebeck silt loam, 8 to 15 percent slopes (RbC).—This soil has stronger slopes than the soil described as typical of the series, but its profile is similar. In most places it is associated with other Rhinebeck soils.

The soil is moderately well drained. It is more erodible than Rhinebeck silt loam, 3 to 8 percent slopes, and requires more intensive practices to control runoff and erosion. Nevertheless, it is used in about the same way as the less sloping soil; good crop yields on this soil require similar applications of lime, nitrogen, phosphate, and potash. This soil is in capability unit IIIe–4.

Rhinebeck silt loam, 15 to 25 percent slopes (RbD).—The profile of this soil is essentially like the profile described as typical of the series. In places, however, where moderately steep areas of this soil occur along drainageways, the profile is shallower than the profile described and the surface layer is no more than 4 inches thick.

The strong slopes make this soil difficult to use and extremely erodible. Because of the rapid runoff, the soil is dry. Like the other Rhinebeck soils, it is permeable to water and air only in the part of the profile above the clayey B_2 horizon. Roots penetrate only to this layer.

Most of this soil is in pasture or forest. It is probably best used to grow trees, but, if the soil is well managed, hay crops and pastures yield well. This soil is in capability unit IVe–3.

Scio Series

This series is composed of moderately well drained, strongly acid soils that have a weak fragipan beginning at depths between 15 and 20 inches. The soils are medium textured. They occur on stream terraces that are well above the present flood plain. The old alluvium from which they formed consists of sediments washed from acid soils of the uplands; the upland soils overlie bedrock of olive-gray to dark grayish-brown sandstone, siltstone, and coarse-textured shale.

The soils are generally free of gravel to depths between 20 and 35 inches. The weak fragipan occurs in a fine gravelly layer just below the gravel-free material. Because of the fragipan, drainage is slightly restricted.

Even though the Scio soils, like the Unadilla soils, have a weakly developed profile, they are in the Sols Bruns Acides great soil group. They are associated with well-drained Unadilla and Chenango soils and somewhat poorly drained to poorly drained Red Hook soils. They also commonly occur in association with poorly drained Wallington and very poorly drained Birdsall soils.

Only one member of the Scio series, Scio silt loam, 0 to 4 percent slopes, has been mapped in Cortland County.

Typical profile (Scio silt loam, 0 to 4 percent slopes; cultivated):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; fine roots abundant; pH 5.9, limed; abrupt, smooth lower boundary.

B_{21} 9 to 15 inches, light olive-brown (2.5Y 5/4) silt loam with a few, fine, prominent mottles of yellowish brown (10YR 5/6) in the lowest 2 inches; very weak, fine, subangular blocky structure; friable to slightly firm; fine and medium-sized roots plentiful; pH 5.1; 3 to 9 inches thick; gradual, wavy lower boundary.

B_{22gm} 15 to 29 inches, light olive-brown (2.5Y 5/4) to light yellowish-brown (2.5Y 6/4) silt loam; weak, fine, subangular peds that are slightly firm; peds are within crudely arranged prisms, 4 to 9 inches across, that are olive gray (5Y 5/2) and firm; a few medium-sized roots on exteriors of prisms; pH 5.0; 10 to 18 inches thick; clear, wavy lower boundary.

D_g 29 to 37 inches, grayish-brown (2.5Y 5/2) to dark grayish-brown (2.5Y 4/2) gravelly silt loam with many, medium, prominent mottles of grayish brown (2.5Y 5/2); compound structure—very weak, fine, subangular blocky to massive (structureless) or very weak, thick, platy; slightly firm, firm in place, but becomes less firm at a depth of about 34 inches; free of roots; pH 5.3.

The depth to gravel varies considerably, but the gravelly layer most commonly begins at a depth of 30 inches. In some areas where these soils are associated with the Red Hook and Chenango soils, gravelly material occurs at a depth of 15 inches and the upper part of the profile contains a few pebbles. In places the D_g horizon is 24 to 36 inches thick.

Scio silt loam, 0 to 4 percent slopes (SaB).—This soil occurs in nearly level areas and in slight depressions on stream terraces. Most of it is in the valley of the Otselic River.

The soil material above the fragipan is moderately permeable to water, has good moisture-holding capacity, and is easily penetrated by roots. The soil is only slightly erodible and is easy to work. In general, it is not high in fertility; it is low in lime and phosphorus and medium in potassium.

This soil is productive and responds well to good management. It is used principally to grow corn for silage, oats, and grass-legume hay crops and pasture. This soil is in capability unit IIw–2.

Sloan Series

These high-lime, very poorly drained soils are on flood plains in valleys. The soils are medium textured to moderately fine textured. They have formed from sediments washed from nearby high-lime and medium-lime soils of the uplands. Because they are on recent flood plains, mostly near present streams, the soils have a permanently high water table.

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These soils are in the Humic Gley great soil group. They are associated mainly with poorly drained Wayland and moderately well drained Lobdell soils.

Only one member of the Sloan series, Sloan silt loam, 0 to 1 percent slopes, has been mapped in Cortland County.

Typical profile (Sloan silt loam, 0 to 1 percent slopes; under a cover of sedges):

A_1 0 to 9 inches, black (10YR 2/1) mucky silt loam with many, fine, distinct mottles of reddish brown (5YR 4/4) along old root channels; moderate, coarse, crumb structure; friable; fine roots abundant to a depth of 6 inches; pH 6.9; 7 to 10 inches thick; abrupt, smooth lower boundary.

G 9 to 18 inches, gray (5Y 5/1) silty clay loam with a few, coarse, distinct mottles of dark brown (10YR 4/3); compound structure—very weak, medium, subangular blocky to massive (structureless); slightly firm, slightly sticky; a few large roots; 6 to 14 inches thick; pH 7.0; gradual lower boundary.

CG 18 to 34 inches, dark-gray (N 4/) silty clay loam to clay loam; content of gravel increases with increasing depth; massive; slightly sticky, slightly firm in place, free of roots; weakly calcareous at a depth of 30 inches.

As a result of frequent flooding, these soils have a surface layer of fine sandy loam in some places. The texture of the other horizons, especially of the CG horizon, is variable. In places the material below a depth of 18 inches is gravelly loam or silt loam. The thickness of the CG horizon is variable.

Sloan silt loam, 0 to 1 percent slopes (SbA).—This soil occurs on flood plains in nearly level areas or in slight depressions. It is mainly near Virgil and north and northwest of the city of Cortland. Small areas are also in valleys in other parts of the county.

This soil occupies only a small acreage. Because of wetness, it is not important for agriculture. The soil is in capability unit VIw–1.

Tioga Series

The soils of the Tioga series are medium textured and well drained. The alluvium from which they formed consists of sediments washed predominantly from adjacent soils of the uplands. These sediments were derived from slightly acid, olive-gray to dark grayish-brown sandstone and coarse-textured shale. The soils are on nearly level first and second bottoms in all the valleys east, northeast, and southeast of the city of Cortland. The ones on first bottoms are subject to frequent flooding.

The Tioga soils belong to the Alluvial great soil group. They are associated with moderately well drained Middlebury, poorly drained Holly, and very poorly drained Papakating soils. The Tioga soils are similar to the Chagrin soils but are strongly acid instead of moderately acid.

Typical profile (Tioga silt loam, high bottom, 0 to 3 percent slopes; cultivated):

A 0 to 8 inches, dark grayish-brown to dark-brown (10YR 4/2 to 4/3) silt loam; weak to moderate, medium, crumb structure; friable; pH 5.0, unlimed; smooth, abrupt lower boundary.

C_{11} 8 to 19 inches, olive-brown to light olive-brown (2.5Y 4/4 to 5/4) silt loam; very weak to weak, subangular blocky structure; friable, slightly firm in place; fine roots abundant; pH 5.0; 9 to 16 inches thick; gradual, wavy lower boundary.

C_{12} 19 to 33 inches, olive-brown (2.5Y 4/4) silt loam to fine sandy loam; a few, fine, faint mottles of yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) along old root channels in the lowest 3 to 4 inches of horizon; very weak, fine, subangular blocky structure; friable; large and medium-sized roots plentiful; pH 5.0; abrupt, wavy lower boundary.

D 33 to 60 inches +, dark grayish-brown (2.5Y 4/2) very gravelly silt loam to sandy loam; essentially structureless; loose; a few large roots; a few, large, distinct mottles of yellowish brown (10YR 5/4) and dark reddish brown (5YR 3/4) at a depth of 48 inches.

In places the D horizon in these soils is several feet thick. In areas of these soils in the main valleys, depth to the D horizon ranges from 36 to 40 inches; in areas in the tributary valleys, this horizon begins at depths between 18 and 20 inches.

These soils are well aerated. They are permeable to water but retain enough moisture to supply the needs of crops. Because they are nearly level, the soils are easy to work and are not likely to erode. They are moderately deficient in potassium, low in available phosphorus, and strongly acid.

These soils are extremely important for agriculture. Along with the moderately well drained Middlebury soils, they provide excellent cropland in areas where most of the farmland consists of Volusia, Mardin, and Lordstown soils. The Tioga soils are well suited to corn grown for grain or silage, oats, and alfalfa and other hay crops. If good management is practiced, continuous high yields are obtained.

Tioga silt loam, high bottom, 0 to 3 percent slopes (TdA).—This soil has a profile like the one described as typical of the series. The areas are on high bottoms that are seldom flooded during the growing season. Little soil is lost through gouging, but the undercutting of streambanks is a problem in some areas.

This soil is moderately to rapidly permeable to water and has good moisture-holding capacity. Roots penetrate easily. The soil is nearly level and is excellent for the use of farm machinery.

Oats, alfalfa, corn grown for silage and grain, and grasses and clover grown for hay or pasture are the principal crops. Most of the acreage is used for alfalfa and for corn grown for silage. Although the soil is highly productive, applications of adequate amounts of lime, nitrogen, phosphate, and potash are needed for crops to make continuous high yields. This soil is in capability unit I–1.

Tioga silt loam, 0 to 2 percent slopes (TcA).—This soil is similar to the soil described as typical of the series, but it has a dark grayish-brown (10YR 4/2) plow layer and its C horizons are less strongly developed. In places there is faint mottling beginning at depths between 24 and 26 inches.

This soil is on first bottoms adjacent to streams. It is flooded occasionally, but flooding occurs more frequently early in spring than during the growing season. Wetness caused by overflow is the principal factor limiting the use of the soil, but, occasionally, gouging by floodwaters and the undercutting of streambanks are problems.

This soil is suited to the same crops as are grown on Tioga silt loam, high bottom, 0 to 3 percent slopes, but it is not so well suited to alfalfa because of frequent flooding in spring. It is highly productive, but liberal applications of lime and fertilizer are needed for continuous high yields. This soil is in capability unit IIw-1.

Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes (TaB).—This soil is somewhat similar to the soil described as typical of the series. It occurs on alluvial fans, however, that were deposited where streams flow down into the valleys; many channery fragments and fragments of flagstone are on the surface and mixed through the soil.

Because of the many fragments of sandstone and shale, the soil profile, in many places, is not so well developed as the profile described as typical of the series. In some areas, however, the horizons are more strongly developed than those in the profile described as typical of the series and are similar to those of the Chenango soils. These areas, which occupy approximately 2,000 acres, are in the eastern and southern parts of the county.

The soil is flooded less frequently than the Tioga soils on first bottoms and is somewhat droughty. Surface runoff is medium, and there is a slight hazard of erosion. Fragments of sandstone and shale interfere slightly with cultivation, but they do not damage farm machinery seriously.

This soil is suited to the same crops as the other Tioga soils. It is low in fertility, and liberal amounts of lime, nitrogen, phosphate, and manure are needed for continuous high yields. The soil is in capability unit IIe-1.

Tioga gravelly loam, 0 to 2 percent slopes (TbA).—The profile of this soil is essentially the same as the profile described for the series. Unlike the other Tioga soils, however, this soil is on first bottoms. Its surface layer is coarser textured, and variable amounts of gravel are scattered over the surface and mixed with the soil material. Included with this soil in mapping are a few, small areas on high bottoms.

This soil is flooded periodically. The floods occur early in spring, however, and do not seriously affect the use of the soil. Nevertheless, some scouring and streambank undercutting may take place during periods of overflow.

The nearly level relief and medium texture of this soil aid in the preparation of seedbeds. The soil is strongly acid, low in phosphorus, and medium in ability to supply potassium. It is limited mainly by periodic flooding and by the small, irregular size of many of the areas.

If properly limed and fertilized and if it is otherwise well managed, this soil is highly productive of the crops commonly grown. The supply of readily decayable organic matter needs to be maintained for high crop yields. This soil is in capability unit IIw-1.

Tuller Series

These are medium-textured, dominantly poorly drained soils of the uplands. The soils are strongly acid. They have formed in acid, gray to dark-gray glacial till or in materials from frost-fractured rocks. Depth to dark grayish-brown and olive-gray sandstone or coarse-textured shale ranges from 10 to 24 inches.

The Tuller soils are members of the Low-Humic Gley great soil group. They are adjacent to well drained Lordstown, moderately well drained Arnot, and very poorly drained Alden soils. The Tuller soils are shallower to bedrock than the Alden soils, and their parent material contains less lime.

Only one soil of the Tuller series, Tuller channery silt loam, 2 to 8 percent slopes, has been mapped in Cortland County.

Typical profile (Tuller channery silt loam, 2 to 8 percent slopes; pastured):

A_{1p} 0 to 3 inches, very dark grayish-brown (10YR 3/2) channery silt loam with a few, fine, distinct mottles of yellowish brown (10YR 5/6) along old root channels; moderate, fine to coarse, granular structure; friable; fine roots abundant; pH 5.0; 1 to 5 inches thick; clear, smooth lower boundary.

A_{21g} 3 to 8 inches, grayish-brown (2.5Y 5/2) or gray (2.5Y 5/1) to dark grayish-brown (2.5Y 4/2) channery silt loam with many, fine, distinct mottles of yellowish brown (10YR 5/6) and olive gray (5Y 5/2); weak, fine, subangular blocky structure; friable, slightly hard; a few fine roots; pH 5.4; 3 to 7 inches thick; clear, wavy lower boundary.

A_{22g} 8 to 10 inches, mottled olive-gray (5Y 5/2) to light olive-gray (5Y 6/2) channery silt loam; a few, fine to medium, distinct mottles of yellowish brown (10YR 5/6); weak, fine, subangular blocky structure or very weak, medium, platy; friable; a few fine roots; pH 5.4; 1 to 3 inches thick; abrupt, smooth lower boundary.

B_{2g} 10 to 16 inches, gray (5Y 5/1) silt that coats weak, fine to medium, subangular blocks or weak prisms; blocky peds have olive (5Y 4/3) to olive-brown (2.5Y 4/4) interiors with a few, coarse, prominent mottles of yellowish brown (10YR 5/6); firm, hard; contains a few flagstones; pH 5.4; 4 to 12 inches thick; abrupt, smooth lower boundary.

D_r 16 inches +, dark grayish-brown (2.5Y 4/2 to 3/2) fractured sandstone and siltstone with mottled gray and olive material in the joints.

In a few areas flaggy fragments are common on the surface of these soils. In local areas, where silt has been deposited, the texture of the surface layer is silty clay loam. Depth to bedrock varies, but in most places bedrock is at depths of 14 to 18 inches. In places water moves over unfractured bedrock in the D_r horizon, and in these places there is commonly 1 or 2 inches of fine sandy loam just above the bedrock. Although predominantly poorly drained, in places these soils are somewhat poorly drained.

Tuller channery silt loam, 2 to 8 percent slopes (TeB).—This soil occurs in areas that are nearly level to gently sloping or in long, narrow depressions on high ridges in the uplands. Runoff is very slow, and water stands on this soil for long periods in spring.

This is not a productive soil. It is high in organic matter, but it is low in available plant nutrients. The soil stays wet and cold until late in summer, but it can be used to grow shallow-rooted, moisture-tolerant plants.

Pasture is the principal use of this soil, but a considerable acreage is idle or has been reforested. In areas that have been drained, the soil responds fairly well to good management. If used for crops, it requires liberal applications of lime and commercial fertilizer. This soil is in capability unit IVw-1.

Unadilla Series

These well-drained, strongly acid soils are medium textured and have formed in old alluvium, which occurs commonly on stream terraces above the present flood plains. The alluvium consists of sediments washed from acid upland soils underlain by olive-gray to dark grayish-brown sandstone, siltstone, and coarse-textured shale. It is generally free of gravel to depths between 26 and 40 inches, but the soils that have formed in it are readily permeable to water.

These soils, though they have only weakly developed profiles, belong to the Sols Bruns Acides great soil group. On the higher outwash terraces, they are associated with moderately well drained Scio and well drained Chenango soils; they also are associated with most of the other soils on lower terraces just above the bottom lands.

Only one member of the Unadilla series, Unadilla silt loam, 0 to 4 percent slopes, has been mapped in Cortland County.

Typical profile (Unadilla silt loam, 0 to 4 percent slopes; cultivated):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, crumb structure; friable; fine roots plentiful; pH 6.1, limed; abrupt lower boundary.

B_{21} 10 to 12 inches, yellowish-brown (10YR 5/6) silt loam; weak, fine, crumb structure; friable; fine and medium-sized roots plentiful; pH 5.1; 2 to 4 inches thick; gradual, smooth lower boundary.

B_{22} 12 to 18 inches, yellowish-brown (10YR 5/4) to light olive-brown (2.5Y 5/4) silt loam; compound structure—weak, medium, crumb to very weak, fine, subangular blocky; friable, but material in lower 2 to 4 inches is slightly firm in place; a few medium-sized roots; pH 4.9; 4 to 9 inches thick; abrupt, smooth lower boundary.

B_3 18 to 29 inches, light olive-brown (2.5Y 5/4) silt loam; massive (structureless) or very weak, fine, subangular blocky structure; slightly firm when removed or in place; a few large roots; a few, faint mottles of light yellowish brown (2.5Y 6/4) in the lowest 6 inches; pH 5.1; 8 to 14 inches thick; abrupt, wavy lower boundary.

D 29 to 38 inches, dark grayish-brown (2.5Y 4/2) alluvium that is weakly stratified in thin layers of gravelly silt loam, loam, and fine sandy loam; structureless; loose to slightly firm in place; a few large roots; pH 4.8.

The depth to gravelly alluvium varies. In some places near Cincinnatus, gravel begins at depths between 4 and 5 feet. In places the D horizon is several feet thick.

Unadilla silt loam, 0 to 4 percent slopes (UaB).—This soil is on nearly level stream terraces well above the level of the stream. Practically all of it is in the valley of the Otselic River. In a few acres the soil has slopes of as much as 15 percent.

This soil has excellent moisture-holding capacity. Because it is nearly level, it is not likely to erode and farm machinery is easy to use.

This soil is inextensive, but it is highly productive and is important for agriculture. It can be used intensively for cultivated crops and is suited to all the crops commonly grown in the area. The soil is low in fertility, but excellent yields of crops are received if adequate pH of the plow layer is maintained, appropriate amounts of complete fertilizer are added, and other good management practices are used. This soil is in capability unit I–1.

Valois Series

The Valois series consists of well-drained, strongly acid to moderately acid soils that have a compact fragipan generally beginning at depths between 24 and 30 inches. The soils have formed in medium-textured glacial till derived predominantly from slightly acid, olive-gray siltstone, sandstone, and coarse-textured shale; mixed with these rocks are small amounts of limestone that was carried into the area by glaciers. The soils are on gently sloping to steep parts of the uplands.

The Valois soils belong to the Sols Bruns Acides great soil group. Associated with them in the uplands are moderately well drained Langford soils, somewhat poorly drained Erie soils, and a few, small areas of poorly drained Ellery soils. In areas where the Valois soils have formed in till consisting largely of gravel, they are commonly associated with Howard soils.

The Valois soils are not mapped separately in Cortland County. Instead, they have been mapped with the Howard soils in soil complexes.

Typical profile (Valois gravelly loam, 8 to 15 percent slopes; meadow):

A_p 0 to 10 inches, dark-brown (10YR 4/3) gravelly loam; moderate, coarse, crumb structure; friable; fine and medium-sized roots abundant; pH 6.4, limed; abrupt lower boundary.

B_{22} 10 to 16 inches, yellowish-brown (10YR 5/4) gravelly loam; very weak, fine, subangular blocky peds that break easily to weak, fine, crumb; friable; fine and medium-sized roots abundant; pH 5.7 (influenced by lime); 4 to 6 inches thick; gradual lower boundary.

B_3 16 to 24 inches, olive-brown (2.5Y 4/4) to light olive-brown (2.5Y 5/4) gravelly loam to channery loam; weak, fine, subangular blocky peds with clean grains of very fine sand on their exteriors; friable; many medium-sized roots; pH 5.1; 5 to 12 inches thick; gradual, wavy lower boundary.

B'_2 24 to 40 inches, olive-brown (2.5Y 4/4) channery silt loam; weak, fine, subangular blocky structure; exteriors and interiors of peds have dark-brown (10YR 4/3) coatings of clay; the peds form prisms that are about 14 inches across; the prisms are separated by thin cracks filled with olive-gray (5Y 5/2) material; prisms and peds are hard and are firm in place; a few coarse roots on exteriors of prisms and some, fine roots between peds; pH 5.4 at a depth of 27 inches but near 6.6 at a depth of 38 inches; 14 to 26 inches thick; diffuse lower boundary.

B'_3 40 to 52 inches, olive-brown (2.5Y 4/4) to dark grayish-brown (2.5Y 4/2) channery silt loam; very weak, medium, subangular blocky structure to massive (structureless); hard, firm in place; a few olive-gray (5Y 5/2) streaks but much less numerous than in horizon just above; clayflow on extensions of peds and on massive fragments; neutral (pH 6.6 to 7.3); 10 to 16 inches thick; diffuse lower boundary.

C 52 to 64 inches, olive-gray (5Y 4/2) to dark grayish-brown (2.5Y 4/2) channery silt loam to gravelly silt loam; massive (structureless) to very weak, very thick, platy structure; neutral in upper part of horizon, but weakly calcareous at a depth of 60 inches.

In some places, where these soils grade to the gently sloping Langford soils, depth to the fragipan is only 20 inches. Where the Valois soils are associated with the Howard soils, the fragipan is weakly expressed and parts of the B'_2 horizon and all of the B'_3 and C horizons consist of gravelly loam that has the characteristics of both outwash and glacial till. Soils with these characteristics occur mainly along Otter Creek in the western part of the county.

The yellowish-brown color in the B_{22} horizon indicates that the soils have good drainage and are well aerated. Roots can penetrate easily and have a large zone in which they can obtain moisture and plant nutrients. Because of favorable structure and texture, the soils have good moisture-holding capacity. They are naturally low in lime and available phosphorus and medium in ability to supply potassium.

These soils are used mostly to grow oats, corn for silage, alfalfa, and grass-legume hay crops.

Valois-Howard gravelly loams, 3 to 8 percent slopes (VaB).—This complex, like the other Valois-Howard complexes, consists of two soils that are so intermingled it was not feasible to show them on the detailed map. The Valois soil has a profile similar to the one described as typical of the Valois series. The profile of the Howard soil is essentially like the profile described as typical of the Howard series.

These soils commonly lie about halfway between the uplands and bottom lands. In some places, particularly west of Virgil near the county line, the soils occur on small, conical knolls. They are most commonly associated with moderately well drained Langford soils and with somewhat poorly drained Erie and poorly drained Ellery soils.

Both the Valois and Howard soils are well drained and are permeable to water. Roots penetrate easily. The soils are easy to work and do not erode readily. If they are fertilized and adequately limed, good yields of oats, corn grown for silage, hay crops, and pasture are obtained. This complex is in capability unit IIe–1.

Valois-Howard gravelly loams, 8 to 15 percent slopes (VaC).—This soil complex consists of areas of Valois and Howard soils that have been mapped as a single unit. The Valois soil has a profile like the one described as typical of the Valois series. The Howard soil is similar to the typical soil described for the Howard series, but it has stronger slopes. The Valois and Howard soils are associated with Langford, Erie, and Ellery soils.

In areas where there are many, conical hills, the soils of this complex have many, short, steep slopes. Here, they were formed mainly from a mixture of outwash and till that was deposited about halfway between the uplands and the bottom lands.

Because both the Valois and Howard soils have moderately rapid to rapid permeability to water, most areas are not eroded severely. Nevertheless, a few areas are severely eroded. These small areas are indicated on the detailed map by a symbol for erosion.

These soils are naturally low in lime and available phosphorus but are medium in potassium. If they have been cultivated to row crops for several years in succession, they are likely to be low in readily decayable organic matter.

Oats, hay, and corn grown for silage are the principal crops. If the soils are adequately limed and fertilized and otherwise managed properly, good crop yields can be obtained. This complex is in capability unit IIIe–1.

Valois-Howard gravelly loams, 15 to 25 percent slopes (VaD).—The soils of this complex occur in the same general area as the other Valois and Howard soils. Except for having stronger slopes, the Valois soil resembles the typical soil described for the Valois series, and the Howard soil, the typical soil described for the Howard series.

These soils have more rapid runoff and are somewhat more droughty than milder sloping Valois and Howard soils. Also, they are more difficult to work. Areas having 15 to 20 percent slopes that are used too often to grow row crops may become eroded. Spots that are already severely eroded are indicated on the detailed map by a symbol for erosion.

These soils are used mainly for hay crops and pasture, but corn can be grown for silage once in a 4- or 5-year rotation. Fair to high yields of crops can be obtained where the soils are limed, fertilized, and otherwise well managed. This complex is in capability unit IVe–1.

Valois and Howard gravelly loams, 25 to 40 percent slopes (VaE).—The soils of this complex have strong slopes. Otherwise, the Valois soil is similar to the soil described as typical of the Valois series, and the Howard soil, to the one described as typical of the Howard series. Mapped with these soils are areas of steep to very steep Chenango and Unadilla soils that were too small to map separately.

The soils of this complex have very rapid runoff. As a result, they are droughty and erodible.

These soils are used mainly for pasture and forest. If the soils in the less strongly sloping areas are limed and otherwise managed properly, the pastures have a fair carrying capacity. This complex is in capability unit VIe–1.

Volusia Series

This series consists of strongly acid, medium-textured soils that are somewhat poorly drained. The soils as mapped have a hard, dense, firm fragipan at depths of 8 to 14 inches. They have formed from firm, medium-textured, glacial till that was moderately acid to slightly acid. The glacial till was derived from olive-gray to dark grayish-brown siltstone, sandstone, and coarse-textured shale.

These soils occupy gently sloping to sloping areas in the uplands. They often receive runoff water from the adjoining higher lying soils. The accumulation of runoff water on the surface and the presence of a slowly permeable fragipan cause the soils to have restricted drainage.

The Volusia soils belong to the Sols Bruns Acides great soil group. They occur mostly just below areas of well drained Lordstown soils in association with moderately well drained Mardin soils and poorly drained Chippewa soils. In some places they are associated with soils of the Bath-Chenango complexes.

Typical profile (Volusia channery silt loam, 2 to 8 percent slopes; cultivated):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) channery silt loam; weak, fine, crumb structure; friable; pH 4.8, unlimed; 6 to 9 inches thick; abrupt, smooth lower boundary.

B_{2g} 8 to 10 inches, yellowish-brown (10YR 5/4) channery silt loam; weak, medium to coarse, crumb structure; friable; many, fine, distinct mottles of gray (10YR 5/1 to 6/2); a few fine roots; pH 5.0; as much as 3 inches thick; abrupt, clear lower boundary.

A'_{2g} 10 to 14 inches, light olive-brown (2.5Y 5/4) to grayish-brown (2.5Y 5/2) channery silt loam with many, large, distinct mottles of yellowish brown (10YR 5/6); weak, thin to medium, platy structure; friable to slightly firm; a few medium-sized roots; pH 5.0; 3 to 6 inches thick; abrupt, wavy lower boundary.

B'_{2gm} 14 to 28 inches, olive-brown (2.5Y 4/4) channery silt loam with a few, medium, faint mottles; medium, subangular blocks form prisms 10 to 20 inches across; prisms are separated by vertical cracks filled with material comparable to that in the A'_{2g} horizon; blocks are very firm, firm in place; a few coarse roots in vertical cracks; pH 5.4 but increases to 5.8 at a depth of 28 inches; 12 to 18 inches thick; diffuse lower boundary.

B'_{3gm} 28 to 49 inches, olive-brown to olive (2.5Y 4/4 to 5Y 5/3) channery silt loam within very weak, coarse, subangular blocks that form prisms 12 to 20 inches across; prisms are separated by extensions of vertical cracks from the horizon just above; firm when removed or in place; contains no roots; pH 5.8 but increases to 6.2 at a depth of 44 inches; 16 to 30 inches thick; diffuse lower boundary.

C 49 to 57 inches +, olive to olive-gray (5Y 4/4 to 4/2) channery silt loam; very weak, very thick, platy structure to massive (structureless); firm when removed or in place; pH 6.2 but nearly neutral at a depth of 60 inches and commonly neutral or weakly calcareous at depths of 70 inches or more.

In these soils the reaction in the fragipan is variable. The Volusia soils, in this respect, differ from the Erie soils, which they resemble. Also, their fragipan contains less clay than that of the Erie soils. In areas where these soils are associated with the Bath and Chenango soils, the fragipan is less strongly developed than that in the profile just described and the B'_{3gm} and C horizons contain a considerable amount of gravel. In some of these areas, the texture of the surface layer is loam.

During the late part of the growing season, the Volusia soils frequently lack available moisture. This is caused, in part, by the firm, impervious fragipan that is 8 to 14 inches below the surface. The pan limits the depth to which roots can penetrate. It also causes the soils to be wet and cold in spring and very dry during most of the rest of the growing season. The soils are low in lime and available phosphorus and medium in ability to supply potassium.

The Volusia soils are very extensive in the uplands. Consequently, on farms where they are dominant, the kind of cropping system used is based on the suitability of these soils for crops. A large acreage of these soils has been abandoned during the last 25 or 30 years. Part of this acreage has been reforested.

Volusia channery silt loam, 2 to 8 percent slopes (VbB).—This is the predominant soil on the gently sloping parts of the uplands. In many places it occurs at the foot of steep slopes occupied by Mardin or Lordstown soils. In general, its profile is like the profile described as typical of the series. Where this soil occurs in association with Bath and Chenango soils, however, the fragipan is less well developed than that in the typical profile, the till is more gravelly, and the surface soil is coarser textured. In places where the soil is nearly level, small areas of poorly drained Chippewa soils have been mapped with this soil.

Volusia channery silt loam, 2 to 8 percent slopes, makes up much of the cropland on many farms. This soil has limited suitability for many crops. Nevertheless, on dairy farms it can be used to grow oats, moisture-tolerant forage legumes and grasses, and corn for silage. This soil is in capability unit IIIw–1.

Volusia channery silt loam, 2 to 8 percent slopes, eroded (VbB3).—The original surface layer of this soil has been lost through erosion. The present plow layer consists of a mixture of the original subsoil and material from the fragipan. As the result of erosion, the depth to the fragipan has been reduced. Roots cannot penetrate below the plow layer.

The soil is cropped in much the same way as Volusia channery silt loam, 2 to 8 percent slopes. For successful crop yields on this soil, the supply of readily decayable organic matter should be built up in the surface layer. This soil is in capability unit IVe–2.

Volusia channery silt loam, 8 to 15 percent slopes (VbC).—This soil is like the typical soil described for the series, but it has stronger slopes. Most of it is on long, smooth slopes just below areas of Lordstown soils. In these places small, seepy areas of Alden soils have been included in mapping. On the convex slopes as much as 10 percent of an individual area of this soil may consist of Mardin soils.

This soil has more rapid runoff than the less sloping Volusia soils, and it warms up earlier in spring. It is more likely to be seriously eroded and needs more intensive practices to control erosion.

The soil is used in about the same way as Volusia channery silt loam, 2 to 8 percent slopes. Suitable hay crops are grown more often, however, in a cropping system that includes corn and oats. This soil is in capability unit IIIe–5.

Volusia channery silt loam, 8 to 15 percent slopes, eroded (VbC3).—This soil is similar to the typical soil described for the series, except that the original surface soil has been lost through erosion. The present plow layer consists of former subsoil mixed with material from the fragipan. Roots can penetrate only to the fragipan.

This soil is suited to the same crops as the less strongly sloping Volusia soils. For successful crop production on this soil, the supply of readily decayable organic matter should be built up in the surface layer. The soil also needs practices to control erosion if its use for crops is continued. This soil is in capability unit IVe–2.

Volusia channery silt loam, 15 to 25 percent slopes (VbD).—This soil is similar to the typical soil described for the series. It has stronger slopes, however, and, in general, the fragipan is 2 or 3 inches nearer the surface. The soil is on the sides of drainageways. It has rapid runoff, and there is a serious hazard of erosion.

This soil is used mainly for meadow. Occasionally, small grains are grown in a cropping system that includes hay crops. Crop yields are low, unless the soil is adequately limed, fertilized, and otherwise well managed. This soil is in capability unit IVe–3.

Volusia channery silt loam, 15 to 25 percent slopes, eroded (VbD3).—Originally, this soil was similar to the typical soil described for the series. As a result of erosion, however, it now has a plow layer composed mainly of mixed materials like the materials in the B_{2g} and A'_{2g} horizons of the typical soil. The soil occurs in association with Volusia channery silt loam, 15 to 25 percent slopes. Runoff is rapid on both of these soils. If the associated Volusia soil is used continuously for row crops, it too will soon become eroded.

Volusia channery silt loam, 15 to 25 percent slopes, eroded, is used principally to grow sod crops for hay or pasture. It is also used to grow small grains and occasionally corn for silage.

The principal management needs of this soil are controlling erosion and increasing fertility. The soil will be low in productivity where erosion has recently occurred. Roots can penetrate no deeper than the top of the fragipan.

For fair crop yields, the soil needs lime, phosphate, some potash, and large amounts of nitrogen fertilizer or manure. Fertility can be improved by growing a sod crop with a suitable legume to increase the supply of organic matter. The lime and fertilizer will increase the growth of other plants in the cropping system. Terraces are needed to divert excess surface water away from this soil and thus prevent erosion. This soil is in capability unit VIe–1.

Wallington Series

These medium-textured to moderately fine textured soils are strongly acid and dominantly poorly drained. They have formed in local deposits of lacustrine materials. The deposits consist of sediments washed from acid soils of the uplands, where the underlying bedrock is sandstone, siltstone, and coarse-textured shale. The soils are slowly permeable, and there is a permanent high water table.

The Wallington soils belong to the Low-Humic Gley great soil group. They are associated with moderately well drained Scio and very poorly drained Birdsall soils.

Only one member of the Wallington series, Wallington silt loam, over gravel, 0 to 3 percent slopes, has been mapped in Cortland County.

Typical profile (Wallington silt loam, over gravel, 0 to 3 percent slopes; meadow):

A_p 0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam with a few, fine, distinct mottles of dark yellowish brown (10YR 4/4); moderate, coarse, granular structure; friable; fine roots abundant; pH 4.8; abrupt, smooth lower boundary.

A_{2g} 9 to 13 inches, mottled grayish-brown (2.5Y 5/2) silt loam with many, fine, dark-brown (7.5YR 3/2) concretions; weak, fine to medium, subangular blocky structure; slightly firm when removed or in place; a few fine and medium-sized roots; pH 5.1; 2 to 6 inches thick; gradual, wavy lower boundary.

B_{21g} 13 to 27 inches, mottled light yellowish-brown (10YR 6/4), yellowish-brown (10YR 5/6), and light olive-gray (5Y 6/2), heavy silt loam to silty clay loam; weak, fine and medium, subangular blocky structure; slightly firm when removed or in place; a few large roots; pH 5.1; gradual lower boundary.

B_{22g} 27 to 40 inches, olive (5Y 4/4) silty clay loam with many, coarse, prominent mottles of olive gray (5Y 5/2) and yellowish brown (10YR 5/6); weak, fine, subangular blocky peds within very weak prisms that are 6 to 11 inches across; the prisms are separated by thin gray streaks; firm, firm to slightly firm in place; free of roots; a few pebbles in the lowest 6 inches of this horizon; pH 5.4; abrupt, wavy lower boundary.

D_g 40 to 48 inches, dark-gray (5Y 4/1) gravelly silt loam, loam, or fine sandy loam in stratified layers; structureless; loose to slightly firm in place; pH 5.5.

In Cortland County, soils of this series range more widely in texture than is typical of the Wallington soils on the lake plain to the north. The texture in the layers below the plow (A_p) layer ranges from clay loam to silty clay loam. Depth to gravel ranges from 24 to 44 inches. In places the D_g horizon is several feet thick. In most places these soils are strongly acid throughout the profile, but, in the valley of Labrador Creek, the Wallington soils are only slightly acid.

Wallington silt loam, over gravel, 0 to 3 percent slopes (WaA).—This soil is nearly level or has slightly concave slopes. It occurs near Harford and in the valleys of the Otselic River and Labrador and Cheningo Creeks. In the northeastern part of the county, this soil lies next to areas of Rhinebeck soils. Most of this soil is poorly drained, but in some small areas drainage is somewhat poor. The soil remains wet and cold during most of the growing season. It is low in natural fertility. After the soil has been drained, applications of lime, phosphate, and potash are needed for successful crop production.

Most of this soil is used for pasture. It is especially desirable for pasture in summer and fall when pastures on soils of the uplands are drying up. This soil is in capability unit IIIw–2.

Wayland Series

The soils in this series are slightly acid to neutral and are medium textured and dominantly poorly drained. They have formed from recent alluvium washed from soils high in lime. The Wayland soils occur in level areas or in depressions. They remain wet during most of the year.

These soils are in the Low-Humic Gley great soil group. In most places they occur in association with moderately well drained Lobdell and very poorly drained Sloan soils.

In Cortland County only one member of the Wayland series, Wayland silt loam, 0 to 1 percent slopes, has been mapped.

Typical profile (Wayland silt loam, 0 to 1 percent slopes; pasture):

A_1 0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam with many, fine, distinct mottles of yellowish brown (10YR 5/8) and yellowish red (5YR 5/6) along old root channels; strong, medium to coarse, crumb structure; friable; fine roots abundant; pH 6.8; 5 to 9 inches thick; gradual, smooth lower boundary.

C_{11g} 7 to 23 inches, dark-gray (5Y 4/1) silt loam with many, coarse, distinct mottles of reddish brown (5YR 4/3); massive; friable, slightly firm in place; a few medium-sized and large roots; pH 6.8; 12 to 20 inches thick; gradual, smooth lower boundary.

C_{12g} 23 to 38 inches, gray (5Y 5/1) silt loam with common, large, distinct mottles of reddish brown (5YR 4/4); massive; slightly plastic, slightly firm in place; essentially free of roots; pH 7.0; 8 to 20 inches thick; abrupt, lower boundary.

D_g 38 to 50 inches, dark-gray (5Y 4/1), stratified silt loam to fine sandy loam; structureless; loose; free of roots; weakly calcareous at a depth of 46 inches.

In some areas this soil differs from the typical soil in that the texture of the C_{12g} horizon is silty clay loam. In a few oxbow areas, which were once parts of lakes, the texture of the soil is silty clay loam to a depth of 26 inches. The thickness of the D_g horizon is variable.

Wayland silt loam, 0 to 1 percent slopes (WbA).—This soil occurs in level areas or in slight depressions adjacent to streams. It is in the valleys north and northwest of the city of Cortland and in the valley of the Tioughnioga River north of Marathon. The soil has a permanently high water table and is flooded frequently during the growing season.

This soil is high in organic matter, lime, and potassium but low in available phosphorus. The areas, unless drained, are too wet for crops throughout the entire growing season. Pastures on this soil produce some forage when most pastures on soils of the uplands are drying up. Because of flooding and the lack of outlets, this soil is difficult to drain. Nevertheless, if the soil is adequately drained, high yields are obtained of the crops commonly grown in the county. This soil is in capability unit IIIw–3.

Use and Management of Soils

This section of the report is a general guide to the use and management of the soils of Cortland County. It does not give specific suggestions for managing individual soils on a farm, because many factors affect such decisions. Some of the factors affecting management of each soil on a farm are described in the section, Descriptions of Soil Series and Mapping Units. To supplement their own knowledge, farmers may consult local agricultural technicians for special help in deciding what practices are best suited to the soils of a particular farm.

The discussion of management is in four parts. The first describes the capability grouping of soils; the second discusses the principal practices needed in managing the soils; the third arranges the soils in capability units and describes general suitability for use and the management needed for successful crop production on the soils of each unit; the fourth gives estimates of yields that can be expected under different levels of management.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the degree of limitations of the soils, on the risk of damage to them, and also on their response to management. In this system there are three successively higher levels of generalization above that of the soil mapping unit. They are the capability unit, subclass, and class.

The capability unit is the lowest level of capability grouping. A capability unit is made up of soils that have similar management needs, risks of damage, and general suitability for use.

The next broader grouping, the subclass, is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means excess water that retards plant growth or interferes with cultivation; "s" shows that the soils are shallow, droughty, or unusually low in fertility; subclass "c" (not used in Cortland County) indicates the soils are limited chiefly by climate.

The broadest grouping, the land capability class, is identified by Roman numerals. All the soils in one class have limitations and hazards of about the same degree, but of different kinds, as shown by the subclass. All the land classes, except class I, may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops.

Class I soils are those that have the widest range of use and the least risk of damage. They are level or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty, or slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use. These need even more careful management.

In class IV are soils that have greater natural limitations than those in class III, but they can be cultivated for some crops under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops, but they can be used for pasture or range, as woodland, or for wildlife.

Class V soils (none recognized in Cortland County) are nearly level and gently sloping but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation.

Class VI soils are not suitable for crops because they are steep, or droughty, or otherwise limited, but they give fair to good yields of forage or forest products. Some soils in class VI can, without damage, be cultivated enough so that forest trees can be set out or pasture crops seeded.

Class VII soils provide only poor to good yields of forage or forest products and have characteristics that limit them severely for these uses.

In class VIII are soils (none recognized in Cortland County) that have practically no agricultural use. They have value as watersheds, and some have value as wildlife habitats or for scenery.

The capability classes, subclasses, and capability units in Cortland County are the following:

Class I.—Deep, nearly level, productive soils; suitable for tilled crops and other uses; few or no permanent limitations.
- Unit I–1.—Deep, well-drained, nearly level soils.

Class II.—Soils with some limitations that reduce the choice of plants or that require moderate conservation practices; suitable for crops, pasture, and trees.
- Subclass IIe.—Soils that have a moderate risk of erosion if cover is not maintained.
  - Unit IIe–1.—Deep to moderately deep, gently sloping soils.
  - Unit IIe–2.—Deep to moderately deep, gently sloping, moderately well drained soils with a fragipan below a depth of 15 inches.
  - Unit IIe–3.—Deep, gently sloping, moderately well drained soil.
  - Unit IIe–4.—Deep, gently sloping, moderately well drained to somewhat poorly drained soil with a slowly permeable subsoil.
- Subclass IIw.—Soils that have moderate limitations because of excess water.
  - Unit IIw–1.—Well-drained soils on flood plains.
  - Unit IIw–2.—Moderately well drained to somewhat poorly drained soils on flood plains and outwash terraces.

Class III.—Soils that have severe limitations that reduce the choice of plants, or that require special conservation practices, or both; suitable for crops, pastures, and trees.
- Subclass IIIe.—Soils that have a severe risk of erosion.
  - Unit IIIe–1.—Well-drained, sloping soils.
  - Unit IIIe–2.—Deep, sloping, moderately well drained soils with a fragipan below depths of 15 to 18 inches.

Unit IIIe-3.—Deep, moderately well drained, sloping soil.

Unit IIIe-4.—Moderately well drained to somewhat poorly drained, sloping soil formed in lacustrine deposits.

Unit IIIe-5.—Deep, somewhat poorly drained, strongly sloping soils with a strongly developed fragipan.

Subclass IIIw.—Soils that have severe limitations because of excess water.

Unit IIIw-1.—Somewhat poorly drained, gently sloping soils.

Unit IIIw-2.—Nearly level, poorly drained and very poorly drained soils.

Unit IIIw-3.—Poorly drained soils of the bottom lands.

Subclass IIIs.—Soils that have severe limitations because of shallowness.

Unit IIIs-1.—Shallow, gently sloping, well-drained soil.

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

Subclass IVe.—Soils that have a very severe risk of erosion.

Unit IVe-1.—Well-drained, moderately steep soils.

Unit IVe-2.—Gently sloping and sloping, eroded soils with a fragipan.

Unit IVe-3.—Moderately well drained to somewhat poorly drained, moderately steep soils with a compact subsoil.

Subclass IVw.—Soils that have very severe limitations because of excess water.

Unit IVw-1.—Nearly level, poorly drained and very poorly drained soils, one of which is shallow to bedrock.

Unit IVw-2.—Nearly level, poorly drained, deep soils.

Class VI.—Soils that have severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture, woodland, or food and cover for wildlife.

Subclass VIe.—Soils moderately limited for pasture plants or trees because of the risk of erosion.

Unit VIe-1.—Steep to very steep soils and an eroded soil with a fragipan.

Subclass VIw.—Soils moderately limited for pasture plants or trees because of excess water.

Unit VIw-1.—Very poorly drained soils subject to frequent flooding.

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

Subclass VIIw.—Soils that are severely limited for pasture plants or trees because of excess water.

Unit VIIw-1.—Wet, mucky soil.

Management Practices

A growing plant obtains water and nutrients from the soil and carbon dioxide from the air. Through the process of photosynthesis, energy from the sun helps combine these raw materials into organic matter. Most plants send roots into the soil, and, therefore, need a favorable root zone. Most of them also need some air around their roots; hence, they need a root zone that is porous. The root zone should be moist but not too wet.

Soils differ in many ways that affect the depth and quality of the root zone and the supply of water and plant nutrients. A farmer can manage his soil to keep it from eroding and can change some things, such as the amount of plant nutrients. He cannot change so easily the thickness of the root zone or the capacity to hold available moisture. Limitations set by the things not easily changed fix, for the most part, the responsiveness of a soil to management.

A wise farmer chooses crops and a cropping system to fit his soils and his farm business. He applies lime, commercial fertilizer, and manure in appropriate amounts to give his crops enough nutrients for profitable yields; he also uses supporting practices that are needed to control water and keep the soil from becoming either too wet or too dry or from washing away.

Cropping systems

Crops vary in their need for plant nutrients and in their effectiveness in preventing losses of soil through erosion. Row crops, such as corn, potatoes, cabbage, and beans, are known as soil-depleting crops because they use up large amounts of nutrients; they are harvested each year leaving the soil bare and likely to erode. On the other hand, close-growing crops, such as oats and other small grains, are not nearly so soil depleting as most row crops. They take a somewhat smaller amount of plant nutrients from the soil and protect the soil from erosion while they are growing. Although they leave the soil exposed from harvesttime until the following spring, their stubble reduces erosion considerably.

Grasses, legumes, and other sod-forming crops improve the soil. Their roots help to hold the soil together in small aggregates and help to prevent erosion. They make the soil more porous and thus more permeable to water and air. Alfalfa, birdsfoot trefoil, clover, and other legumes grown under suitable conditions also add nitrogen to the soil but draw heavily on the available supplies of phosphorus and potassium.

Farmers in the county are increasing the length of stands of legumes by seeding new, vigorous varieties that are well suited to the area. These new, high-yielding varieties of deep-rooted forage legumes, grown in soils that have suitable drainage, the proper pH, and adequate amounts of available phosphorous and potassium, and that are well managed, are essentially as valuable as corn in the cropping system. Stands of alfalfa mixed with grass can last for a minimum of 3 years and a maximum of 8 years. Appropriate combinations of new varieties of alfalfa, birdsfoot trefoil, timothy, and smooth bromegrass produce satisfactory yields on the well drained and moderately well drained soils and on most of the somewhat poorly drained soils in this county.

The results of new research continually make available to Cortland County farmers better varieties of crops and improved knowledge of varieties suitable to the soils, pH and fertility levels that are most profitable, and management practices that are most appropriate. It is up to the individual farmer to utilize these results to the extent that he desires.

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The proportion of sod-forming crops to row crops in a cropping system can be adjusted to provide not only the yields the farmer needs but also protection for his soils. For example, on nearly level soils suited to intensive use, a high-value row crop, which depletes the soil, can be grown in a 5-year cropping system that includes 1 or 2 years of a sod-forming crop. The sod-forming crop helps to replenish the supply of organic matter and nitrogen in the soil. On soils that are more likely to erode, sod-forming crops should be grown longer than 1 or 2 years in a 5-year cropping system.

Erosion is likely to be severe on sloping soils that are being used continuously for row crops. It can be reduced by growing a sod-forming crop. How often the sod-forming crop is grown depends on the kind of soil, the degree of slope, the need for erosion control, and the farming system. If a sod-forming crop is grown after a row crop has been grown for 2 years and followed by 1 year of a close-growing crop, erosion is reduced somewhat on soils that have slopes of 3 to 8 percent. But if the row crop is grown only 1 year, and followed by 1 year of a close-growing crop, and then a sod-forming crop is grown for 2 years, erosion is essentially controlled on the same soils. The cropping systems recommended on the soils indicate the maximum intensity of use considered safe with the supporting practices shown. (See table that accompanies the description of each capability unit.)

In the discussion of capability units, the cropping systems suggested are ones suitable for dairy farms. The cropping systems are designated by groups of letters, each letter representing a crop year. The symbols used are: R=row crop; Rc=row crop with a cover crop; C=close-growing crop; and S=sod-forming crop.

An example of an intensive 4-year cropping system suitable for use on some of the soils of the county is represented by the letters Rc–Rc–C–S. This cropping system consists of 2 years of row crops, followed each year by a cover crop, and then 1 year each of a close-growing crop (oats, wheat, or barley) and a sod-forming crop. The cover crop, which follows the row crop, provides a protective cover for the soil about 50 percent of the time.

Lime and fertilizer

The needs for lime and fertilizer must be satisfied if crops are to produce good yields and help conserve the soil. In this subsection the general needs of the soils and crops for lime, nitrogen, phosphorus, and potassium are discussed.

Lime.—Soils vary in the amount of lime they require. Different crops vary in their pH requirements for optimum yields. Besides correcting soil acidity and increasing the availability of other nutrients, lime provides a favorable medium for soil organisms to help decompose plant remains.

Most of the soils of the county developed from parent materials that were originally low or medium in calcium or from materials in which the calcium had been leached out by water. Consequently, essentially all the soils are acid.

Most soils that have not been limed in the last 5 years will probably need 2 to 3 tons of lime per acre for production of crops. The most effective timing and placement of lime applied to soils is discussed in current editions of the following publications of the New York State College of Agriculture at Cornell University: Bulletin 822, entitled More Lime on Your Land; Cornell Recommends for Field Crops; and Vegetable Production Recommendations. The amount of lime to apply depends on the texture of the plow layer, its organic-matter content, the thickness of the plow layer, the present acidity of the plow layer, and the requirements of the specific crop. A pH of 5.2 to 5.4 is currently suggested for potatoes; a pH of 6.4, for birdsfoot trefoil; and a pH of 6.8 for alfalfa (*9*).[2]

After the first heavy application, most soils in Cortland County will normally require about 1 ton of ground limestone once every 4 or 5 years to maintain the desired pH. In the tables showing management of the soils in capability units, the lime level of the profile is indicated by the terms "very low," "low," "medium," and "high." These terms generally indicate the amount of lime present in the root zone. The lime level of different soil profiles in Cortland County is shown in figure 10.

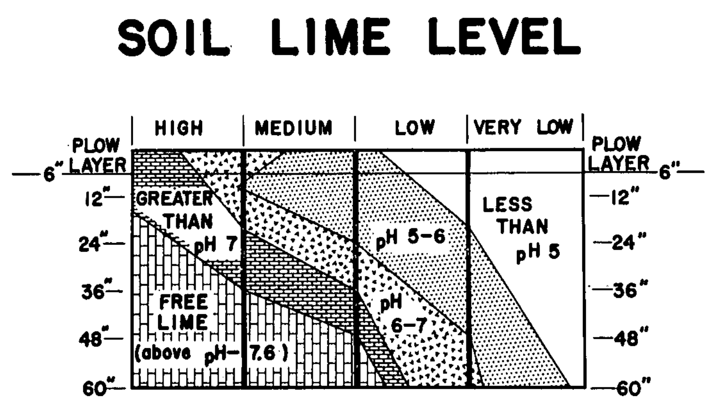

Figure 10.—**Lime level of different soil profiles in Cortland County.**

High-lime soils have neutral to slightly acid surface layers, but acidity becomes less with increasing depth, and free lime usually occurs at depths of 20 to 36 inches. Crops grown on these soils need little or no lime. Medium-lime soils may have a medium to strongly acid surface soil and upper subsoil, but acidity decreases with increasing depth, and free lime may be present at depths of 40 to 50 inches. Crops grown on such soils may need as much lime as crops grown on low-lime soils, but deep-rooted legumes, once started, will utilize lime from the substratum and will persist for longer periods than on low-lime soils. Low-lime soils are strongly acid to depths of 20 to 30 inches and may have slightly acid to neutral material below a depth of 30 inches. They may be weakly calcareous below a depth of 60 inches. Crops grown on low-lime soils need lime. They generally yield slightly more than those grown on very low-lime soils. Very low-lime soils are very strongly acid to depths of 24 to 36 inches and medium acid below those depths.

In the descriptions of capability units, the individual table showing amounts of lime to add to produce a specified change of pH are approximations to the nearest half ton for a 6-inch plow layer. For current recommendations, consult the publications previously mentioned in this subsection.

[2] Italic numbers in parentheses refer to Literature Cited, p. 119.

Phosphorus.—This nutrient is essential for the growth of plants. It hastens the maturing of plants, increases the proportion of grain to straw, stimulates the development of roots, and helps make the grain plump and full.

In general, the soils of Cortland County are low in phosphorus. Unlike nitrogen, phosphorus is only slightly soluble, and reserves of this nutrient accumulate in the soil. If phosphate has been added over a period of years, some soils will not be deficient in this element. This is especially true if superphosphate has been spread on stable floors and mixed with manure that was later applied to the soils. If the soils have not received manure treated with superphosphate in the last 3 or 4 years or have not received phosphate in some other form, the level of available phosphorus for crops will be low. At present, most of the soils need 20 to 30 pounds of phosphate per acre annually. If you are not familiar with the past management of a particular field, it is best to have the soil tested to determine the need for phosphate.

Nitrogen.—This nutrient helps develop the leaves and stems of plants. Nitrogen makes the plants dark green, but, if it is lacking, the plants are pale green. Most of the nitrogen in the soil is related to the amount of organic matter. Soils that are cold and wet during part or most of the growing season many contain large amounts of organic matter, but they release nitrogen slowly, especially during the early part of the growing season. Consequently, the growing crop may lack nitrogen, although the soil contains a large amount of it, because the nitrogen is not readily available early in the growing season. Plants deficient in nitrogen are generally stunted. No matter how much phosphorus and potassium are available in the soil, plants do not grow well if the supply of available nitrogen is low.

Farm manure is a source of nitrogen, but it seldom supplies enough of this nutrient to satisfy the requirements of plants. Additional nitrogen generally is needed if high yields of crops are to be obtained. It is advantageous to inoculate legume seeds before planting them. Legumes that have been inoculated properly seldom need additional nitrogen.

Avoid applying more nitrogen than is needed. An oversupply of this nutrient causes the stems of plants to be weak and grain to lodge. Most of the excess nitrogen is removed from the soil through drainage water.

Potassium.—This nutrient is necessary to promote the buildup of starch, sugar, and cellulose in plants; it also causes plants to mature more rapidly and strengthens their stems. Alfalfa and birdsfoot trefoil require large amounts of potassium and fail to do well if this nutrient is not available.

In Cortland County the Lansing, Conesus, and Kendaia soils are normally high in potassium-supplying power, but most of the other soils are medium. The content of available potassium is generally related to the texture of the soil, although several other factors also influence the rate and amount of potassium that becomes available each year from a soil. The clayey soils contain the largest amounts, and the sandy soils, the least. Most of the soils in the county are medium-textured silt loams that are medium in ability to supply potassium. Consequently, for good yields of most crops, extra potash from manure, commercial fertilizer, or both is required.

Though potassium is soluble and can be washed out of the soil by drainage water, it is not so soluble as nitrogen. The supply of available potassium can be supplemented most efficiently through the addition of small amounts of potash each year. However, if too much potash is applied to the soil, plants, especially legumes, tend to use more of this nutrient than they need; this is known as luxury consumption. For this reason, it is considered best to add potash annually.

Potash is applied mainly in the form of commercial fertilizer. Manure, as usually handled, commonly contributes about 4 to 6 pounds of potash for each ton applied; the potash is mainly in the liquid part of the manure.

An estimate of the ability of individual soils to supply potassium is given in the table in the description of each capability unit. If the past management of a soil is not known, it is best to have the soil tested to determine its amount of available potassium. Then, use the results of the test in conjunction with current information.

Supporting practices for the cropping system

In addition to using a suitable cropping system, practices are needed that will conserve water, remove excess water, and control erosion.

Water is needed to dissolve most plant nutrients and to make them available to plants. Too much water or too little water, however, is commonly the limiting factor in the growth of plants. Water lost by excessive runoff, besides causing plants to lack moisture, increases the risk of erosion on cultivated fields.

How beneficial rainfall is depends largely on how much water infiltrates into the soil. Some factors that affect the rate of infiltration are (1) the amount of surface cover available to break the impact of falling raindrops; (2) the amount of pore space and the degree of aggregation of soil particles; (3) the content of clay in the soil; and (4) the degree of slope of the soil. The farm operator can do something about some of these factors. For example, by growing grasses and legumes in the cropping system, he can improve the aggregation and aeration of the soil and thereby increase the rate of infiltration. On steep soils that have rapid runoff, diversion terraces will break the length of slope and safely remove excess water. Cultivating on the contour slows down the rate of runoff, decreases erosion, and permits more water to enter the soil.

Because of a high water table or an impervious layer, some soils are seasonally saturated with water; as a consequence, plants are damaged from too much water and too little air. These soils are cold and wet during a large part of the growing season, but later in the growing season they may become very dry. When the soils are wet, plants are able to develop only shallow roots. Then, when the soils dry out, the roots are too shallow to obtain a good supply of water. Figure 11 shows that the roots in very wet, or poorly drained, soils extend to a depth of only a few inches; in contrast, the roots of well-drained soils extend to a depth of about 36 inches.

Artificial drainage can be installed in most of the wet soils, especially in soils that lack a firm fragipan. In planning a drainage system, the farm operator needs to consider the cost involved and the kind of drainage needed. It is best to consult a drainage engineer to deter-

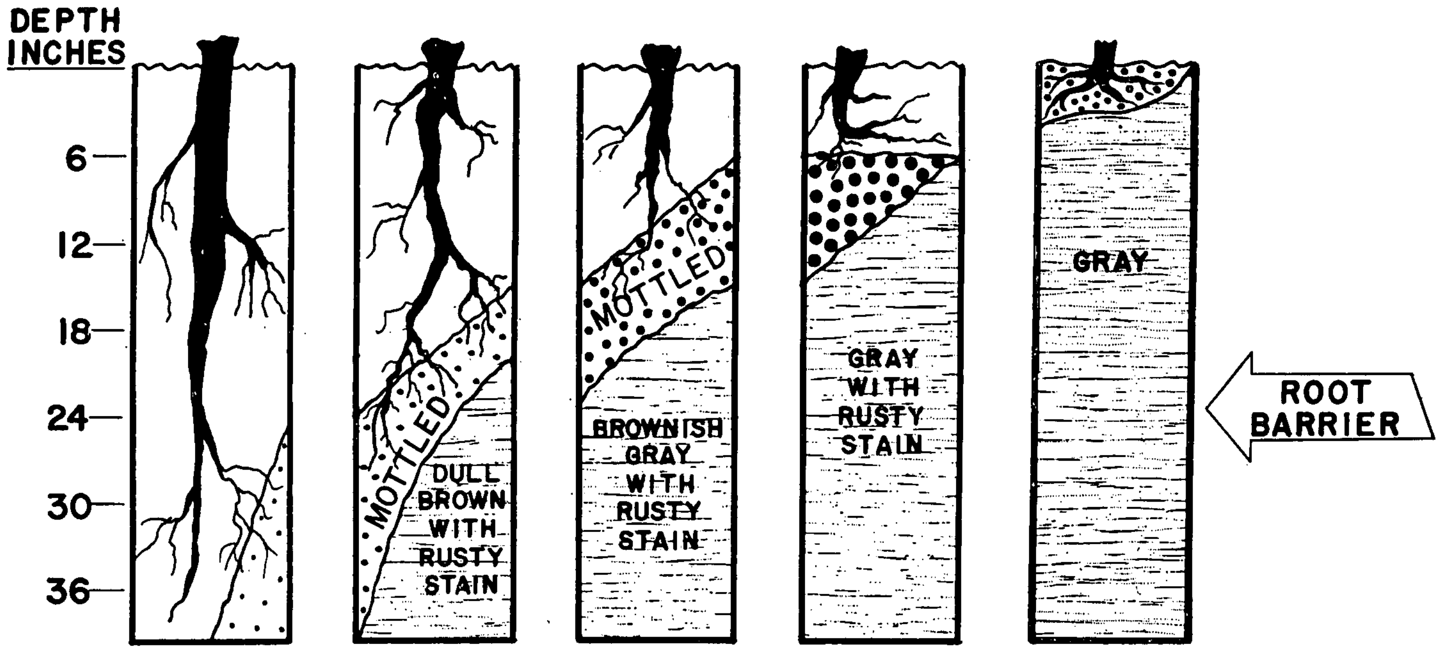

Figure 11.—**Depths to which roots penetrate in soils of different drainage classes. The profiles in sequence from left to right are well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained.**

mine whether artificial drainage is feasible on a particular soil or field.

Practices and structures suggested for conserving water, removing excess water, and controlling erosion are as follows:

Cross-slope tillage.—Tilling the soil across the general direction of the slope so that the rate of runoff is reduced and more water enters the soil.

Contour stripcropping.—Growing crops in strips on the contour and at right angles to the natural slope of the land. Strips of grass or other close-growing crops alternate with strips of clean-tilled crops. In *graded stripcropping* the strips have a grade of not more than 2 percent and are laid out from a guideline in the center of the strip. Rows and furrows grade to a grassed waterway. Graded strips should be used on soils that are both wet and sloping. They help drain the soil and control erosion.

Diversion terrace.—A shallow channel that is graded or dug and that has a supporting ridge on the lower side. The channel curves around the slope at a gentle gradient; this helps to control erosion, and if the channel is deep enough it intercepts and safely diverts seepage water. The diversion empties the water into a protected waterway or a natural drainageway; from the drainageway the water can be transported without causing excessive erosion.

Field stripcropping.—When this practice is used, alternate strips of different crops are grown across the direction of the slope. Field stripcropping is similar to cross-slope tillage except that different kinds of crops are grown in strips.

Open ditches or drains.—Drainageways constructed to remove excess water, primarily from very wet soils.

Capability Units

For the purpose of discussing management requirements, the soils of Cortland County have been placed in 24 capability units. All the soils in any one unit are similar in use suitability and management needs. For each unit there is a table listing the soils in the unit, as well as facts about lime and potassium, suitable cropping systems, and supporting practices. The information in this section is not specific but is a general guide for the use, management, and conservation of the soils of the county.

Many of the statements concerning suggested use and management apply to the soils in general and are subject to change as more information becomes available. For specific suggestions about different crops, contact the county agricultural agent. Recommendations for suitable field crops are revised annually by the Agronomy Department of Cornell University and are published in Cornell Recommends.

Recommendations for suitable field crops, efficient use of lime and fertilizer, and effective soil and crop management practices are revised annually by the New York State College of Agriculture at Cornell University. These recommendations are published in Cornell Recommends for Field Crops (*9*) and in Cornell Extension Bulletins No. 780, Fertilizers for Field Crops; No. 781, Hay and Pasture Seedings; and No. 821, Weed Control in Field Crops. Current recommendations are also published monthly by the Cortland County Extension Service.

Class I.—*Deep, nearly level, productive soils; suitable for tilled crops and other uses; few or no permanent limitations.*

CAPABILITY UNIT I–1

This capability unit is made up of deep, well-drained soils that are nearly level. The soils range from moderate to high in water-holding capacity and in their ability to supply and hold plant nutrients. All of the soils are easy to work, although Howard cobbly loam, 0 to 3 percent slopes, and Palmyra cobbly loam, 0 to 3 percent slopes, both contain cobblestones that hinder tillage to some extent. Except for the Howard, Palmyra, and Chenango soils, the soils are free of gravel to a depth of 2 or 3 feet. The Howard, Palmyra, and Chenango soils are slightly droughty in years when the amount of rainfall during the growing season is below normal.

The soils of capability unit I-1 respond well to good management and are among the most productive soils in the county. They are listed in table 2 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 2.—*Soils of capability unit I-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Chagrin silt loam, high bottom, 0 to 4 percent slopes.	Medium	Medium.
Chenango gravelly loam, 0 to 3 percent slopes.	Low to very low	Medium.
Dunkirk silt loam, over gravel, 0 to 4 percent slopes.	Low	Medium.
Howard cobbly loam, 0 to 3 percent slopes.	Medium	Medium.
Howard gravelly loam, 0 to 3 percent slopes.	Medium	Medium.
Palmyra cobbly loam, 0 to 3 percent slopes.	High	Medium.
Palmyra gravelly silt loam, 0 to 3 percent slopes.	High	Medium.
Tioga silt loam, high bottom, 0 to 3 percent slopes.	Low	Medium.
Unadilla silt loam, 0 to 4 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0		1.0	1.2

Cropping systems [1]	Supporting practices
Rc-Rc-Rc; R-R-C-S; R-C-S.	Cross-slope cultivation on Unadilla and Dunkirk soils.
R-C-S-S; R-C-S-S-S; C-S-S-S.	Not needed.

[1] Rc=row crop with cover crop; R=row crop; C=close-growing crop; S=sod-forming crop.

Suitability for crops and pastures.—The soils of this capability unit are suited to all the crops grown in the county. On the Chenango, Howard, and Palmyra soils, which are all gravelly or cobbly, shallow-rooted crops may be damaged slightly by drought; nevertheless, yields seldom are affected seriously. The soils can be planted to the same kinds of crops as are grown on other well-drained soils that have similar moisture-holding capacity.

In general, these soils are more valuable for growing intertilled crops than for pasture. Nevertheless, if a sod crop is grown in the rotation, it will help to maintain adequate supplies of readily decayable organic matter and plant nutrients and to maintain good tilth. The soils are well suited to all of the hay and pasture mixtures commonly used for seeding. The kind of forage mixture to use for seeding will vary according to the intended use of the crop, lime and fertility levels, and the length of time the soil is to be kept in sod.

Liming.—The content of lime in these soils ranges from very low to high. The amount of lime required in the initial application varies according to the management system used on each soil. After the initial application of lime has been made, about the same amount of lime in subsequent applications will be necessary to maintain a similar reaction to a depth of approximately 6 inches in any of the soils. The Palmyra soils are the only soils of this capability unit that have free lime at a depth of about 30 inches. Tests are needed to determine how much lime will be required to attain the desired pH.

Fertilization.—Because of differences in past use and management, no specific rates of applying fertilizer are given for specific crops on individual soils of this group. Rates used in applying fertilizer should be based on applicable results of research on these or similar soils, on successful past experience, on general recommendations for these soils, or on recent soil tests. If the soils have not been tested recently, consult the county agricultural agent for assistance in testing them.

Suitability for planting trees.—Most trees, especially black locust, hybrid poplar, and other common deciduous trees, grow well on these soils. The soils are also well suited to conifers commonly grown for sale as Christmas trees. Norway spruce and Japanese larch will grow where the reaction is higher than pH 6.0 but are susceptible to root rot fungus (*Fomes annosus*) when they become older. Red pine does not grow well on soils that have a surface pH of more than 6.0.

Class II.—*Soils with some limitations that reduce the choice of plants or that require moderate conservation practices; suitable for crops, pasture, and trees.*

SUBCLASS IIe.—SOILS THAT HAVE A MODERATE RISK OF EROSION IF COVER IS NOT MAINTAINED.

CAPABILITY UNIT IIe-1

This capability unit consists of deep to moderately deep, gently sloping soils. The soils have moderate to good moisture-holding capacity and retain most of the plant nutrients that are applied. Consequently, they are among the best agricultural soils in the county. Runoff is medium; therefore, some practices are needed to control erosion.

The soils of this capability unit are listed in table 3 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 3.—*Soils of capability unit IIe-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Bath channery silt loam, 3 to 8 percent slopes.	Low	Medium.
Bath-Chenango gravelly loams, 3 to 8 percent slopes.	Low	Medium.
Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes.	Medium	Medium.
Chenango gravelly loam, 3 to 8 percent slopes.	Low to very low.	Medium.
Howard cobbly loam, 3 to 8 percent slopes.	Medium	Medium.
Howard gravelly loam, 3 to 8 percent slopes.	Medium	Medium.
Lansing gravelly silt loam, 3 to 8 percent slopes.	Medium	Medium to high.
Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes.	Low	Medium to low.
Palmyra gravelly silt loam, 3 to 8 percent slopes.	High	Medium.
Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes.	Low	Medium.
Valois-Howard gravelly loams, 3 to 8 percent slopes.	Low to medium.	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.5

Cropping systems [1]	Supporting practices
Rc-Rc-C-S; R-R-C-S-S; R-C-S; R-C-S-S; R-C-S-S-S; C-S-S-S.	*300-foot slopes:* Cross-slope tillage.
S-S-S-S	Not needed.
Rc-Rc-C-S; R-R-C-S-S; R-C-S.	*400-foot slopes:* Contour tillage; diversion terraces, mainly on Bath and Lansing soils; diversion terraces may not be practical on Lordstown soil because of shallow depth to bedrock.
R-C-S-S	Stripcropping; contour tillage.
R-C-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
Rc-Rc-C-S; R-R-C-S-S; R-C-S.	*600-foot slopes:* Stripcropping; contour tillage; diversion terraces, mainly on Bath and Lansing soils; diversion terraces not practical on Lordstown soil because of shallow depth to bedrock.
R-C-S-S	Stripcropping; contour tillage.
R-C-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.

[1] Rc=row crop with a cover crop; C=close-growing crop; S=sod-forming crop; R=row crop.

Suitability for crops and pastures.—The soils of this capability unit are suited to most of the crops grown in the county. On farms where they predominate, much of the acreage is used to grow row crops. The crops most commonly grown are corn for silage and grain, oats, wheat, and grass-legume hay crops and pasture. Potatoes and cabbage are grown mainly on the Palmyra, Howard, Bath, Lansing, and Lordstown soils, and dry and snap beans are grown to some extent.

Because the growing season is fairly short in this area, early maturing varieties of corn should be grown. Potato scab is not a serious problem in the rotation sequence currently being followed on the Palmyra soil, even though the Palmyra and Lansing soils have free lime at depths between 30 and 40 inches.

When the soils are used for hay crops or pasture, the same kinds of forage seeding mixtures can be used as are used on the nearly level, well-drained soils of unit I-1. The kind of forage mixture used varies according to the intended use of the crop, lime and fertility levels, and the length of time the soil is to remain in sod. The Chagrin, Chenango, Howard, Palmyra and Tioga soils have gravelly substrata. Some shallow-rooted legumes do not grow so well on these soils as on other soils of this capability unit. Nevertheless, yields are only slightly lower.

Liming.—Lime is required for successful crop production on all soils of this unit. In general, the soils are moderately acid to strongly acid to depths between 24 and 36 inches, even though the Palmyra soil has free lime at a depth of 30 inches. Tests are needed to determine specific requirements for lime. After the soil has been tested, table 3 will serve as a guide for determining the amounts of lime to apply.

Fertilization.—The soils in this unit generally are low in available phosphorus and nitrogen. Because of differences in the past use and management of these soils, no specific rates for applying fertilizer are given for specific crops on individual soils. Individual soils should be tested to determine the fertilizer needs for specific crops.

Suitability for planting trees.—These soils are well suited to many kinds of trees. The degree of suitability for red pine is limited by the pH of the surface layer and subsoil. If the surface layer is neutral or mildly alkaline, as in some areas of the Palmyra soil, red pine should not be planted. Most conifers commonly grown for Christmas trees are suitable on these soils. In general, tree seedlings develop best in soils in which the pH of the surface layer is 6.0 or slightly lower. Once established, however, hardwoods have a wide tolerance range in pH.

CAPABILITY UNIT IIe-2

Deep to moderately deep, gently sloping soils make up this capability unit. The soils are moderately well drained. They have a fragipan at depths between 15 and 18 inches. The fragipan restricts internal drainage and causes the soils to have only moderate capacity to hold moisture and plant nutrients. Runoff is medium, and there is a moderate hazard of erosion if row crops are grown continuously. Nevertheless, the soils are productive if well managed.

The soils of capability unit IIe-2 are listed in table 4 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 4.—*Soils of capability unit IIe-2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Arnot channery silt loam, 2 to 8 percent slopes.	Low	Medium.
Langford channery silt loam, 3 to 8 percent slopes.	Low	Medium.
Mardin channery silt loam, 2 to 8 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices [2]
R-R-C-S; R-C-S	*300-foot slopes:* Contour tillage; stripcropping.
R-C-S-S	Contour tillage.
R-C-S; C-S	Not needed.
R-R-C-S; R-C-S	*400-foot slopes:* Contour tillage; stripcropping.
R-C-S-S	Contour tillage.
R-C-S	Cross-slope tillage.
C-S	Not needed.
R-R-C-S; R-C-S	*600-foot slopes:* Diversion terraces; contour tillage; stripcropping.
R-C-S-S	Diversion terraces; contour tillage.
R-C-S	Diversion terraces.
C-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.
[2] Diversion terraces may not be feasible on the Arnot soil because of the shallow depth to bedrock.

Suitability for crops and pastures.—The soils of this capability unit are well suited to the same crops as are grown on the soils of capability unit IIe-1. They are used less extensively, however, to grow potatoes, cabbage, and dry and snap beans.

The growing season is fairly short in this area; therefore, early maturing varieties of corn should be grown. Because of the firm fragipan, the soils are not well suited to deep-rooted legumes; nevertheless, some deep-rooted legumes can be grown successfully. If adequately limed and fertilized, the soils are productive of most crops.

The same kinds of forage seeding mixtures recommended for the soils in unit IIe-1 can be used for hay crops and pasture on these soils. If the soils are limed and fertilized according to the rates suggested, hay crops and pastures make good yields. The soils are better used for rotational pastures than for permanent pastures. Permanent pastures on these soils do not supply good yields of forage.

Liming.—The soils of this unit are strongly acid. If they have not been limed during the past 5 years, several tons of lime per acre may be needed to raise the pH to a level favorable for plants and for soil organisms to live and grow. Tests are needed to determine specific requirements for lime. After the soils have been tested, table 4 will serve as a guide in determining the amounts of lime to apply.

Fertilization.—Because of differences in past management, crops on these soils vary in their need for fertilizer. They are medium in ability to supply potassium and are generally low to moderate in available phosphorus and nitrogen. Soil tests are desirable as a guide for fertilizer use.

Suitability for planting trees.—The soils of this capability unit are suitable for most conifers grown for sale as Christmas trees. The trees must be planted carefully. Plant balsam fir and Douglas-fir only if advised to do so by a forester. Areas of Arnot soil that are somewhat poorly drained and less than 20 inches deep over bedrock are less desirable for trees than other soils of this unit. The soils are not suited to long-term production of red pine.

CAPABILITY UNIT IIe-3

Only one soil—Conesus gravelly silt loam, 2 to 8 percent slopes—is in this capability unit. This gently sloping soil is deep and is moderately well drained. It has free lime at a depth of about 42 inches. The moisture-holding capacity is moderate to high. The soil is high in ability to release potassium to plants, but it needs practices to conserve soil and water.

This soil is productive if it is well managed. In table 5 are facts about the lime level of the soil profile and ability to supply potassium. Also listed are cropping systems and supporting practices suitable for this soil.

Suitability for crops and pastures.—This soil is well suited to corn and oats and to alfalfa and other hay crops. It is also suited to cabbage, potatoes, and dry and snap beans. Early maturing varieties of corn should be grown. The crops respond well to good management, and good yields are obtained.

When this soil is used for hay crops or pasture, yields are high if the same kinds of mixtures are used for seeding as are suitable for the soils in unit IIe-1. Rotational pasture on this soil has a higher carrying capacity than permanent pasture.

Liming.—Though it has free lime at a depth of approximately 42 inches, this soil needs lime to make it less acid to depths of 12 to 16 inches. Areas that have not been limed in the past 4 or 5 years need to be tested to determine the need for lime. After the soil has been tested, table 5 will serve as a guide for determining the rates of lime to apply.

Fertilization.—If row crops have been grown continuously without adding commercial fertilizer or manure, this soil will probably be low in nitrogen and in available phosphorus. When yields increase, as the result of adding nitrogen and phosphate, the soil will eventually need potash. Because the rates and kinds of fertilizer vary with the specific crop grown, this soil should be tested to determine the need for fertilizer.

Suitability for planting trees.—If good management is used, most conifers grown for sale as Christmas trees can be grown on this soil. Plant balsam fir and Douglas-fir, however, only if advised to do so by a forester. Red pine should be grown only for sale as Christmas trees. White pine, Scotch pine, white spruce, Norway spruce, and Japanese larch are suited to other uses.

TABLE 5.—*Soil of capability unit IIe-3, its lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Conesus gravelly silt loam, 2 to 8 percent slopes.	Medium	High.

If the pH value of the soil by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices
R-R-C-S; R-C-S	*300-foot slopes:* Contour stripcropping.
R-C-S-S	Contour tillage.
R-C-S-S-S; C-S	Not needed.
R-R-C-S; R-C-S	*400-foot slopes:* Contour tillage; stripcropping.
R-C-S-S	Contour tillage.
R-C-S-S-S	Cross-slope tillage.
C-S	Not needed.
R-R-C-S; R-C-S	*600-foot slopes:* Diversion terraces; contour stripcropping.
R-C-S-S-S	Diversion terraces; contour tillage.
C-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

CAPABILITY UNIT IIe-4

Only one soil—Rhinebeck silt loam, 3 to 8 percent slopes—is in this capability unit. This soil is deep, gently sloping, and moderately well drained to somewhat poorly drained. It has a clayey B horizon, which limits its capacity for storing available moisture and plant nutrients. This slowly permeable horizon begins at a depth of 13 inches. Because of its silty texture, the soil is likely to erode if left bare for long periods. Nevertheless, it responds well to proper management.

In table 6 are facts about the lime level of the soil profile and the ability of this soil to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—Rhinebeck silt loam, 3 to 8 percent slopes, is suited to oats and forage crops. It is suited to varieties of alfalfa and trefoil that do well on soils that warm up late in spring. Ladino clover and birdsfoot trefoil grow well, and corn can be grown for silage in favorably situated areas. When this soil is used for pasture, it is best to rotate the pasture with other crops in a regular cropping system. Then the sod crop will receive the kind of management needed to provide maximum carrying capacity.

TABLE 6.—*Soil of capability unit IIe-4, its lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Rhinebeck silt loam, 3 to 8 percent slopes.	Medium	High.

If the pH value of the soil by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.5	5.5	6.0
5.5	3.0	3.5	4.0
6.0	----------	1.5	2.0

Cropping systems [1]	Supporting practices
R-C-S-S; R-C-S-S-S	*300-foot slopes:* Cross-slope cultivation.
C-S-S	Not needed.
R-C-S-S; R-C-S-S-S	*400-foot slopes:* Drainage diversions.
C-S-S	Not needed.
R-C-S-S; R-C-S-S-S	*600-foot slopes:* Drainage diversions; graded stripcropping.
C-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Liming.—In this soil free lime is at depths of only 26 inches, but lime has leached out of the surface soil. Consequently, crops need additional lime. After the soil has been tested, apply lime using table 6 as a guide and according to the needs of the crops to be grown. If more than 2 tons per acre are needed, it may be advisable to apply the lime in split applications.

Fertilization.—As a rule, the soil needs nitrogen if it has been used continuously for row crops without being manured. The supply of available phosphorus is medium. Potash is seldom needed. Have the soil tested to determine the kinds and amounts of fertilizer needed for specific crops.

Suitability for planting trees.—This soil is suitable for Austrian, white, and Scotch pine, Japanese larch, Norway and white spruce, and northern white-cedar. It is also suited to cuttings of hybrid poplar. Where erosion control is needed, jack pine and redcedar can be grown. Most Christmas tree stock, except balsam fir and Douglas-fir, are suitable.

SUBCLASS IIw.—SOILS THAT HAVE MODERATE LIMITATIONS BECAUSE OF EXCESS WATER.

CAPABILITY UNIT IIw-1

Well-drained soils on flood plains make up this capability unit. The soils are flooded during the growing season, but most of the flooding occurs early in spring or late in winter. The soils have excellent moisture-holding capacity, and they retain and furnish nutrients essential for the growth of plants. They are among the most productive soils in the county.

The soils in this capability unit are listed in table 7 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 7.—*Soils of capability unit IIw-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Chagrin silt loam, 0 to 2 percent slopes	Medium	Medium.
Tioga silt loam, 0 to 2 percent slopes	Low	Medium.
Tioga gravelly loam, 0 to 2 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices
Rc-Rc-Rc; Rc-Rc-S; R-R-C-S-S-S; R-C-S; R-C-S-S; R-C-S-S-S; C-S-S; S-S-S-S.	Streambank protection and channel control.

[1] Rc=row crop with a cover crop; S=sod-forming crop; R=row crop; C=close-growing crop.

Suitability for crops and pastures.—All the crops commonly grown in the county grow well on the soils of this capability unit. Cultivated crops can be grown for several years in succession; however, a sod crop that includes legumes and that is grown at least once every 5 or 6 years will help maintain good tilth and fertility. Vegetables are grown only for home use.

When these soils are used for meadow or pasture, forage mixtures suitable for well-drained soils will produce good results. Both shallow-rooted and deep-rooted legumes can be grown. Nevertheless, most areas of these highly productive soils are best used for intensive cropping rather than for hay crops or pasture. If the areas are somewhat inaccessible, are subject to severe flooding, or occur in small fields, however, they can be used for hay crops or pasture.

Flooding is the principal limitation of these soils. The degree of flooding varies from place to place. Therefore, the cropping system used and the intensity of flood-control practices will differ from farm to farm.

Liming.—Crops grown on the soils in this capability unit all need lime, even though the Chagrin soil is commonly neutral at depths of 30 to 40 inches below the surface. The need for lime can be determined through soil tests and by the requirements of the specific crop to be grown.

Fertilization.—These soils have a medium supply of nitrogen and available phosphorus. They are medium in their ability to supply potassium. Have each soil tested and follow current fertilizer recommendations.

Suitability for planting trees.—Norway and white spruce; white, Austrian, and Scotch pine; Japanese and European larch; white-cedar; and hybrid poplar do well on these soils if they do not receive too much competition from other trees. Red pine can be planted on the drier sites if shoot moth is not a problem. In areas flooded more frequently, hybrid poplar and white-cedar can be planted. Suitable species grown for Christmas trees are white, Scotch, and Austrian pine and white and Norway spruce.

CAPABILITY UNIT IIw-2

Moderately well drained to somewhat poorly drained soils on flood plains and outwash terraces are in this capability unit. The soils are deep and gently sloping. The Middlebury and Scio soils are very strongly acid, the Lobdell soil is slightly to moderately acid, and the Phelps soil is slightly acid. The Lobdell and Middlebury soils are subject to overflow in spring but are seldom flooded in summer. Neither the Phelps nor the Scio soil is subject to overflow, but both may have water standing on them at various times during the year, especially early in spring. Because of a high water table, all of the soils are cold and wet for short periods during the early part of the growing season; later in the season, after the level of the water table has dropped, the soils are excellent for storing moisture and plant nutrients. The soils are easy to work and respond well to good management.

The Phelps soil has formed from gravelly outwash fairly high in lime; it is slightly wet as the result of a high water table. The Scio soil formed in acid, old alluvium. Although it is not flooded, the Scio soil is wet because a weak fragipan, which begins at depths between 15 and 20 inches, restricts the movement of water.

The soils in this capability unit are listed in table 8 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—These soils are suited to most of the crops grown in the county, except crops that will not tolerate short periods of wetness. They are well suited to pasture and meadow, even where they have not been drained. If they have been artificially drained, they can be used for intertilled crops. Many of the farms where the Middlebury and Scio soils occur are along narrow tributary valleys; on these farms these two soils are extremely important for agriculture because the upland soils are less productive.

Corn for grain or silage and sod crops for hay or pasture grow well on the soils of this capability unit. Legumes used in the forage mixture for hay crops or pasture should be tolerant to wetness. Oats do well on these soils, but yields are not so high as those obtained on better drained soils.

TABLE 8.—*Soils of capability unit IIw-2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Lobdell silt loam, 0 to 2 percent slopes	Medium	Medium.
Middlebury silt loam, 0 to 2 percent slopes.	Low	Medium.
Phelps gravelly silt loam, 0 to 3 percent slopes.	High	Medium.
Scio silt loam, 0 to 4 percent slopes	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach [1]—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [2]	Supporting practices
Rc-Rc-Rc; Rc-Rc-C-S; R-C-S-S-S; C-S-S-S; S-S-S-S.	Spot drainage; streambank protection and channel improvement on the Lobdell and Middlebury soils.

[1] For the Phelps soil, use about ½ ton less than the rates indicated; for the Scio soil, use ½ ton more than rates indicated.

[2] Rc=row crop with a cover crop; C=close-growing crop; S=sod-forming crop; R=row crop.

The flooding hazard varies in areas of Lobdell and Middlebury soils of the bottom lands. Consequently, each area requires individual treatment.

Liming.—The soils should be tested to determine specific needs for lime. After this is done, table 8 will serve as a guide for determining the amounts of lime to apply, but the needs of the specific crop must be considered.

Fertilization.—The soils in this capability unit have a medium supply of nitrogen, are low in available phosphorus, and are medium in their ability to supply potassium. If the past management of each soil is known, the rates of fertilization currently suggested in the county can be used. However, some crops may have drawn especially heavy on potassium or other nutrients. In general, it is best to have the soils tested and then to apply fertilizer on the basis of the test results.

Suitability for planting trees.—Areas of these soils that have an acid to neutral surface layer and that are somewhat better drained than other areas are suited to white and Scotch pine, white and Norway spruce, and Japanese larch. The wetter areas can be used for white spruce, white pine, and white-cedar. The areas of more alkaline soils are suited to white-cedar or to white spruce, balsam fir, and Austrian pine grown for sale as Christmas trees. Red pine, Japanese larch, and Norway spruce planted on the Phelps soil are susceptible to root rot when they become older.

Class III.—*Soils that have severe limitations that reduce the choice of plants, or that require special conservation practices, or both; suitable for crops, pastures, and trees.*

SUBCLASS IIIe.—SOILS THAT HAVE A SEVERE RISK OF EROSION.

CAPABILITY UNIT IIIe-1

Well-drained, sloping soils make up this capability unit. The Palmyra, Howard, Chenango, and Dunkirk soils have formed in material deposited by running water. The other soils have formed in glacial till. Only the Lordstown soil is less than 36 inches deep over bedrock. These soils have medium to moderately rapid runoff; they are subject to severe erosion and loss of water unless protected.

The soils in this capability unit are listed in table 9 along with facts about the lime level of the soil profile and the ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—The soils of this unit are suited to the crops commonly grown in the county. Nevertheless, because of strong slopes, they are somewhat restricted in their use; this is apparent on farms on which these soils make up most of the cropland. The soils are somewhat difficult to till, but they can be used in any of the cropping systems listed in table 9. On many farms that lack less sloping areas, these soils are used for row crops.

Crops commonly grown are oats, corn for silage and grain, and grasses and legumes in a mixture for hay or pasture. Potatoes, cabbage, and, to some extent, dry and snap beans are grown, especially on the Palmyra, Howard, Bath, Lansing, and Lordstown soils. Potatoes grown on the Palmyra and Howard soils, however, are not subject to potato scab because of the rotation sequences being followed. Unless limed, however, neither of these soils has a pH of greater than 5.8 to 6.0 in the upper part of the profile.

Suitable forage mixtures for hay crops and pasture should be used on these soils. Because the gravelly Palmyra, Howard, and Chenango soils have a slightly lower moisture-holding capacity than the other soils of this unit, they are not so well suited to shallow-rooted legumes as the other soils. Nevertheless, all the grasses and legumes commonly grown in the area do exceptionally well under the best management practices.

Liming.—In general, these soils have a medium to strongly acid plow layer. Only the Palmyra, Lansing, and Howard soils typically have free lime at depths of less than 5 feet, and only the Palmyra soil has free lime within reach of shallow-rooted plants. After the soils have been tested to determine their reaction, table 9 will serve as a guide to the amounts of lime to apply. Because different crops require different amounts of lime, check the latest suggestions for the amount of lime needed for specific crops.

Fertilization.—Because of differences in past management, the soils in this unit vary in fertility. Most of them have a medium supply of nitrogen, are low in available phosphorus, and are medium in their ability to supply potassium. The Palmyra and Lansing soils, however, will require less potash than the other soils. If the fertilizer needs of the soils are not known, it is best to have the soils tested and then to fertilize according to the rates suggested by a local agricultural technician.

TABLE 9.—*Soils of capability unit IIIe-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Bath channery silt loam, 8 to 15 percent slopes.	Low	Medium.
Bath-Chenango gravelly loams, 8 to 15 percent slopes.	Low	Medium.
Chenango gravelly loam, 8 to 15 percent slopes.	Low	Medium.
Dunkirk silt loam, over gravel, 8 to 20 percent slopes.	Low	Medium.
Howard gravelly loam, 8 to 15 percent slopes.	Medium	Medium.
Lansing gravelly silt loam, 8 to 15 percent slopes.	Medium	High.
Lordstown channery silt loam, 8 to 15 percent slopes.	Low	Medium.
Palmyra gravelly silt loam, 8 to 15 percent slopes.	High	Medium.
Valois-Howard gravelly loams, 8 to 15 percent slopes.	Low to medium.	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0		1.0	1.2

Cropping systems [1]	Supporting practices [2]
Rc-Rc-C-S-S; R-C-S-S; R-C-S-S-S.	*300-foot slopes:* Contour tillage.
R-C-S-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
Rc-Rc-C-S-S; R-C-S-S	*400-foot slopes:* Contour tillage; diversion terraces.
R-C-S-S-S	Contour tillage.
R-C-S-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
Rc-Rc-C-S-S; R-C-S-S	*600-foot slopes:* Contour stripcropping; diversion terraces.
R-C-S-S-S	Contour stripcropping.
R-C-S-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.

[1] Rc=row crop with a cover crop; C=close-growing crop; S=sod-forming crop; R=row crop.

[2] Because of shallow depth to bedrock, the Lordstown soil is not suitable for diversion terraces; therefore, cropping systems that do not require diversion terraces should be used on this soil. Because of complex slopes, Dunkirk silt loam, over gravel, 8 to 20 percent slopes, is not too practical for stripcropping and contour farming.

Suitability for planting trees.—The soils of this unit are well suited to most of the trees commonly grown in the county. Hardwoods, including black locust and hybrid poplar, grow well where the depth to bedrock is 30 inches or more. Areas in which the surface layer has a pH of less than 6.0 are best suited to red pine, Norway spruce, and Japanese larch; if the surface layer has a pH of more than 6.5, the areas are not suited to red pine and some other conifers because of the risk of damage from root rot when the trees become older. In areas where the pH is 7.0 or more in the surface layer, the soil is best planted to Austrian pine, European larch, and white-cedar. Most conifers available at the State nursery do well as Christmas trees.

CAPABILITY UNIT IIIe-2

Deep, sloping, moderately well drained soils make up this capability unit. The soils have formed in glacial till. They have restricted internal drainage and moderate capacity for holding available moisture and plant nutrients. A fragipan begins below depths of about 15 to 18 inches. The soils are productive if fertilized and otherwise well managed. Because of the strong slopes, runoff is rapid; as a result, erosion is a serious problem and water needed for the growth of plants is lost.

The soils of this capability unit are listed in table 10 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 10.—*Soils of capability unit IIIe-2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Langford channery silt loam, 8 to 15 percent slopes.	Low	Medium.
Mardin channery silt loam, 8 to 15 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.5		1.0	1.2

Cropping systems [1]	Supporting practices
R-R-C-S; R-C-S; R-C-S-S.	*300-foot slopes:* Diversion terraces.
R-C-S-S-S	Contour stripcropping.
C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
R-R-C-S; R-C-S; R-C-S-S; R-C-S-S-S.	*400-foot slopes:* Diversion terraces; contour stripcropping.
C-S-S-S	Contour tillage.
S-S-S-S	Not needed.
R-R-C-S; R-C-S; R-C-S-S.	*600-foot slopes:* Diversion terraces; contour stripcropping.
R-C-S-S-S; C-S-S-S	Contour stripcropping.
S-S-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Suitability for crops and pastures.—In general, these soils are suited to most of the crops grown in the county. Because of wetness and the risk of erosion, however, yields are not so profitable as on other soils that require less intensive management. However, where these soils are managed well, good yields of corn grown for silage, oats, and wheat are obtained. Early maturing varieties of corn should be grown because the growing season is fairly short.

If these soils are limed and fertilized, the same kinds of forage seeding mixtures currently recommended for moderately well drained soils can be used. Varieties of trefoil or alfalfa that will tolerate seasonal wetness should be grown. These soils, with proper management, provide good grazing and good yields of hay. Pastures are more productive if they are rotated with other crops in a cropping system.

Liming.—These soils are strongly acid to the depths to which roots penetrate. Soil tests are needed to determine specific needs for lime. Then, lime can be applied using table 10 as a guide and according to the needs of specific crops.

Fertilization.—These soils are medium in their ability to supply potassium but are somewhat deficient in their supply of nitrogen and available phosphorus. They should be tested for specific fertilizer needs. Rates and kinds of fertilizer required can be suggested by a local agricultural technician.

Suitability for planting trees.—Evergreens that do well on these soils are jack and Scotch pine, Japanese larch, and Norway and white spruce. White-cedar can be used for fence posts. Jack pine, Japanese larch, and redcedar do not tolerate shading and should be grown only on exposed slopes; here, they will furnish cover and help control erosion. Most trees suitable for sale as Christmas trees can be safely grown, but Douglas-fir and balsam fir are not well suited.

CAPABILITY UNIT IIIe-3

Only one soil—Conesus gravelly silt loam, 8 to 15 percent slopes—is in this capability unit. This soil is deep, sloping, and moderately well drained. In most places it has free lime at a depth of about 42 inches. Because of the strong slopes, the soil needs proper management if it is to remain productive.

In table 11 are facts about the lime level of the soil profile and the ability of this soil to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—Conesus gravelly silt loam, 8 to 15 percent slopes, is well suited to corn, oats, potatoes, cabbage, and beans, and to alfalfa and other hay and pasture plants. Early maturing varieties of corn should be grown. Seeding mixtures suitable for hay and pasture on moderately well drained soils do exceptionally well on this soil. To get a good carrying capacity from pasture, rotate the pasture with other crops in the cropping system.

Liming.—In most places this soil has been leached of free lime to a depth of 42 inches; consequently, lime is needed if good yields of crops are to be obtained. After the soil has been tested to determine its reaction, apply lime using table 11 as a guide and according to the needs of the specific crop to be grown.

TABLE 11.—*Soil of capability unit IIIe-3, its lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Conesus gravelly silt loam, 8 to 15 percent slopes.	Medium	High.

If the pH value of the soil by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	Tons	Tons
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0		1.0	1.2

Cropping systems [1]	Supporting practices
R-R-S-S; R-C-S; R-C-S-S.	*300-foot slopes:* Diversion terraces.
R-C-S-S-S	Contour stripcropping.
C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
R-R-S-S; R-C-S; R-C-S-S; R-C-S-S-S.	*400-foot slopes:* Diversion terraces; contour stripcropping.
C-S-S-S	Contour tillage.
S-S-S-S	Not needed.
R-R-S-S; R-C-S; R-C-S-S.	*600-foot slopes:* Diversion terraces; contour stripcropping.
R-C-S-S-S; C-S-S-S	Contour stripcropping.
S-S-S-S	Not needed.

[1] R=row crop; S=sod-forming crop; C=close-growing crop.

Fertilization.—This soil has medium ability to supply potassium, but it normally contains only a small supply of nitrogen and available phosphorus. However, if manure treated with phosphate has been added in excess of 10 tons an acre per year, the soil probably contains enough phosphorus for good yields. It is advantageous to have the soil tested for fertilizer needs. A local agricultural technician can suggest the kinds and amounts of fertilizer to use.

Suitability for planting trees.—This soil is suited to most evergreens grown for sale as Christmas trees. Balsam fir and Douglas-fir can be grown in places recommended by a forester, but extreme care should be taken with the small seedlings. Austrian pine and white pine can also be planted on this soil. Evergreens suitable for long-term growth are white pine, Scotch pine, Japanese larch, and Norway and white spruce.

CAPABILITY UNIT IIIe-4

Only one soil—Rhinebeck silt loam, 8 to 15 percent slopes—is in this capability unit. This soil is deep, sloping, and moderately well drained to somewhat poorly drained. It has formed in lacustrine deposits. Its B horizon is clayey and restricts the movement of water and the penetration of plant roots. Because of its silty texture and strong slopes, this soil is subject to erosion if not protected by the practices described in table 12. The soil responds well if fertilizer is added and other good management practices used, and good yields of crops are obtained.

In table 12 are facts about the lime level of the soil profile and ability of this soil to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 12.—*Soil of capability unit IIIe-4, its lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Rhinebeck silt loam, 8 to 15 percent slopes.	Medium	High.

If the pH value of the soil by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.5	5.5	6.0
5.5	3.0	3.5	4.0
6.0		1.5	2.0

Cropping systems [1]	Supporting practices
R–C–S–S–S–S; C–S–S–S.	Cross-slope tillage; diversion terraces can be used in a few places; other practices can seldom be used because most areas have short, steep slopes.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Suitability for crops and pastures.—This soil is well suited to oats, corn grown for silage, and certain varieties of alfalfa, trefoil, and clover. Plant early maturing varieties of corn; because of the risk of erosion, however, do not grow a row crop in 2 or more successive years. Areas to be used for hay crops and pasture should be seeded to plants that are tolerant of short periods of wetness during the growing season. It is best to rotate pasture with other crops in the cropping system so that the pasture will receive the kind of management needed to obtain a good carrying capacity.

Liming.—If it has not been limed recently, this soil will need applications of lime. After it has been tested to determine its reaction, apply lime according to the rates given in table 12 and according to the needs of the specific crop to be grown. If more than 2 tons of lime per acre are needed, add the lime in split applications.

Fertilization.—Crops grown on this soil seldom need potash, but the soil will be low in nitrogen and available phosphorus if it has been used intensively to grow row crops for several years. If the past management of the soil is not known, it is best to have the soil tested.

Suitability for planting trees.—Jack, Austrian, Scotch, and white pine, Japanese larch, and Norway and white spruce do well on this soil. Redcedar and Scotch and jack pine can be planted on exposed slopes to help control erosion. Northern white-cedar can be grown for use as fence posts. All conifers available at the State nursery will grow well for Christmas trees, but balsam fir and Douglas-fir are not likely to have good air drainage.

CAPABILITY UNIT IIIe-5

Deep, strongly sloping, somewhat poorly drained soils with a strongly developed fragipan make up this capability unit. The soils have formed in firm glacial till. They have rapid runoff, and, as a result, are subject to serious erosion. The fragipan restricts internal drainage and causes the soils to remain cold and wet during most of the spring months and intermittently throughout the year. Because of the hazards of erosion and wetness, the use of these soils is limited. Nevertheless, fair yields of crops are obtained, if the soils are limed, fertilized, and well managed.

The soils in this unit are listed in table 13 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 13.—*Soils of capability unit IIIe-5, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Erie channery silt loam, 8 to 15 percent slopes.	Low	Medium.
Volusia channery silt loam, 8 to 15 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0		1.0	1.2

Cropping systems [1]	Supporting practices
R-C-S-S; R-C-S-S-S; C-S-S-S.	*300-foot slopes:* Cross-slope tillage.
S-S-S-S	Not needed.
R-C-S-S	*400-foot slopes:* Drainage diversions.
R-C-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
R-C-S-S; R-C-S-S-S; C-S-S-S.	*600-foot slopes:* Drainage diversions; graded stripcropping.
S-S-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Suitability for crops and pastures.—Because the soils remain wet and cold until late in spring or early in summer, only varieties of crops that will tolerate somewhat poor drainage should be planted. Many farmers of the uplands must rely on the soils of this unit for hay crops and pasture. If the proper forage seeding mixtures are planted and the soils are limed and fertilized, good yields of hay and pasture can be obtained. The forage mixtures should include varieties of trefoil and alfalfa that will tolerate somewhat poor drainage and that are suitable for soils having a fragipan beginning at depths of 8 to 13 inches. Yields of pasture plants may be increased by rotating the pasture with meadow crops in any of the cropping systems shown in table 13.

Yields of crops grown on these soils may not be high enough to justify a large expenditure of labor and expense; crops should be planted that are not expensive to grow.

Liming.—These soils are acid in reaction; if they have not been limed during the past 5 years, they will probably need lime. After the soils have been tested to determine their reaction, apply lime using table 13 as a guide and according to the requirements of the specific crop.

Fertilization.—The soils in this unit generally have a medium supply of nitrogen, a low supply of available phosphorus, and are medium in their ability to supply potassium. They should be tested to determine the kinds and amounts of fertilizer needed. After the soils have been limed, legume crops will need additional potash. Because of wetness, the soils release only small amounts of nitrogen during the early part of the growing season. Therefore, manure or commercial fertilizer should be added in spring.

For best results in choosing and applying fertilizer, obtain the latest research information about these or similar soils and treat the soils accordingly.

Suitability for planting trees.—On these soils Scotch pine is the best suited of the evergreens grown for sale as Christmas trees. Norway and white spruce and possibly Austrian and white pine can be grown for the same purpose. Japanese and European larch to be used as fence posts make fairly good growth; Japanese larch is the more tolerant of restricted drainage.

Subclass IIIw.—Soils That Have Severe Limitations Because of Excess Water.

CAPABILITY UNIT IIIw-1

Deep, gently sloping, somewhat poorly drained soils comprise this capability unit. The soils have formed in glacial till. They have a fragipan that begins at depths of 8 to 13 inches. The fragipan restricts internal drainage and limits the depth to which the soils can store water and nutrients for plant use. Although their dominant limitation is wetness, these soils are also subject to erosion. The management practices shown in table 14 will help to overcome wetness and control erosion.

The soils in this unit are listed in table 14 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—Wetness and the degree of slope limit the suitability of these soils for crops. The soils remain cold and wet for long periods in spring and are poorly suited to crops that require early planting. They are used principally for corn grown for silage, oats, hay crops, and pasture. The soils are well suited to ladino clover and other shallow-rooted legumes, as well as to certain varieties of alfalfa and trefoil. However, high yields are obtained from long-lived, moisture-tolerant, deep-rooted legumes, such as birdsfoot trefoil. With drainage diversions, particularly good yields of high-quality hay can be obtained from a forage mixture consisting of moisture-tolerant alfalfa, an early maturing birdsfoot trefoil, and a medium- or late-maturing timothy. Yields are lower than those obtained on better drained soils; nevertheless, farmers who grow crops that tolerate somewhat poor drainage obtain good yields.

Table 14.—*Soils of capability unit IIIw-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Erie channery silt loam, 2 to 8 percent slopes.	Low	Medium.
Volusia channery silt loam, 2 to 8 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0		1.0	1.2

Cropping systems [1]	Supporting practices
R-C-S	*300-foot slopes:* Graded stripcropping.
R-C-S-S; R-C-S-S-S; C-S-S-S.	Cross-slope tillage.
S-S-S-S	Not needed.
R-C-S; R-C-S-S	*400-foot slopes:* Drainage diversions.
R-C-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.
R-C-S; R-C-S-S	*600-foot slopes:* Drainage diversions; graded stripcropping.
R-C-S-S-S; C-S-S-S	Drainage diversions.
S-S-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Many farmers rely on these soils for hay crops and pasture. If the soils are limed, fertilized, and partially drained, crop yields can be increased. If meadows are grazed for 1 year before reseeding, they will generally furnish more forage than the average permanent pasture.

Liming.—These soils need lime. Have the soils tested to determine their reaction. Then, apply lime using table 14 as a guide and according to the needs of the specific crop to be grown.

Fertilization.—The soils of this unit are medium or below medium in fertility. Because they are wet, nutrients are not immediately available to plants during the early part of the growing season. The soils need to be tested to determine their needs for phosphate and potash. Then, obtain the latest suggestions from a local agricultural technician as to kinds and amounts of fertilizer to apply.

After the soils have been limed, additional potash may be required because of the more vigorous growth of the plants.

Suitability for planting trees.—Scotch and white pine and Norway and white spruce are the most suitable evergreens grown for sale as Christmas trees on the Volusia soil. The Erie soil is suited to Japanese and European larch, to white spruce, and to Scotch, Austrian, and white pine grown for other uses. Norway spruce can also be grown with some success.

CAPABILITY UNIT IIIw-2

Nearly level, poorly drained and very poorly drained soils make up this capability unit. The soils occupy only a small acreage in the county. The Homer soil has formed in outwash material, and the Kendaia soil, in firm glacial till. Both of these soils are high in lime. The Red Hook and Atherton soils have formed in strongly acid outwash. The Red Hook soil has a weak fragipan beginning at depths of 10 to 12 inches. The Wallington and Birdsall soils have formed from strongly acid lacustrine silts underlain by gravel; these soils occur mostly in localized areas.

In general, the soils of this unit are productive but are low in phosphorus. They have good capacity for holding moisture and nutrients available to plants. Because of excessive wetness, however, they are severely limited in use suitability and are less productive of crops than better drained soils formed in similar materials. If the soils are artifically drained and well managed, exceptionally good yields of crops are obtained.

The soils in this unit are listed in table 15 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—If artificial drainage is provided so that these soils drain similarly to moderately well drained to well drained soils, they are suited to the crops commonly grown in the county. The principal crops are oats, corn grown for silage, and grasses and legumes grown for hay and pasture. Cabbage, beans, and alfalfa can be grown to some extent, especially in areas of the Homer and Kendaia soils that have been drained.

Where the soils have been only partly drained, use seeding mixtures for hay and pasture that are suitable for somewhat poorly drained to moderately well drained soils. The mixtures, however, should contain legumes suited to wet soil, because the drained areas have a few wet spots where birdsfoot trefoil will grow well. High yields of hay crops and pasture are obtained in drained areas, especially on the Homer and Kendaia soils.

In areas that have not been drained, use a seeding mixture suitable for poorly drained soils. Only fair yields of hay and pasture can be expected. On most farms undrained areas of these soils are used only for pasture. For good carrying capacity, it is best to rotate pasture with other crops in the cropping system.

Liming.—After they are drained, the Atherton, Red Hook, Wallington, and Birdsall soils will require lime for successful crop production. However, the soils need to be tested to determine their reaction. Then, except for the Wallington and Birdsall soils, apply lime, using table 15 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown. The Wallington and Birdsall soils will require ½ to ¾ ton more lime per acre than the amounts shown in table 15 because they contain a high amount of organic matter.

TABLE 15.—*Soils of capability unit IIIw-2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Atherton silt loam, 0 to 3 percent slopes.	Low	Medium.
Birdsall silt loam, over gravel, 0 to 1 percent slopes.	Low	Medium.
Homer silt loam, 0 to 2 percent slopes	High	Medium.
Kendaia silt loam, 1 to 6 percent slopes	High	High.
Red Hook silt loam, 0 to 3 percent slopes.	Low	Medium.
Wallington silt loam, over gravel, 0 to 3 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0–5.0	5.0–6.0	5.2–6.5
5.5	2.0–3.0	3.0–4.0	3.5–4.5
6.0		1.5	1.5–2.5

Cropping systems [1]	Supporting practices
Rc–Rc–Rc; R–R–C–S–S; R–C–S–S.	Tile drainage can be used in most areas of Homer and Kendaia soils; the weak pan in the Red Hook and Atherton soils and the clayey texture of the Wallington soil limit the use of tile drainage; if open ditches are used on the Wallington and Birdsall soils, the ditchbanks should be protected from erosion and from trampling by cattle.
C–S–S; S–S–S–S	Improved drainage may be needed in some places.

[1] Rc=row crop with a cover crop; R=row crop; C=close-growing crop; S=sod-forming crop.

Fertilization.—After the soils have been artificially drained and cultivated for several years, they will probably become low in nitrogen and phosphorus but medium in their supply of potassium. Additions of manure and commercial fertilizer will be necessary at that time to produce good crop yields. The soils should be tested to determine the needs for fertilizer.

Suitability for planting trees.—The Homer and Kendaia soils are best suited to white-cedar and white spruce. Balsam fir and white pine, when grown for sale as Christmas trees, do well. Areas that have not been plowed are hummocky and will support trees better than other areas. All larches can be planted on soils in the hummocky areas.

CAPABILITY UNIT IIIw-3

Level, poorly drained soils of the bottom lands comprise this capability unit. These soils may be flooded frequently during the growing season. Although fertile, they are seldom productive unless artificially drained.

The soils are difficult to drain because of their low-lying positions and permanently high water table.

The soils in this unit are listed in table 16 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 16.—*Soils of capability unit IIIw-3, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Holly silt loam, 0 to 1 percent slopes	Low	Medium.
Wayland silt loam, 0 to 1 percent slopes.	High	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.5	5.5	5.5
5.5	2.5	4.0	4.5
6.0	----------	1.5	2.0

Cropping systems [1]	Supporting practices
R-C-S-S-S; C-S-S-S. S-S-S-S	Open ditches to remove surface water and to divert water from higher areas. Channel improvement may help in some places.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

Suitability for crops and pastures.—Most areas of these soils can be only partly drained. Consequently, the soils are best used for sod crops; mixtures of grasses and legumes that have shallow roots and that tolerate wetness are the most suitable for seeding. In areas that are adequately drained, the soils are suited to corn and oats, although lodging and damage by floods can seriously reduce yields.

These soils are used mainly for pasture. They provide good pasture, especially during dry periods of the growing season when pastures in the uplands produce little forage. If the soils are grazed when too wet, considerable damage results from "punching" by the hooves of cattle. To increase the yields of unimproved pasture, apply fertilizer and lime according to research results pertaining to these or similar soils.

Liming.—The Wayland soil is high in lime. The Holly soil is medium acid to strongly acid. Have the soil tested to determine its reaction. Then, apply lime, using table 16 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—These soils contain a large supply of nitrogen, but they do not release this element to plants until late in the growing season. They have a low supply of available phosphorus and are medium in their ability to supply potassium. If these soils are used intensively for a long period, it is best to have the soil tested to determine fertilizer needs for a specified crop.

Suitability for planting trees.—Frequent and prolonged flooding causes these soils to be unsuited to most trees. Of the conifers, Norway and white spruce grow best on acid to neutral soils, but white-cedar grows best on soils that have a neutral to alkaline surface layer. Willow and poplar can be planted in areas where cover is needed.

SUBCLASS IIIs.—SOILS THAT HAVE SEVERE LIMITATIONS BECAUSE OF SHALLOWNESS.

CAPABILITY UNIT IIIs-1

Only one soil—Lordstown channery silt loam, shallow, 2 to 8 percent slopes—is in this capability unit. This soil is shallow, gently sloping, and well drained. It has less than 20 inches of soil material over bedrock; this is the major limitation in the use of the soil. Tillage is difficult in areas where bedrock outcrops. Where the soil has slopes of 6 to 8 percent, runoff is medium and erosion is a hazard. Nevertheless, if the soil is limed, fertilized, and otherwise well managed, fair to good yields of oats, corn grown for silage, and hay crops are obtained. These yields are possible because of the normally abundant, well-distributed rainfall in summer and low evaporation loss at the high elevations where most of this soil is located.

In table 17 are facts about the lime level of the soil profile and ability of this soil to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—This soil is used mainly for oats, corn grown for silage, and hay crops. Potatoes and cabbage are grown in some areas, and beans are grown to some extent. This soil has a somewhat shorter growing season than the other soils in the county because it occurs on the highest ridgetops. Consequently, early maturing varieties of crops should be planted.

For hay crops and pasture, use forage seeding mixtures suitable for well-drained, but shallow, soils. The plants must be able to withstand short periods of drought during the middle part of the growing season. The kind of mixture used also depends on the length of time the land is to be kept in sod. On most farms this soil is kept in sod for 5 to 8 years.

Most farmers use this soil mainly for permanent pasture. The pastures can be improved if they receive the same management as meadows.

Liming.—If this soil has not been limed in the past 5 or more years, it should be tested to determine its reaction. Then, apply lime, using table 17 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—This soil is naturally low in fertility. In areas that have not been fertilized in recent years, it will probably be low in nitrogen and available phosphorus and medium in ability to supply potassium. For average yields, crops grown on this soil need moderate amounts of fertilizer. Because the soil is limited in potential productivity, overfertilization should be avoided. Past management of the soil should be considered in deciding the kinds and amounts of fertilizer to use.

For best results, the soil should be tested to determine fertilizer needs. Then, follow current recommendations on the amounts and kinds of fertilizer to use.

TABLE 17.—*Soil of capability unit IIIs-1, its lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Lordstown channery silt loam, shallow, 2 to 8 percent slopes	Low	Medium to low.

If the pH value of the soil by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices [2]
R-R-C-S-S; R-C-S-S; R-C-S-S-S-; C-S-S-S.	*300-foot slopes:* Cross-slope tillage.
S-S-S-S	Not needed.
R-R-C-S-S; R-C-S-S	*400-foot slopes:* Contour tillage; stripcropping.
R-C-S-S-S; C-S-S-S	Cross-slope tillage.
S-S-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop. If the soil is low in organic matter, use a cropping system consisting of R-C-S-S-S; C-S-S-S; or S-S-S-S before using a cropping system of R-R-C-S-S or R-C-S-S.

[2] In places where these soils have complex slopes, contour tillage may not be practical.

Suitability for planting trees.—Scotch, pitch, jack, and red pine, redcedar, and black locust are suitable to provide cover on this soil. European larch is desirable, except that the trees grow slowly. In moist areas, consisting of pockets of deeper soil or containing joints of fractured bedrock, white, Scotch, and red pine can be grown for sale as Christmas trees.

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

SUBCLASS IVe.—SOILS THAT HAVE A VERY SEVERE RISK OF EROSION.

CAPABILITY UNIT IVe-1

Well-drained, moderately steep soils are in this capability unit. Their moisture-holding capacity is good to moderate, and they generally retain most plant nutrients that are added. The Palmyra, Howard, and Chenango soils have formed in gravelly deposits, but the other soils have formed in glacial till. Only the Lordstown soil has bedrock within 36 inches of the surface. Steepness and excessive runoff limit the use suitability of the soils. Because of rapid runoff, the soils absorb only a limited amount of water for plant use and they are subject to erosion.

The soils in this unit are listed in table 18 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 18.—*Soils of capability unit IVe-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Bath channery silt loam, 15 to 25 percent slopes.	Low	Medium.
Bath-Chenango gravelly loams, 15 to 25 percent slopes.	Low	Medium.
Howard gravelly loam, 15 to 25 percent slopes.	Medium	Medium.
Lansing gravelly silt loam, 15 to 25 percent slopes.	Medium	Medium to high.
Lordstown channery silt loam, 15 to 25 percent slopes.	Low	Medium to low.
Palmyra gravelly silt loam, 15 to 25 percent slopes.	High	Medium.
Valois-Howard gravelly loams, 15 to 25 percent slopes.	Low to medium.	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0	5.0	5.2
5.5	2.0	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices [2]
R-C-S-S-S-S	*300-foot slopes:* Cross-slope tillage.
C-S-S S	Cross-slope tillage.
S-S-S-S	Not needed.
R-C-S-S-S-S	*400-foot slopes:* Contour tillage.
C-S-S-S	Plow in strips.
S-S-S-S	Not needed.
R-C-S-S-S-S	*600-foot slopes:* Stripcropping.
C-S-S-S	Plow in strips.
S-S-S-S	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.

[2] The Howard and Palmyra soils and other soils that have complex slopes may not be suitable for contour tillage. These soils can be used in a cropping system consisting of C-S-S-S or S-S-S-S. If they are used for row crops, special care must be taken to prevent erosion.

Suitability for crops and pastures.—Ordinarily, close-growing crops should be grown on the soils of this unit because of the hazard of erosion; however, an occasional row crop, such as corn for silage, may be grown. Generally, oats or some other close-growing crop follows corn in the cropping system. The close-growing crop is then followed by a sod crop. Forage seeding mixtures that contain alfalfa or other deep-rooted legumes and that are suitable for use on well-drained soils can be planted for sod crops. The sod should not be plowed until the stand becomes depleted.

In areas of these soils used dominantly for pasture, most of the pastured areas are extremely low in productivity if not properly managed. If the pasture is fitted into the regular cropping system as a grazed meadow, higher yields can be obtained. Most forage seeding mixtures for well-drained soils can be used. The mixture should contain deep-rooted legumes. The deep-rooted legumes obtain nutrients and water from greater depths than the shallow-rooted legumes and provide better grazing during dry periods.

Liming.—These soils are predominantly moderately acid or strongly acid to depths of 10 to 12 inches. The Palmyra, Howard, and Lansing soils have free lime at depths of less than 5 feet, but only the Palmyra normally has free lime within reach of plant roots. The soils should be tested to determine their reaction. Then, apply lime, using table 18 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—In areas where the past management of these soils is known, apply fertilizer according to the rates needed for soils that are medium or below in nitrogen, low in available phosphorus, and medium or high in ability to supply potassium. If the past management of these soils is not known, it is best to have the soils tested.

Suitability for planting trees.—These soils are well suited to trees, but the kind of tree that is best to plant depends on the reaction of the surface soil. Areas in which the surface soil has a pH of less than 6.5 are suited to red pine grown for Christmas trees. White spruce and Douglas-fir are also grown for Christmas trees. Austrian pine will produce Christmas trees on areas of these soils with a high pH (7.0+). If the surface layer of these soils is neutral to mildly alkaline, it is best not to plant permanent stands of red pine and most other conifers. These trees are susceptible to root rot when they become older.

Black locust, hybrid poplar, and other hardwoods can be grown on all the soils. Poplar and other hardwoods and Norway spruce, balsam fir, and Japanese and European larch should not be planted in areas where the Lordstown soil is less than 30 inches deep over bedrock. On steep, gravelly soils that slope toward the south and west, white spruce and balsam fir may grow slowly and have a poor rate of survival.

CAPABILITY UNIT IVe–2

Gently sloping and sloping soils that have been damaged by erosion make up this capability unit. The soils range from moderately well drained to somewhat poorly drained and have a fragipan at shallow depths. Because of the damage by erosion, the soils are probably low in organic matter and most plant nutrients. In addition, they have very weak structure.

The soils of this unit are listed in table 19 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—Because they are very low in organic matter and most plant nutrients, the soils of this unit are best used in a cropping system consisting of 1 year of a close-growing crop followed by 4 years of sod-forming crops. This cropping system will increase the supply of organic matter. Then, the soils can be used to grow oats, corn for silage, and hay crops by applying the cropping systems suggested for the soils of units IIIe–5 and IIIe–2.

TABLE 19.—*Soils of capability unit IVe–2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Mardin channery silt loam, 8 to 15 percent slopes, eroded.	Low	Medium to low.
Volusia channery silt loam, 2 to 8 percent slopes, eroded.	Low	Medium to low.
Volusia channery silt loam, 8 to 15 percent slopes, eroded.	Low	Medium to low.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	2.5	5.0	5.2
5.5	1.5	3.0	3.2
6.0	----------	1.0	1.2

Cropping systems [1]	Supporting practices
C–S–S–S–S	*300-foot slopes:* Graded stripcropping. *400-foot slopes:* Drainage diversions; reseed in strips. *600-foot slopes:* Drainage diversions; graded stripcropping.

[1] C=close-growing crop; S=sod-forming crop.

Legumes mixed with grasses need to be tolerant of wetness because the soils are wet during part of the growing season. For meadows, use only seeding mixtures suitable for somewhat poorly drained and poorly drained soils. Ladino clover and birdsfoot trefoil are probably the most suitable legumes. Unless properly managed, pastures are extremely low in carrying capacity. They can be improved if a system of rotational grazing is followed.

Fertilization.—These soils are low in nitrogen and available phosphorus but medium to low in their ability to supply potassium. Where the soils are fertilized and limed, fair yields of crops are obtained. Leaving the soils in permanent pasture that is fertilized with manure until the supply of organic matter is increased is probably more economical than growing crops that require large amounts of commercial fertilizer.

Liming.—Have the soils tested to determine their reaction. Then, apply lime, in amounts shown in table 19, to raise the pH of the soil to the level needed for the specific crop to be grown.

Suitability for planting trees.—Scotch pine is the most suitable kind of evergreen to grow for sale as Christmas trees. Norway and white spruce and possibly Austrian and white pine can also be grown for this purpose. European and Japanese larch can be planted on these soils, but they may not grow well after they reach the size suitable for fence posts.

CAPABILITY UNIT IVe-3

Moderately steep, moderately well drained to somewhat poorly drained soils with a compact subsoil comprise this capability unit. The Langford and Mardin soils have a fragipan beginning at depths of about 15 to 18 inches; the Volusia soil has a fragipan 8 to 13 inches below the surface; and the Rhinebeck soil has a very slowly permeable, clayey B horizon at a depth of about 13 inches. The fragipan, or clayey horizon, in the Rhinebeck soil seriously restricts internal drainage and limits the capacity of this soil to store water. The soils of this capability unit absorb water slowly.

All of the soils, except the Rhinebeck, have formed in firm, acid glacial till. The Rhinebeck soil has formed in lacustrine clay and silt. It is included in this capability unit because it occurs in extremely small areas and can be managed the same as the other soils.

These soils respond fairly well to proper management. They are limited in use suitability because of their moderately steep slopes that permit rapid to very rapid runoff and make the soils subject to erosion.

The soils of this unit are listed in table 20 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

Suitability for crops and pastures.—The soils of this unit are suitable for most of the crops grown on dairy farms, but the moderately steep slopes greatly hinder the use of farm machinery. Consequently, the cost of working the soils limits the returns realized from cultivated crops, and it is well to use the soil for sod-forming crops, which are less expensive to grow. If row crops are grown, early maturing varieties that tolerate seasonal wetness should be planted. The principal crop now grown is corn for silage.

These soils are suited to most of the seeding mixtures used for meadow and pastures on moderately well drained and somewhat poorly drained soils. Because of somewhat poor drainage, the Volusia soil stays wet longer than the Mardin, Langford, and Rhinebeck soils, and, consequently, only legumes that tolerate wetness should be planted. Most of the pastures on these soils are low in carrying capacity if they have not been rotated with other crops in the cropping system. Yields of forage can be increased by improving management.

Liming.—The soils of this unit have a medium acid to strongly acid surface layer and need lime for the best growth of crops. The Rhinebeck soil is the only soil of this unit that has free lime in its profile; nevertheless, because it has a finer texture than the other soils, this soil requires ½ to ¾ ton more lime per acre than indicated in the rates shown in table 20. It is best to have the soils tested to determine their reaction. Then, apply lime in amounts necessary to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—Except for the Rhinebeck soil, the soils of this unit are medium in their ability to supply potassium. The Rhinebeck soil, which is high in its ability to supply potassium, generally does not need to have the supply of this element supplemented. All the soils are low or below medium in their supply of nitrogen and available phosphorus. Some of the nitrogen needed can be supplied by manure. It is advantageous to have the soils tested periodically to determine fertilizer needs.

TABLE 20.—*Soils of capability unit IVe-3, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Langford channery silt loam, 15 to 25 percent slopes.	Low	Medium.
Mardin channery silt loam, 15 to 25 percent slopes.	Low	Medium.
Rhinebeck silt loam, 15 to 25 percent slopes.	Medium	High.
Volusia channery silt loam, 15 to 25 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4. 0	5. 0	5. 2
5.5	2. 0	3. 0	3. 2
6.0		1. 0	1. 2

Cropping systems [1]	Supporting practices
R-C-S-S-S-S (Mardin and Langford soils).	*300-foot slopes:* Cross-slope tillage. *400-foot slopes:* Contour tillage. *600-foot slopes:* Contour tillage; stripcropping.
C-S-S-S-S (Rhinebeck and Volusia soils).	*300-foot slopes:* Cross-slope tillage. *400-foot slopes:* Reseed in strips. *600-foot slopes:* Stripcropping.
S-S-S-S (Rhinebeck and Volusia soils).	Not needed.

[1] R=row crop; C=close-growing crop; S=sod-forming crop. Row crops should be grown only in places where no mildly sloping soils are available; even then, row crops should be grown only once in a 6-year rotation.

Suitability for planting trees.—Austrian and Scotch pine, Douglas-fir, balsam fir, red and white pine, and Norway and white spruce can be grown for sale as Christmas trees. The trees grow best on slopes facing northeast.

SUBCLASS IVw.—SOILS THAT HAVE VERY SEVERE LIMITATIONS BECAUSE OF EXCESS WATER.

CAPABILITY UNIT IVw-1

Nearly level, poorly drained and very poorly drained soils make up this capability unit. The Alden and Birdsall soils are deep, but the Tuller soil has bedrock at a depth of about 18 inches.

The soils in this unit are listed in table 21 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 21.—*Soils of capability unit IVw-1, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Alden and Birdsall silt loams, 0 to 3 percent slopes.	High to medium.	Medium.
Tuller channery silt loam, 2 to 8 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0–5.0	5.0–6.0	5.2–6.5
5.5	2.0–3.0	3.0–4.0	3.5–4.5
6.0	----------	1.5	1.5–2.5

Cropping systems [1]	Supporting practices [2]
R–C–S–S; C–S–S; S–S–S.	Open ditches; spot drainage.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.
[2] Draining the Tuller soil may not be practical in some places because of limited depth to bedrock; before attempting to drain individual areas, the soil should be examined by digging pits. Tile drainage can be used in the Alden and Birdsall soils.

Suitability for crops and pastures.—Unless drained, the soils of this unit are unsuited to most crops. Areas that are drained can be used for corn, oats, and hay crops. Yields of crops depend mainly on how well the soils have been drained. In general, where the soils have been only partly drained, it is best to grow shallow-rooted crops instead of corn. In some places the cost of drainage may be too high to be feasible. Therefore, it is advisable to consult a soil drainage engineer to determine the feasibility of drainage. Most areas of Tuller soils are less productive than areas of Alden and Birdsall soils.

Areas of these soils that have not been improved seldom have good quality forage growing on them. Areas that have been partly drained by road ditches or other means are commonly pastured, especially during that part of the growing season when pastures have dried up on the better drained soils. In partly drained areas of these soils, legumes and grasses that tolerate wetness can be grown.

Liming.—The Alden soil is neutral to slightly acid in reaction and will need little lime added. The Tuller and Birdsall soils, however, require lime. Have the soils tested to determine their reaction. Then, apply lime, using table 21 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—These soils are naturally high in organic matter and, therefore, are high in nitrogen. But, because the soils are cold and wet during most of the year, little nitrogen is released to plants. In drained areas, however, the soils release nitrogen slowly in the early part of the growing season; as a result, if nitrogen is added early in spring, it will supply the needs of plants until the nitrogen in the soil becomes available.

Suitability for planting trees.—Pitch pine, white pine, and white-cedar provide suitable cover on these soils. Scotch pine, white spruce, and balsam fir can be grown for sale as Christmas trees. Nevertheless, wetness is a serious limitation to the growing of trees on these soils.

CAPABILITY UNIT IVw-2

Nearly level, poorly drained, deep soils make up this capability unit. Most areas of these soils can be artificially drained; when drained, the soils are moderate to high in fertility.

The soils of this unit are listed in table 22 along with facts about the lime level of the soil profile and ability to supply potassium. Also listed are suitable cropping systems and supporting practices.

TABLE 22.—*Soils of capability unit IVw-2, their lime level and ability to supply potassium, lime needed at different pH values, and cropping systems and practices*

Soil	Lime level of profile	Ability to supply potassium
Chippewa channery silt loam, 0 to 3 percent slopes.	Low	Medium.
Chippewa channery silt loam, 3 to 8 percent slopes.	Low	Medium.
Ellery channery silt loam, 0 to 3 percent slopes.	Medium to high.	Medium.
Ellery channery silt loam, 3 to 8 percent slopes.	Medium to high.	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.5	5.5	5.5
5.5	2.5	4.0	4.5
6.0	----------	1.5	2.0

Cropping systems [1]	Supporting practices [2]
R–C–S–S–S; C–S–S–S; S–S–S–S.	Open ditches; cross-slope tillage on slopes of 3 to 8 percent.

[1] R=row crop; C=close-growing crop; S=sod-forming crop.
[2] Tile drainage can be used for the Ellery soils but may not be practical for the Chippewa soils.

Suitability for crops and pastures.—Unless artificially drained, the soils of this unit are not suited to crops. The kinds of crops grown depend on effective drainage. If adequately drained, the soils can be used to grow row crops; if completely drained, they are productive of corn, small grains, and hay crops. In areas partly drained by open ditches or tile, the soils can be used for sod crops. Plant a seeding mixture of plants that tolerate wetness. In some places the cost of drainage will be high; it is doubtful if complete drainage of these areas is feasible.

In undrained areas these soils have a cover of sedges, reeds, alders, and a few willows. In places where drainage has been improved by road ditches, the soils are used for pasture and occasionally for hay crops. Legumes are seldom included in the seeding mixture.

Liming.—The Ellery soils are dominantly neutral in reaction and seldom need lime immediately after being drained. In some places, however, they have a slightly acid to medium acid surface layer. The Chippewa soils are naturally low in lime. It is best to have both the Ellery and Chippewa soils tested to determine their reaction. Then, apply lime, using table 22 as a guide, to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—The soils have a medium to high supply of nitrogen. But, because little nitrogen is released to plants early in spring and during wet periods, it is best to add this element to nonlegumes. The soils are low in available phosphorus and are medium in their ability to supply potassium. Have the soils tested periodically to determine needs for fertilizer.

Suitability for planting trees.—Because they are wet and covered by a heavy growth of other vegetation, these soils are difficult to reforest. White and Norway spruce and balsam fir can be planted in unplowed, hummocky areas. On the Ellery soils, pitch pine, white pine, and white-cedar can be grown for cover, and balsam fir, Norway spruce, white spruce, and Scotch pine can be planted for sale as Christmas trees. Willow and poplar, which grow rapidly, are also suitable for cover.

Class VI.—*Soils that have severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture, woodland, or food and cover for wildlife.*

Subclass VIe.—Soils Moderately Limited for Pasture Plants or Trees Because of the Risk of Erosion.

CAPABILITY UNIT VIe-1

Steep to very steep soils and an eroded soil with a fragipan comprise this capability unit. In most areas the soils have slopes of about 30 percent. As a result, the use of farm machinery is extremely difficult. Most of the soils have good moisture-holding capacity. Because of very rapid runoff, however, they absorb little water. Consequently, the soils are droughty during most of the growing season. The Lordstown soils have an additional limitation—shallowness to bedrock.

The soils of this unit are listed in table 23 along with facts about the lime level of the soil profile and ability to supply potassium.

Suitability for crops and pastures.—Unless a special need exists, the soils of this unit should not be used for cultivated crops. Erosion is a constant threat, and, because of the low supply of available moisture as the result of runoff, low yields of crops can be expected.

It is best to leave the soils in permanent sod, even though most pastures have only a low carrying capacity. Yields on the Lansing soil and on the Valois and Howard soils are higher than those obtained on the other soils of this unit. Commonly, unimproved pastures consist mostly of grass and weeds. If the soils are limed and fertilized and seeded to legumes, such as trefoil, the quality of forage can be improved. Where they have slopes of 35 percent or more, the soils are best used for forests.

Table 23.—*Soils of capability unit VIe-1, their lime level and ability to supply potassium, and lime needed at different pH values*

Soil	Lime level of profile	Ability to supply potassium
Bath-Chenango gravelly loams, 25 to 40 percent slopes.	Low	Medium.
Bath and Mardin soils, 25 to 40 percent slopes.	Low	Medium.
Lansing gravelly silt loam, 25 to 35 percent slopes.	Medium	High.
Lordstown soils, 25 to 55 percent slopes.	Low	Medium to low.
Valois and Howard gravelly loams, 25 to 40 persent slopes.	Medium	Medium.
Volusia channery silt loam, 15 to 25 percent slopes, eroded.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5. 0	4. 0	5. 0	5. 2
5. 5	2. 0	3. 0	3. 2
6. 0		1. 0	1. 2

Liming.—Lime should be applied to all the soils of this unit that are to be used for improved pasture or forage. Most areas of these soils have not been limed since they were cleared, and they will need liberal applications of lime. Rates shown in table 23 should be considered to be the minimum. Have the soils tested to determine their reaction. Then, apply enough lime to raise the pH of the soil to the level needed for the specific crop to be grown.

Fertilization.—Most of these soils are likely to have a low to medium supply of nitrogen and are low in available phosphorus. Except for the Lansing soil, which is high in ability to supply potassium, the soils are medium in ability to supply potassium. They should be tested to determine fertilizer needs.

Suitability for planting trees.—Trees can be planted on all parts of the Lansing soil. On the other soils of this unit, jack, Scotch, red, and white pine should be planted only on slopes facing southeast, south, southwest, and west. On soils that have a gradient of more than 30 percent, larches survive best if planted carefully on only the north-facing slopes. Norway spruce and Austrian and Scotch pine can be grown on the south-facing slopes for sale as Christmas trees, and Douglas-fir and white spruce, on the north-facing slopes. Black locust and redcedar are grown to provide cover.

Scotch pine is the most dependable tree grown on the Volusia soil for sale as Christmas trees. Japanese larch grows to fence-post size on the Volusia soil, but it is doubtful whether this is the best kind of tree to plant. In places the Valois and Howard soils have a high pH in the surface soil and are suitable only for Scotch and Austrian pine, white and Norway spruce, and white-cedar.

Subclass VIw.—Soils Moderately Limited for Pasture Plants or Trees Because of Excess Water.

CAPABILITY UNIT VIw-1

Very poorly drained soils subject to frequent flooding make up this capability unit. The soils are wet and cold during the entire year. Most areas cannot be drained well enough to be used for crops. In places where excess surface water can be removed, the soils provide good pasture.

The soils of this unit are listed in table 24 along with facts about the lime level of the soil profile and ability to supply lime and potassium.

Table 24.—*Soils of capability unit VIw-1, their lime level and ability to supply potassium, and lime needed at different pH values*

Soil	Lime level of profile	Ability to supply potassium
Alluvial land	Variable	Variable.
Sloan silt loam, 0 to 1 percent slopes	High	Medium.
Papakating silt loam, 0 to 1 percent slopes.	Low	Medium.

If the pH value of these soils by soil test is—	Lime needed to reach—		
	pH 6.0	pH 6.5	pH 7.0
	Tons	*Tons*	*Tons*
5.0	4.0–5.0	5.0–6.0	5.2–6.5
5.5	2.0–3.0	3.0–4.0	3.5–4.5
6.5	----------	1.5	1.5–2.5

Suitability for crops and pastures.—The soils of this unit can be used for pasture. Seed only grasses and legumes that tolerate wetness. In general, after these soils have been drained, several wet spots still remain in an area; therefore, select a seeding mixture suitable for the wettest soil in the drained area.

Liming.—The Sloan soil does not need lime, but Alluvial land will need lime if pastures are to be improved. Have the soils in individual areas of Alluvial land tested to determine their reaction. Then, apply lime, using table 24 as a guide, to raise the pH of the soil to the level needed for the specific pasture plants to be grown.

Fertilization.—These soils have a high supply of nitrogen and a medium supply of available phosphorus. They are medium or variable in their ability to supply potassium. Although the soils are high in nitrogen, they release this nutrient very slowly; consequently, small applications of a nitrogen fertilizer may be needed. The soils should be tested to determine fertilizer needs. Then, specific suggestions as to kinds and amounts of fertilizer required can be obtained from a local agricultural technician.

Suitability for planting trees.—In general, these soils are not suited to trees. Nevertheless, white spruce, white pine, and balsam fir can be planted on the better drained areas or on hummocks in unplowed areas.

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

Subclass VIIw.—Soils That Are Severely Limited for Pasture Plants or Trees Because of Excess Water.

CAPABILITY UNIT VIIw-1

Only one soil—Muck—is in this capability unit. This organic soil is wet during the entire year. It can be used for wildlife and for woodland. In table 25 are facts about the lime level of the soil profile and ability of this soil to supply potassium.

Table 25.—*Soil of capability unit VIIw-1 and its lime level and ability to supply potassium*

Soil	Lime level of profile	Ability to supply potassium
Muck	Low	Low.

Suitability for planting trees.—Muck, an organic soil, has been used to a limited extent to grow trees. In areas where it is neutral to alkaline in reaction, the soil is suited to white-cedar. Where it is neutral to acid and has been partly drained or has hummocky relief, it is suited to white, red, and Norway spruce, balsam fir, and white pine.

Estimated Yields

Table 26 gives the estimated average acre yields of crops to be expected from the soils of the county at three levels of management. For some soils, yields are shown only under the level of management considered practical. For others, yields are not given because the soils are unsuited to the crops listed, are difficult to evaluate, or are extremely variable in suitability. Consequently, some soils are not listed in table 26.

TABLE 26.—*Estimated average acre yields of principal crops to be expected under different levels of management*

[Estimates based on yields obtained from 1956 to 1958. Higher yields can be expected as improved varieties of crops are developed. Absence of a yield estimate indicates crop is not commonly grown on the soil at the level of management specified]

Map symbol	Soil	Capability unit [1]	Corn [2]						Oats [3]			Hay [4]							Grass mixed with clover
			Silage			Grain						DA		NV		NVi		Vi	
			A	B	C	A	B	C	A	B	C	B	C	B	C	B	C	B	A
			Tons	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
AcB	Arnot channery silt loam, 2 to 8 percent slopes.	IIe-2	10.2	11.8	14.8	56	65	81	45	52	62	3.5	4.0	3.3	3.8	3.5	4.0	------	2.1
BaB	Bath channery silt loam, 3 to 8 percent slopes.	IIe-1	12.4	14.5	18.1	68	80	100	52	67	77	4.1	4.6	3.8	4.3	------	------	------	2.2
BaC	Bath channery silt loam, 8 to 15 percent slopes.	IIIe-1	12.6	14.6	17.7	69	80	97	53	68	78	3.9	4.3	3.7	4.2	------	------	------	2.2
BaD	Bath channery silt loam, 15 to 25 percent slopes.	IVe-1	10.7	12.4	------	59	68	------	45	59	66	------	------	------	------	[5] 3.3	------	[6] 2.9	2.1
BbB	Bath-Chenango gravelly loams, 3 to 8 percent slopes.	IIe-1	12.8	14.8	18.5	70	81	102	54	68	79	4.1	4.6	3.8	4.3	------	------	------	2.3
BbC	Bath-Chenango gravelly loams, 8 to 15 percent slopes.	IIIe-1	12.8	14.9	18.0	70	82	98	54	69	79	4.0	4.5	3.7	4.2	------	------	------	2.2
BbD	Bath-Chenango gravelly loams, 15 to 25 percent slopes.	IVe-1	10.9	12.6	------	60	69	------	46	59	67	------	------	------	------	[5] 3.4	------	[6] 3.0	2.1
CaB	Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes.	IIe-1	13.8	16.0	20.1	76	89	110	58	74	85	5.0	5.5	4.5	4.9	------	------	------	2.5
CbA	Chagrin silt loam, 0 to 2 percent slopes.	IIw-1	15.7	18.3	22.8	86	100	125	60	77	88	------	------	4.9	5.4	------	------	------	2.5
CcB	Chagrin silt loam, high bottom, 0 to 4 percent slopes.	I-1	15.9	18.5	23.1	87	102	127	61	78	89	5.1	5.5	4.3	4.7	------	------	------	2.8
CdA	Chenango gravelly loam, 0 to 3 percent slopes.	I-1	12.9	15.0	18.8	75	83	103	54	69	80	4.3	4.8	4.0	4.5	------	------	------	2.4
CdB	Chenango gravelly loam, 3 to 8 percent slopes.	IIe-1	13.0	15.0	18.8	72	83	103	54	69	80	4.3	4.8	4.0	4.5	------	------	------	2.4
CdC	Chenango gravelly loam, 8 to 15 percent slopes.	IIIe-1	13.0	15.0	18.2	71	84	100	54	69	79	4.2	4.7	3.9	4.4	------	------	------	2.3
CeA	Chippewa channery silt loam, 0 to 3 percent slopes (drained).	IVw-2	(7)	(7)	(7)	------	------	------	37	45	------	------	------	------	------	------	------	2.4	1.9
CeB	Chippewa channery silt loam, 3 to 8 percent slopes (drained).	IVw-2	8.4	10.0	12.5	------	------	------	37	45	49	------	------	------	------	------	------	2.4	1.9
CfB	Conesus gravelly silt loam, 2 to 8 percent slopes.	IIe-3	13.8	16.0	19.5	76	88	107	58	74	85	4.0	4.5	3.8	4.3	4.0	4.5	------	2.5
CfC	Conesus gravelly silt loam, 8 to 15 percent slopes.	IIIe-3	13.9	16.5	20.0	77	89	110	59	76	87	4.2	4.8	4.0	4.6	4.2	4.8	------	2.6
DaB	Dunkirk silt loam, over gravel, 0 to 4 percent slopes.	I-1	15.8	18.4	23.0	87	101	126	61	77	89	5.1	5.5	4.3	4.7	------	------	------	2.5
DaC	Dunkirk silt loam, over gravel, 8 to 20 percent slopes.	IIIe-1	13.0	15.0	18.2	71	83	100	55	70	80	4.5	5.0	4.1	4.6	------	------	------	2.4
EaA	Ellery channery silt loam, 0 to 3 percent slopes (drained).	IVw-2	(7)	(7)	(7)	------	------	------	41	45	------	------	------	------	------	------	------	2.8	2.0
EaB	Ellery channery silt loam, 3 to 8 percent slopes (drained).	IVw-2	9.2	11.0	13.7	------	------	------	41	45	49	------	------	------	------	------	------	2.8	2.0
EbB	Erie channery silt loam, 2 to 8 percent slopes.	IIIw-1	9.7	11.5	14.3	------	------	------	42	46	57	------	------	------	------	3.0	3.4	2.8	1.9
EbC	Erie channery silt loam, 8 to 15 percent slopes.	IIIe-5	10.6	12.2	14.6	------	------	------	45	49	61	------	------	------	------	3.2	3.7	3.0	2.0
HaA	Holly silt loam, 0 to 1 percent slopes (drained).	IIIw-3	(7)	(7)	(7)	------	------	------	(7)	(7)	------	------	------	------	------	------	------	2.0	1.9

See footnotes at end of table.

TABLE 26.—*Estimated average acre yields of principal crops to be expected under different levels of management*—Continued

[Estimates based on yields obtained from 1956 to 1958. Higher yields can be expected as improved varieties of crops are developed. Absence of a yield estimate indicates crop is not commonly grown on the soil at the level of management specified]

Map symbol	Soil	Capability unit [1]	Corn [2]						Oats [3]			Hay [4]							Grass mixed with clover
			Silage			Grain						DA		NV		NVi		Vi	
			A	B	C	A	B	C	A	B	C	B	C	B	C	B	C	B	A
			Tons	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
HbA	Homer silt loam, 0 to 2 percent slopes (drained).	IIIw-2	(7)	(7)	(7)	----	----	----	50	65	----	----	----	----	----	----	----	2.8	2.3
HcA	Howard cobbly loam, 0 to 3 percent slopes.	I-1	12.4	14.5	17.2	68	80	100	52	67	77	4.0	4.5	3.8	4.4	----	----	----	2.3
HcB	Howard cobbly loam, 3 to 8 percent slopes.	IIe-1	12.4	14.5	18.1	68	80	100	52	67	77	4.0	4.5	3.8	4.4	----	----	----	2.3
HdA	Howard gravelly loam, 0 to 3 percent slopes.	I-1	13.1	15.1	18.9	72	83	104	55	70	80	4.3	4.8	4.0	4.5	----	----	----	2.4
HdB	Howard gravelly loam, 3 to 8 percent slopes.	IIe-1	13.1	15.1	18.9	72	83	104	55	70	80	4.3	4.8	4.0	4.5	----	----	----	2.4
HdC	Howard gravelly loam, 8 to 15 percent slopes.	IIIe-1	13.0	15.0	18.2	71	83	100	55	69	80	4.2	4.7	3.9	4.4	----	----	----	2.3
HdD	Howard gravelly loam, 15 to 25 percent slopes.	IVe-1	11.1	12.7	----	61	70	----	46	59	68	----	----	----	----	[5] 3.6	----	[6] 3.2	2.2
KaB	Kendaia silt loam, 1 to 6 percent slopes (drained).	IIIw-2	12.7	14.7	18.4	70	81	101	52	69	77	----	----	----	----	3.1	3.5	2.8	2.2
LaB	Langford channery silt loam, 3 to 8 percent slopes.	IIe-2	11.9	13.7	17.1	66	75	94	53	60	72	3.9	4.5	3.7	4.3	3.9	4.5	----	2.2
LaC	Langford channery silt loam, 8 to 15 percent slopes.	IIIe-2	12.1	14.1	17.3	67	78	95	53	62	73	4.1	4.7	3.9	4.5	4.1	4.7	----	2.3
LaD	Langford channery silt loam, 15 to 25 percent slopes.	IVe-3	10.1	12.0	----	56	66	----	45	53	62	----	----	----	----	3.5	----	[6] 3.1	2.2
LbB	Lansing gravelly silt loam, 3 to 8 percent slopes.	IIe-1	13.4	15.5	19.4	74	85	106	56	72	82	4.6	5.1	4.2	4.7	----	----	----	2.4
LbC	Lansing gravelly silt loam, 8 to 15 percent slopes.	IIIe-1	13.2	15.2	18.4	73	84	101	55	70	81	4.5	5.0	4.1	4.6	----	----	----	2.3
LbD	Lansing gravelly silt loam, 15 to 25 percent slopes.	IVe-1	11.4	12.9	----	63	71	----	47	60	69	----	----	----	----	[5] 3.8	----	[6] 3.4	2.2
LcA	Lobdell silt loam, 0 to 2 percent slopes.	IIw-2	15.1	17.5	21.9	83	96	121	58	73	84	4.7	5.2	4.5	5.0	4.7	5.2	----	2.4
LdB	Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes.	IIe-1	12.3	14.3	17.9	67	79	99	52	66	76	4.0	4.5	3.7	4.2	----	----	----	2.2
LeB	Lordstown channery silt loam, shallow, 2 to 8 percent slopes.	IIIs-1	8.8	10.5	----	48	57	----	38	43	53	----	----	----	----	2.6	3.0	2.4	1.8
LfC	Lordstown channery silt loam, 8 to 15 percent slopes.	IIIe-1	12.4	14.4	17.4	68	79	96	52	67	77	3.9	4.3	3.7	4.2	----	----	----	2.2
LfD	Lordstown channery silt loam, 15 to 25 percent slopes.	IVe-1	10.4	12.2	----	57	67	----	45	57	65	----	----	----	----	[5] 3.3	----	[6] 2.9	2.1
MaB	Mardin channery silt loam, 2 to 8 percent slopes.	IIe-2	11.0	12.7	15.9	61	70	88	41	57	68	3.8	4.4	3.6	4.2	3.8	4.4	----	2.1
MaC	Mardin channery silt loam, 8 to 15 percent slopes.	IIIe-2	11.3	13.1	16.0	62	72	88	52	59	70	4.0	4.6	3.8	4.4	4.0	4.6	----	2.2
MaC3	Mardin channery silt loam, 8 to 15 percent slopes, eroded.	IVe-2	----	----	----	----	----	----	----	----	----	----	----	----	----	2.5	2.8	2.3	1.8
MaD	Mardin channery silt loam, 15 to 25 percent slopes.	IVe-3	9.6	11.1	----	53	61	----	44	50	60	----	----	----	----	3.4	----	[6] 3.0	2.1
MbA	Middlebury silt loam, 0 to 2 percent slopes.	IIw-2	15.1	17.5	21.9	83	96	121	58	73	84	4.7	5.2	4.5	5.0	4.7	5.2	----	2.4

PaA	Palmyra cobbly loam, 0 to 3 percent slopes.	I-1	12.4	14.5	18.4	70	81	101	52	67	77	4.0	4.5	3.8	4.4	------	------	------	2.3
PbA	Palmyra gravelly silt loam, 0 to 3 percent slopes.	I-1	13.1	15.1	18.9	72	83	104	55	70	80	4.3	4.8	4.0	4.5	------	------	------	2.4
PbB	Palmyra gravelly silt loam, 3 to 8 percent slopes.	IIe-1	13.1	15.1	18.9	72	83	104	55	70	80	4.3	4.8	4.0	4.5	------	------	------	2.4
PbC	Palmyra gravelly silt loam, 8 to 15 percent slopes.	IIIe-1	13.0	15.0	18.2	71	83	100	55	69	80	4.2	4.7	3.9	4.4	------	------	------	2.3
PbD	Palmyra gravelly silt loam, 15 to 25 percent slopes.	IVe-1	11.1	12.7	------	61	70	------	46	59	68	------	------	------	------	[5] 3.6	------	[6] 3.2	2.2
PdA	Phelps gravelly silt loam, 0 to 3 percent slopes.	IIw-2	12.7	14.8	18.5	70	81	102	53	68	80	------	------	4.0	4.5	4.2	4.7	------	2.2
RaA	Red Hook silt loam, 0 to 3 percent slopes (drained).	IIIw-2	(7)	(7)	(7)	------	------	78	50	65	------	------	------	------	------	------	------	2.8	2.1
RbB	Rhinebeck silt loam, 3 to 8 percent slopes.	IIe-4	10.6	12.3	15.4	58	68	85	47	54	65	3.6	4.1	3.4	3.9	3.6	4.1	------	2.1
RbC	Rhinebeck silt loam, 8 to 15 percent slopes.	IIIe-4	10.9	12.7	15.6	60	70	86	48	56	67	3.7	4.3	3.5	4.3	3.7	4.3	------	2.2
RbD	Rhinebeck silt loam, 15 to 25 percent slopes.	IVe-3	9.2	10.8	------	51	59	------	41	47	57	------	------	------	------	3.1	------	[6] 2.8	1.9
SaB	Scio silt loam, 0 to 4 percent slopes.	IIw-2	12.7	14.7	18.4	70	81	101	53	68	79	------	------	4.0	4.5	4.2	4.7	------	2.2
TaB	Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes.	IIe-1	13.3	15.3	19.1	73	85	105	56	71	81	4.6	5.1	4.2	4.7	------	------	------	2.4
TbA	Tioga gravelly loam, 0 to 2 percent slopes.	IIw-1	14.7	17.0	21.2	81	94	111	57	71	82	4.7	5.2	4.5	5.0	4.7	5.2	------	2.4
TcA	Tioga silt loam, 0 to 2 percent slopes.	IIw-1	15.7	18.3	22.8	86	100	125	60	77	88	------	------	4.9	5.4	------	------	------	2.5
TdA	Tioga silt loam, high bottom, 0 to 3 percent slopes.	I-1	15.9	18.5	23.1	87	102	127	61	78	89	5.1	5.5	4.3	4.7	------	------	------	2.8
UaB	Unadilla silt loam, 0 to 4 percent slopes.	I-1	15.9	18.5	23.1	87	102	127	61	78	89	5.1	5.5	4.3	4.7	------	------	------	2.8
VaB	Valois-Howard gravelly loams, 3 to 8 percent slopes.	IIe-1	12.8	14.8	18.5	70	81	102	54	68	79	4.1	4.6	3.8	4.3	------	------	------	2.3
VaC	Valois-Howard gravelly loams, 8 to 15 percent slopes.	IIIe-1	12.8	14.9	18.0	70	82	98	54	69	79	4.0	4.5	3.7	4.2	------	------	------	2.2
VaD	Valois-Howard gravelly loams, 15 to 25 percent slopes.	IVe-1	10.9	12.6	------	60	69	------	46	59	67	------	------	------	------	[5] 3.4	------	[6] 3.0	2.1
VbB	Volusia channery silt loam, 2 to 8 percent slopes.	IIIw-1	9.2	10.9	13.6	------	------	------	40	44	55	------	------	------	------	2.6	3.0	2.4	1.9
VbB3	Volusia channery silt loam, 2 to 8 percent slopes, eroded.	IVe-2	------	------	------	------	------	------	37	43	53	------	------	------	------	2.3	2.6	2.1	1.7
VbC	Volusia channery silt loam, 8 to 15 percent slopes.	IIIe-5	9.7	11.5	13.8	------	------	------	42	47	58	------	------	------	------	2.7	3.1	2.5	2.0
VbC3	Volusia channery silt loam, 8 to 15 percent slopes, eroded.	IVe-2	------	------	------	------	------	------	38	42	------	------	------	------	------	2.3	2.6	2.1	1.6
VbD	Volusia channery silt loam, 15 to 25 percent slopes.	IVe-3	8.2	9.7	------	------	------	------	36	41	49	------	------	------	------	2.3	------	[6] 2.1	1.7
VbD3	Volusia channery silt loam, 15 to 25 percent slopes, eroded.	VIe-1	------	------	------	------	------	------	32	36	------	------	------	------	------	1.9	------	[6] 1.7	1.5

[1] Supporting practices and cropping systems needed for the soils are given in the descriptions of the capability units.

[2] Estimates based on yields obtained from the Cornell M4 variety.

[3] Estimates based on yields obtained from the Garry variety.

[4] Estimates based on yields obtained from the following mixtures:

DA=Du Puits or Alfa varieties of alfalfa and timothy or smooth brome; yields are those expected each year over a 4-year period with three cuttings of hay per year.

NV=Narragansett or Vernal varieties of alfalfa and timothy or smooth brome; yields are those expected each year over a 4-year period with two cuttings of hay per year.

NVi=Narragansett variety of alfalfa and Viking variety of birdsfoot trefoil with timothy; yields are those expected each year over a 4-year period with two cuttings of hay per year.

Vi=Viking variety of birdsfoot trefoil with timothy; yields are those expected each year over a 5-year period with two cuttings of hay per year.

[5] For long-term stands on this soil, trefoil should be mixed with Vernal alfalfa.

[6] The Empire variety of birdsfoot trefoil can be substituted for the Viking variety on this soil, but estimated yields will be ½ to ¾ ton less per acre each year.

[7] Available yield figures are not reliable enough to provide a basis for estimating yields of specified crops on this soil.

551289—61——5

Table 27 gives examples of typical rates of fertilization for level A and level B management under several different situations. This table shows the pounds per acre of nitrogen, phosphoric acid, and potash that are needed in the fertilizer. The rates suggested for corn are high enough to meet the needs of this crop on most soils. Rates for the other crops vary somewhat according to the present nutrient status of the soil. All the rates given in this table are examples only; the needs for any crop in a given year should be estimated in relation to the cropping system, history of past management, probable supply of moisture for the crop, and the general level of management.

TABLE 27.—*Two levels of fertilization for different crops*

[Rates in column A are those needed to get yields shown in columns A of table 26; those in column B are needed to get yields shown in columns B of table 26. Rates given in column A apply to soils with a pH of 6.0; those in column B apply to soils with a pH of 6.6. The rates correspond to those recommended in the publication, Cornell Recommends for Field Crops (1959) (*5*)]

Crop	Fertilizer	
	Management level A	Management level B
	Lb. per acre per year [1]	*Lb. per acre per year* [1]
Corn:		
With 10 tons of manure or a good legume sod plowed under.	15–15–15	20–20–20.
No manure added or legume sod plowed under.	30–30–30 and 20–0–0 or 0–15–0 and 30–0–0.	40–40–40 and 30–0–0 or 20–40–40 and 50–0–0.
Spring oats seeded to a forage mixture:		
Soils on which grain is not likely to lodge:		
Soils high in potassium and medium to low in nitrogen.	20–40–20	40–80–40.
Soils medium to low in potassium.	20–40–40	40–80–80.
Soils on which grain lodges in some years:		
Soils high in potassium	10–20–10	20–40–20.
Soils medium to low in potassium.	10–20–20	20–40–40.
Soils on which grain lodges in most years:		
Soils high in potassium	0–20–0	0–40–0.
Soils medium to low in potassium.	0–20–20	0–40–40.
Alfalfa, ladino clover, or birdsfoot trefoil (fertilizer used as a top dressing):		
Soils low in potassium and high to medium in phosphorus.	0–0–40 or 0–20–40.	0–0–80 or 0–40–80.
Soils low in potassium and phosphorus.	0–20–40	0–40–80.
Soils medium in potassium	0–15–30	0–30–60.
Soils high in potassium	0–20–20	0–40–40.

[1] Pounds of available nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O_5). In the table that accompanies the description of each capability unit, the ability of each soil to supply potassium is given in terms, as "high," "medium," and "low." A discussion of potassium is also given in the subsection, Management Practices.

The three levels of management shown in table 26 are defined as follows:

Level A.—This level of management, considered typical for most dairy farms, is that needed to get the yields shown in columns A of table 26. The cropping systems and supporting practices used will maintain the content of organic matter in the soil, keep the soil in good tilth, control erosion, and conserve water through improved infiltration. The soils are limed so that they have a pH of 6.0; rates of fertilization are comparable to those shown in column A of table 27.

Level B.—This is the level of management required to obtain the yields shown in columns B of table 26. The cropping systems maintain about 1 or 2 percent more organic matter in the soil than do the cropping systems used under the A level of management. Maintenance of good soil tilth, control of erosion, and conservation of water are provided in about the same way as under the A level of management, but at the B level the pH of the soil is kept at about 6.6 and amendments are applied in amounts similar to those shown in table 27. The B level of management is considered above average, or high. A number of farm owners and managers operate at this level at present.

Level C.—This is the ideal, or optimum, system of management and should provide maximum yields at present. The yields are shown in columns C of table 26. Under this level of management, the soil receives about 40 percent more nutrients for corn and 50 percent more for hay than are furnished by the fertilization rates given in column B of table 27. About 1 percent more organic matter is maintained in the soil than under the B level of management. Very intensive measures are used to maintain good soil tilth and to conserve water. The estimates of yields under the C level of management are less reliable than those given for the A and B levels. Yields comparable to those shown in columns C of table 26, however, are now being obtained on experimental plots. They are also being obtained by some individual operators in Cortland County and on similar soils in the southern tier of counties in the western part of the State.

At all three levels of management, practices necessary to conserve the soils are carried out and fertilizer, lime, and other needed amendments are applied. The levels defined differ in rates of liming and fertilization and in the intensity of management. It is assumed that factors of crop production, other than fertilization, are progressively more carefully controlled from the A to the C level. As management becomes more intense, the operator selects better varieties of corn, oats, and mixtures grown for hay, provides better control of insect pests and weeds, and regulates better the time of planting and harvesting.

No yield estimates are given under management below the A level. But, in general, the yields expected under a low level of management would be 20 to 40 percent below those obtained at the A level.

Mixtures of hay different from those shown in table 26 are grown in the county. Nevertheless, the results on experimental plots and the yields reported by individual farmers indicate that the mixtures shown in table 26 are best suited to the soils at present. Estimated yields are given under the A level of management for grass mixed with some clover. For the other hay mixtures, estimated yields are given at the B and C level.

Two farmers working the same kind of soil seldom practice the same management; therefore, the management levels suggested in table 26 are based on judgment and not on the existence of any sharply defined systems, or levels, of management that are being practiced in the county. Some farmers will find it practical to use the A level of management, some the B level, and others the C. Whether it is practical for an operator to manage a particular soil at a level corresponding to the A, B, or C level depends, to a large degree, on (1) the kinds and distribution of soils on his farm, (2) the cost involved, and (3) the return he expects to receive from the sale of products. Each operator must decide what level of management best fits the unique set of circumstances on his farm.

The estimated yields given for different crops were reviewed by agriculturists familiar with the soils and agriculture of the county. They considered the fact that yields of crops vary from 1 year to the next because of variations in climate and differences in the managerial ability of the farmers. Under the A and B levels of management, one can expect yields of small grains to vary from 20 to 30 percent from 1 year to another, yields of corn to vary 20 to 30 percent, and yields of hay to vary 10 to 20 percent. The estimated yields given for the C level of management are based on less reliable data and may be considerably more variable than yields for the A and B levels.

The yield estimates for soils that have been drained are not very reliable because it is extremely difficult to predict the degree of effectiveness of the drainage systems used for two similar soils on different farms. Some wet soils, if effectively drained, will perform like well-drained soils, and yields expected will be much higher than those given in table 26.

Engineering Applications [3]

This soil survey report for Cortland County, N.Y., although made primarily for agricultural purposes, has considerable value for other uses. It contains information that can be used by engineers to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for water and soil conservation.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways and airports and in planning detailed investigations for the intended locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structure.
6. Determine the suitability of soil units for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs, for the purpose of making maps and reports that can be used readily by engineers.
8. Develop preliminary estimates for construction purposes pertinent to a particular area.

The mapping and the descriptive report are somewhat generalized and should be used only in planning more detailed field surveys that will, in turn, be used to determine the in-place condition of the soil at the site of the proposed engineering construction. It is not intended that this report will eliminate the need for sampling and testing for design and construction of specific engineering work.

Soil Science Terminology

Some of the terms used by the agricultural soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, sand, aggregate, and granular—may have a special meaning in soil science. These and other special terms used in the soil survey report are defined in the glossary in the back of the report. The following are definitions of several engineering terms that may be unfamiliar.

Plastic limit.—The moisture content at which the soil material passes from a solid to a plastic state.

Liquid limit.—The moisture content at which the soil material passes from a plastic to a liquid state.

Plasticity index.—The numerical difference between the liquid limit and the plastic limit. The plasticity index indicates the range of moisture content within which a soil material is plastic.

Moisture density.—If a soil material is compacted at successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Data showing moisture density are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted at about the maximum dry density when it is at approximately the optimum moisture content.

Engineering Classification Systems

The system used by the U.S. Department of Agriculture (*11*) for classifying soils according to texture (see table 29) is in some ways comparable to the systems engineers use for classifying soils. These are explained briefly as follows:

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, which is made up of clayey soils having low strength when wet. The soils of Cortland County have been classified under this system in table 29.

[3] This section was prepared by WALTER S. ATKINSON, State conservation engineer, Soil Conservation Service.

Some engineers prefer to use the Unified Soil Classification system (*12*). In this system, soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic. An approximate classification can be made in the field. The soils of Cortland County have been classified under this system in table 29.

Soil Engineering Data and Interpretations

The engineering interpretations in this section are based on the results of 15 soils sampled in the Soils Laboratory, Bureau of Public Roads. (See table 28.) The soil types sampled are extensive in this county. In addition to the test data, descriptions of the soils, information given elsewhere in the report, and knowledge obtained through past experience in using the soils for engineering construction were used in estimating properties of the soils. These estimates are shown in table 29.

The intent of the engineering interpretation is to provide a set of guides and indicators of potential hazards or characteristics that require unusual or special precautions in planning, designing, or constructing engineering structures.

Because samples were taken from only six soil types, it was necessary to estimate the AASHO and Unified engineering classifications for the rest of the soils mapped and to estimate permeability and available moisture-holding capacity, as shown in table 29.

Estimates of physical properties have not been given for Muck; this organic soil is unsuitable for engineering work.

TABLE 28.—*Engineering test data* [1] *for*

Soil name and location	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density: Maximum dry density	Moisture-density: Optimum moisture	Fragments more than 3 inches in diameter discarded in field sampling (estimated)
			Inches		*Lb. per cu. ft.*	*Percent*	*Percent*
Chippewa channery silt loam:							
3 miles N. and 1.5 miles E. of McGraw; 50 feet S. of road (modal profile).	Glacial till	S32589	0–2	A_1	75	37	
		S32590	13–23	B'_{2gm}	118	14	5
		S32591	23–34	B'_{3gm}	121	12	
		S32592	34–44	C	124	12	10
3 miles N. and 1.5 E. of McGraw; 1,000 feet N. of road (intergrading to Ellery soils).	Glacial till	S32593	0–4	A_1	71	42	
		S32594	14–25	B'_{2gm}	121	13	10
		S32595	33–43	C	123	12	
0.5 mile N. and 2 miles E. of Killawog (developed in local deposit of silt).	Alluvium over glacial till.	S32596	5–13	B_{2g} or B'_{2gm}	109	18	
		S32597	13–28	B'_{2gm} or D_1	121	13	10
		S32598	28–34	D_2	121	13	12
Howard gravelly loam:							
2 miles N. of South Cortland (modal profile).	Glacial outwash	S32599	0–8	A_p	95	23	15
		S32600	8–20	A_{21}	113	15	15
		S32601	32–48	B_{22}	125	11	25
		S32602	48–66	C_1	130	9	25
1 mile S. and 1,000 feet E. of South Cortland on Highway 13 (less fragments in B and C horizons).	Glacial outwash	S32603	0–6	A_p	114	14	
		S32604	6–18	A_{21}	121	13	
		S32605	32–46	B_{22}	127	11	
		S32606	46–66	C	132	10	
Valois-Howard gravelly loams:							
0.5 mile N. and 1 mile W. of Virgil (nonmodal profile).	Glacial till and outwash deposits.	S32607	0–6	A_p	95	23	
		S32608	6–20	A_{21}	104	18	5
		S32609	28–43	B_{22}	119	13	15
		S32610	43–60	C	125	10	20
Lordstown channery silt loam:							
3 miles N. and 1.5 miles E. of McGraw (modal profile).	Glacial till	S32611	0–8	A_p	93	25	2
		S32612	8–20	B_2	100	22	5
2 miles S. of McGraw (intergrading to Bath soils).	Glacial till	S32613	0–8	A_p	94	25	5
		S32614	8–14	B_{21}	100	23	5
		S32615	25–32	B_3 or A'_2	122	12	15
		S32616	43–48	D_t	124	12	25
2.5 miles SE. of Franks Corners; 100 feet N. of road (formed in shaly till).	Glacial till	S32617	0–8	A_p	83	30	
		S32618	8–18	B_{21}	110	17	
		S32619	24–30	B_3 or C	122	12	
		S32620	30–34	D	121	12	
Mardin channery silt loam:							
2.5 miles E. of Marathon and 500 feet W. of Merrill Creek (modal profile).	Glacial till	S32621	0–8	A_p	90	27	
		S32622	19–28	B'_{2gm}	123	12	2
		S32623	49–59	C	124	11	5
0.25 mile N. and 1 mile W. of Truxton (less strongly developed fragipan).	Glacial till	S32624	0–5	A_p	85	29	
		S32625	16–29	B'_{2gm}	125	11	5
		S32626	50–64	C or D	127	11	8

See footnotes at end of table.

Samples of each of the six soil types were taken in two or three different places. The soils from which the samples were taken (table 28) were formed from highly variable glacial till or from water-deposited materials. Because they were formed in materials that vary greatly in texture (grain size), the soils vary somewhat in texture from place to place within any one given series. Therefore, the engineering soil classifications given in table 28 may not apply to all areas of a mapping unit. Although the test data show some variation in characteristics within one soil type, they probably do not show the maximum variation possible in the profile of any one given series. All of the samples were obtained at depths of less than 6 feet; consequently, the test data given in table 28 may not be a suitable basis for estimating the characteristics of a soil that is in a deep cut or in a rolling or hilly area.

Many of the soils formed in glacial till present problems in engineering because they contain large stones and boulders. In some places the stones and boulders have been removed from the surface but are still present in the subsoil and substratum. In making the classifications shown in table 28, cobblestones and other stones larger than 3 inches in diameter were not considered.

Some soils present problems because they are shallow to bedrock. The Arnot, Lordstown, Tuller, and other shallow soils require careful investigation when structures that require excavation are planned.

Table 30 lists some appraisals of the suitability of the soils for highway construction and as a source of topsoil, sand, and gravel. In table 30 are also listed characteristics of the soils that affect their suitability for conservation engineering.

soil samples taken from 15 soil profiles

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve [3]						Percentage smaller than [3]						AASHO [4]	Unified [5]
3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
------	99	97	96	92	84	80	60	30	20	60	14	A-7-5(14)	MH.
95	88	79	75	72	66	63	42	20	13	24	5	A-4(7)	ML-CL.
100	91	85	79	72	64	60	43	26	17	25	7	A-4(6)	ML-CL.
90	86	77	67	58	53	49	37	22	14	24	6	A-4(5)	ML-CL.
------	------	------	100	98	89	87	70	42	29	69	13	A-7-5(13)	MH.
90	86	78	72	67	60	58	45	27	19	27	8	A-4(6)	CL.
------	95	84	75	66	59	56	45	29	20	26	8	A-4(5)	CL.
------	98	96	95	94	92	89	65	35	24	33	10	A-4(8)	ML-CL.
90	82	66	57	51	49	47	38	22	14	30	9	A-4(4)	ML-CL.
88	79	65	60	55	49	48	39	22	14	30	8	A-4(4)	ML-CL.
85	58	48	45	41	34	32	26	15	10	48	13	A-7-5(2)	GM.
85	49	37	32	28	23	21	14	7	5	29	6	A-2-4(0)	GM.
73	41	26	21	17	13	11	8	4	3	25	6	A-1-b(0)	GM-GC.
75	44	26	23	17	14	12	8	5	3	21	3	A-1-b(0)	GM.
------	92	76	61	40	34	31	23	14	10	40	9	A-2-4(0)	SM.
100	75	48	40	31	26	24	18	11	7	29	6	A-2-4(0)	GM-GC.
100	76	67	62	40	28	27	20	13	9	22	5	A-2-4(0)	SM-SC.
------	97	90	80	35	20	18	14	12	9	(6)	(6)	A-1-b(0)	SM.
------	85	71	65	59	53	51	37	18	12	44	9	A-5(4)	ML.
90	77	67	64	59	53	50	36	18	10	30	5	A-4(5)	ML.
85	59	45	41	36	31	29	21	12	8	26	6	A-4(0)	GM-GC.
78	42	26	23	21	18	16	11	6	4	21	4	A-1-b(0)	GM-GC.
98	93	81	75	69	64	61	45	24	15	50	9	A-5(8)	ML.
95	85	75	70	63	58	55	41	21	14	38	7	A-4(5)	ML.
95	77	68	63	57	52	52	41	23	14	50	11	A-7-5(5)	ML.
95	90	81	72	68	65	65	49	28	19	40	8	A-4(7)	ML.
85	76	65	58	52	46	44	31	15	8	23	3	A-4(4)	ML.
75	65	50	44	38	34	32	23	14	10	26	6	A-4(2)	GM-GC.
100	84	77	72	68	64	62	47	25	17	54	12	A-7-5(9)	MH.
100	93	87	83	79	76	72	51	29	19	31	5	A-4(8)	ML.
------	98	93	82	72	66	62	39	20	12	25	3	A-4(6)	ML.
100	82	62	48	40	36	34	22	12	9	27	4	A-4(0)	GM-GC.
100	78	64	59	54	45	42	30	15	9	50	10	A-5(3)	GM.
98	79	68	62	56	50	47	33	20	13	23	6	A-4(3)	ML-CL.
95	81	67	61	56	49	45	31	20	12	23	5	A-4(3)	ML-CL.
100	82	71	67	63	57	54	40	21	14	56	13	A-7-5(7)	MH.
95	85	69	63	56	49	45	30	17	11	23	5	A-4(3)	ML-CL.
92	79	64	54	46	40	39	29	19	14	25	7	A-4(2)	GM-GC.

TABLE 28.—*Engineering test data*[1] *for*

Soil name and location	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density: Maximum dry density	Moisture-density: Optimum moisture	Fragments more than 3 inches in diameter discarded in field sampling (estimated)
			Inches		*Lb. per cu. ft.*	*Percent*	*Percent*
Mardin channery silt loam—Continued							
3 miles N. and 1.5 miles E. of McGraw; 75 feet S. of road (intergrading to Arnot soil).	Glacial till	S32627	0–8	A_p	86	30	
		S32628	18–29	B'_{2gm}	122	13	7
		S32629	36–44	C	123	13	20
Volusia channery silt loam:							
3.5 miles N. and 0.75 mile E. of Marathon (modal profile).	Glacial till	S32630	0–8	A_p	90	26	
		S32631	13–30	B'_{2gm}	120	12	5
		S32632	44–65	C	122	12	12
3 miles N. of Ithaca (Tompkins County) on Mitchell Street (intergrading to Erie soils).	Glacial till	S32633	0–9	A_p	90	27	
		S32634	15–32	B'_{2gm}	124	12	8
		S32635	50–60	C	124	12	10
0.25 mile N. and 1 mile W. of Truxton (weaker developed fragipan).	Reworked glacial till.	S32636	0–5	A_p	85	31	
		S32637	13–26	B'_{2gm}	116	15	8
		S32638	38–52	C	124	11	

[1] Tests performed by the Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

[2] Mechanical analyses according to the AASHO Designation, T–88. Results obtained by this procedure frequently differ somewhat from results that would have been obtained by using 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 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification: USDA texture
		Feet		*Inches*	
AaA	Alden and Birdsall silt loams, 0 to 3 percent slopes.	0	Very poorly drained undifferentiated soils formed in 1 to 3 feet of glacial till or lacustrine material derived from sandstone, siltstone, and coarse-textured shale; high content of silt and clay; in level areas, in slight depressions, and along drainageways in parts of the uplands in which water accumulates on the surface; subject to seepage of water from permeable strata in the till of surrounding areas; some stones and shale fragments on the surface and within the soil profile; the Birdsall soil differs from Birdsall silt loam, over gravel, 0 to 1 percent slopes, in that it is underlain by till instead of by stratified sand and gravel.	0–14	Silt loam
				14–30	Silty clay loam
Ab	Alluvial land	0–1½	Mixture of well-drained to very poorly drained soils formed in alluvium recently deposited along streams; alluvial material, 1 to 2 feet thick; gravelly layers at depths of 2 to 3 feet; areas subject to flooding.	0–40	Because of the varia-
AcB	Arnot channery silt loam, 2 to 8 percent slopes.		Moderately well drained soil formed in 1½ to 2 feet of glacial till over fractured sandstone and siltstone; on gentle slopes of high ridges in the uplands.	0–24	Channery silt loam
				24	Bedrock

See footnotes at end of table.

soil samples taken from 15 soil profiles—Continued

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve [3]						Percentage smaller than [3]						AASHO [4]	Unified [5]
3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
100	94	87	84	82	77	75	58	34	24	55	14	A-7-5(13)	MH.
93	89	78	71	63	58	55	43	28	19	27	8	A-4(5)	CL.
80	74	67	60	54	47	46	35	22	16	27	9	A-4(5)	CL.
97	79	70	66	63	58	56	41	21	15	52	15	A-7-5(8)	MH.
95	77	65	59	55	49	46	30	13	9	23	4	A-4(3)	ML-CL.
88	56	42	40	36	31	28	19	10	6	24	5	A-2-4(0)	GM-GC.
92	88	82	80	76	65	62	47	30	21	54	16	A-7-5(12)	MH.
92	87	78	70	62	50	46	34	21	14	23	5	A-4(4)	ML-CL.
90	83	74	68	61	49	46	33	21	14	24	7	A-4(4)	ML-CL.
92	70	61	59	57	54	51	40	24	18	59	16	A-7-5(9)	MH.
92	90	82	76	70	67	64	45	21	16	27	6	A-4(8)	ML-CL.
89	82	71	64	58	53	50	36	17	12	23	4	A-4(5)	ML-CL.

than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes of soils.

[3] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[4] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. AASHO Designation: M 145-49 (*1*).

[5] Based on the Unified Soil Classification System, Tech. Memo. No. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers, March 1953 (*12*).

[6] Nonplastic.

and brief descriptions of the soils

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML	A-6	80–90	85–95	85–95	Moderate	Granular to blocky	2. 0–2. 3	5. 7–6. 5
ML-CL	A-4	55–65	60–75	65–85	Moderate to moderately slow.	Massive; firm in place.	2. 0–2. 3	5. 8–7. 0
bility of soil material included in this mapping unit, no estimates of physical properties have been made.								
ML	A-4	50–60	60–70	65–75	Moderate	Weak, subangular blocky.	2. 0–2. 3	4. 5–5. 0

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
AdA	Atherton silt loam, 0 to 3 percent slopes.	0	Very poorly drained soil with a firm, slowly permeable layer at depths of ½ to 2½ feet; underlain by stratified sand and gravel; formed in glacial outwash derived from sandstone, siltstone, and coarse-textured shale; occurs in depressions of outwash terraces; subject to seepage of water from surrounding areas and wet during most of the growing season.	0–30 30–46	Silt loam Stratified gravel and sand.
BaB BaC BaD	Bath channery silt loam, 3 to 8 percent slopes. Bath channery silt loam, 8 to 15 percent slopes. Bath channery silt loam, 15 to 25 percent slopes.	3–5	Well-drained soil with a hard, compact layer that is firm in place and very slowly permeable at depths of about 1½ to 3 feet; formed in glacial till derived from sandstone, siltstone, and coarse-textured shale; occurs on convex slopes in the uplands; numerous fragments of stone and shale on the surface and in the soil profile.	0–21 21–64	Channery silt loam Silt loam
BbB BbC BbD BbE	Bath-Chenango gravelly loams, 3 to 8 percent slopes. Bath-Chenango gravelly loams, 8 to 15 percent slopes. Bath-Chenango gravelly loams, 15 to 25 percent slopes. Bath-Chenango gravelly loams, 25 to 40 percent slopes.	3–5	Well-drained soils in level to steep areas; occur on valley walls and in the uplands; Bath and Chenango soils intermixed on valley walls; in some places the glacial till is overlain with outwash material; the till may become saturated by water that moves down through the outwash, and it is likely to slough out causing slumps or slips on the steep slopes; soils subject to internal erosion; Chenango soils closely resemble Chenango gravelly loams that are mapped separately.	See Bath soils and Chenango soils.	
BcE	Bath and Mardin soils, 25 to 40 percent slopes.	2–3	Bath soil is similar to Bath channery silt loams, and Mardin soil is similar to Mardin channery silt loam; because they have steep slopes, these soils are used in about the same way and have been mapped together as an undifferentiated unit; they occur on slopes bordering tributary streams.	See Bath soils and Mardin soils.	
BdA	Birdsall silt loam, over gravel, 0 to 1 percent slopes.	0	2 to 3 feet of very poorly drained soil over gravelly, sandy material that is permeable to water; formed in finely sorted sediments, mainly lacustrine material and silty alluvium; occupies local basins and flats in valleys; high water table keeps soil wet during entire growing season; poor drainage because outlets are inadequate.	0–26 26–48	Silty clay loam Stratified sand and gravel.
CaB	Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes.	(4)	Well-drained soil containing a high proportion of coarse fragments; occurs on alluvial fans at the point where small streams enter valleys; not subject to flooding by main streams, but sheet flooding and erosion accompany heavy rains; stony alluvial material is loose in place and rapidly permeable to water; stones and fragments of shale on surface and in soil profile; in places deep substratum consists entirely of coarse fragments 3 to 6 inches in diameter.	0–34 34–50	Channery silt loam Stratified sand and gravel.

See footnotes at end of table.

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML	A-4	55-65	60-75	65-85	Moderately slow to slow.	Weak blocky to massive.	2. 0-2. 3	5. 5-5. 8
GM-GC; SM-SC; SM.	A-1-6 or A-2-4.	20-30	25-50	35-60	Rapid	Single grain		5. 4-5. 6
ML	A-4	50-60	60-70	65-75	Moderately rapid	Medium, subangular blocky.	2. 5-3. 0	5. 0-5. 2
ML-CL	A-4	45-55	55-65	60-70	Moderately slow to slow.	Very weak, coarse blocky to massive.		5. 4-6. 0
CL-ML	A-6 or A-7	60-70	65-75	70-80	Moderately slow to slow.	Massive	2. 0-2. 3	5. 5-5. 8
GM-GC; SM-SC; SM.	A-2-4	35-45	50-60	55-70	Rapid	Single grain		5. 8-6. 0
GM	A-4	30-45	35-60	45-70	Moderate to rapid	Massive to weak, fine, subangular blocky; weakly developed.	2. 0-2. 5	5. 7-6. 0
GM or SM	A-2-4	25-35	30-45	45-70	Rapid	Single grain		5. 9-6. 5

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
CbA CcB	Chagrin silt loam, 0 to 2 percent slopes. Chagrin silt loam, high bottom, 0 to 4 percent slopes.	0 1½–2	2 to 3 feet of well-drained alluvial soil over sand and gravel; soils occur on low and high bottoms in valleys; depth to gravel varies, but gravel generally occurs at a depth of 3 feet; Chagrin silt loam, 0 to 2 percent slopes, subject to frequent flooding from main streams; Chagrin silt loam, high bottom, 0 to 4 percent slopes, subject to occasional flooding by main streams.	0–34 34–50	Silt loam Stratified sand and gravel.
CdA CdB CdC	Chenango gravelly loam, 0 to 3 percent slopes. Chenango gravelly loam, 3 to 8 percent slopes. Chenango gravelly loam, 8 to 15 percent slopes.	(4)	2 to 2½ feet of well-drained gravelly soil over stratified sand and gravel; soils occur on glacial outwash terraces in valleys and on valley walls; outwash derived from acid siltstone, sandstone, and coarse-textured shale; soils rapidly permeable to water; contain cobblestones and stones on surface and throughout profile; Chenango gravelly loam, 8 to 15 percent slopes, occurs on small knolls and on the short slopes of terrace faces.	0–20 20–144	Gravelly loam Stratified sand and gravel.
CeA CeB	Chippewa channery silt loam, 0 to 3 percent slopes. Chippewa channery silt loam, 3 to 8 percent slopes.	0–1	Poorly drained soils with a slowly permeable layer at a depth of 8 to 12 inches; formed from glacial till derived from siltstone, sandstone, and coarse-textured shale; occur in depressions in the uplands; stones on the surface and in the soil profile; in places soils contain thin deposits of silt and clay; subject to seepage of water from surrounding soils.	0–11 11–72	Channery silt loam Channery silt loam
CfB CfC	Conesus gravelly silt loam, 2 to 8 percent slopes. Conesus gravelly silt loam, 8 to 15 percent slopes.	½–1½	2 to 2½ feet of moderately well drained gravelly material over a clayey layer about 1 to 1½ feet thick; formed in gravelly till derived from sandstone, siltstone, limestone, and coarse-textured shale; soils occur between uplands and valleys in areas where valleys have been plugged; subject to erosion and inclined to be droughty; these mapping units contain small areas of poorly drained Kendaia silt loam, 1 to 6 percent slopes.	0–22 22–38 38–59	Gravelly silt loam Gravelly silty clay loam. Gravelly silt loam
DaB DaC	Dunkirk silt loam, over gravel, 0 to 4 percent slopes. Dunkirk silt loam, over gravel, 8 to 20 percent slopes.	(4)	2½ to 3 feet of well-drained soil over stratified sand and gravel; formed from lake-laid materials or silty alluvium; soils occur in valleys; depth to gravel ranges from about 2½ to 5 feet; Dunkirk silt loam, over gravel, 8 to 20 percent slopes, has short, moderately steep slopes giving it a complex topography; soil on moderately steep slopes subject to erosion.	0–28 28–66	Silt loam Stratified sand and gravel.
EaA EaB	Ellery channery silt loam, 0 to 3 percent slopes. Ellery channery silt loam, 3 to 8 percent slopes.	½–1	Poorly drained soils with slowly permeable layer at depths of 1 to 1½ feet; formed in stony or gravelly till derived from siltstone, sandstone, limestone, and coarse-textured shale; occur in depressions in uplands; have stones on surface and in soil profile; subject to seepage of water from surrounding soils; Ellery channery silt loam, 0 to 3 percent slopes, wet during most of growing season.	0–14 14–26 26–37	Channery silt loam Channery silt loam to silty clay loam. Channery silt loam

See footnotes at end of table.

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML	A-4	55-70	60-80	65-85	Moderate to moderately slow.	Massive to weak, fine, subangular blocky.	2. 5-3. 0	5. 8
GM or SM	A-4	35-45	40-50	45-75	Rapid	Single grain		6. 0
GM	A-1-b or A-2-4.	15-30	20-35	25-40	Rapid	Weak crumb to structureless.	1. 8-2. 5	4. 9
GM or SM	A-2-4	15-30	40-55	45-70	Rapid	Single grain		5. 3-6. 0
ML-CL	A-4	60-70	70-80	75-90	Moderate to moderately slow.	Weak, subangular blocky.	2. 5-3. 0	5. 0-5. 2
ML-CL	A-4	50-60	60-75	70-85	Slow	Blocky or platy		5. 6-6. 4
ML-CL	A-4	55-65	60-70	65-75	Moderately rapid	Crumb to subangular blocky.	1. 8-2. 5	5. 6-6. 0
CL	A-6	60-70	65-75	70-80	Moderate	Subangular blocky		6. 5-7. 3
ML-CL; GM	A-4	45-55	50-60	55-70	Moderate	Massive		6. 5-7. 0
ML	A-4	55-65	60-80	65-85	Moderately rapid	Coarse, subangular blocky.	2. 0-2. 8	5. 2-5. 5
GM	A-2 or A-4	30-40	45-50	50-65	Rapid	Single grain		6. 5-7. 0
ML-CL	A-4	60-70	70-80	75-90	Moderate	Weak, fine blocky	2. 5-3. 0	6. 0-6. 5
ML-CL	A-4 or A-6	65-75	70-80	75-90	Moderate to moderately slow.	Subangular blocky		6. 4-6. 6
ML-CL	A-4	50-60	60-75	70-85	Slow	Blocky to massive		6. 5-7. 0

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
EbB EbC	Erie channery silt loam, 2 to 8 percent slopes. Erie channery silt loam, 8 to 15 percent slopes.	1-1½	Somewhat poorly drained soils with very firm, hard, very slowly permeable layer at depths between 1 and 4 to 5 feet; formed in stony glacial till derived from siltstone, sandstone, coarse-textured shale, and some limestone; occur on slopes in uplands; water seeps along top of very slowly permeable layer and may come to the surface in places where the surface layer is shallow, causing prolonged wetness in the area.	0-11 11-58	Channery silt loam Channery silt loam to clay loam.
HaA	Holly silt loam, 0 to 1 percent slopes.	0	1½ to 2½ feet of poorly drained soil over stratified sands and gravel; formed in alluvial sediments washed from soils on glacial till derived from sandstone, siltstone, and coarse-textured shale; soil occurs in oxbows of former stream channels; has high water table most of the year; depth to gravel varies.	0-34 34-44	Silt loam Stratified sand and gravel.
HbA	Homer silt loam, 0 to 2 percent slopes.	0	Poorly drained soil with 6 to 8 inches of silty clay beginning at depths of 6 to 12 inches; formed in 2½ to 3 feet of gravelly outwash material; occurs in depressions in valleys.	0-6 6-12 12-36+	Silt loam Gravelly silty clay loam. Stratified sand and gravel.
HdA HdB HdC HdD HcA HcB	Howard gravelly loam, 0 to 3 percent slopes. Howard gravelly loam, 3 to 8 percent slopes. Howard gravelly loam, 8 to 15 percent slopes. Howard gravelly loam, 15 to 25 percent slopes. Howard cobbly loam, 0 to 3 percent slopes. Howard cobbly loam, 3 to 8 percent slopes.	(4)	Well-drained soils with 1½ to 2 feet of silt, gravel, and sand over a moderately permeable (instead of rapidly permeable) layer of clayey material 7 to 10 inches thick; below this is sandy, gravelly material that is rapidly permeable; soils formed in glacial outwash derived from limestone, siltstone, sandstone, and coarse-textured shale; occur on nearly level terraces and hummocky areas called kames; Howard cobbly loams have large amounts of cobblestones, 3 to 10 inches in diameter, on the surface and throughout the profile	0-23 23-30 30-85	Gravelly loam Gravelly loam to clay loam. Stratified sand and gravel.
KaB	Kendaia silt loam, 1 to 6 percent slopes.	½	Poorly drained to somewhat poorly drained soil with 1½ to 2 feet of fine-grained material over till containing some gravel and stones; formed in glacial till derived from siltstone, sandstone, coarse-textured shale, and limestone; occurs in nearly level areas and on convex slopes in valley fills between uplands and bottom lands; subject to ponding of surface runoff.	0-15 15-26 26-39	Silt loam Silty clay loam Silt loam
LaB LaC LaD	Langford channery silt loam, 3 to 8 percent slopes. Langford channery silt loam, 8 to 15 percent slopes. Langford channery silt loam, 15 to 25 percent slopes.	1-1½	Moderately well drained soils with 15 to 18 inches of material containing some stones and gravel over slowly permeable layer 2 to 3 feet thick; formed in glacial till derived from siltstone, sandstone, limestone, and coarse-textured shale; occur on rolling slopes in uplands; some stones and gravel throughout soil profile.	0-18 18-84	Channery silt loam Channery silt loam
LbB LbC LbD LbE	Lansing gravelly silt loam, 3 to 8 percent slopes. Lansing gravelly silt loam, 8 to 15 percent slopes. Lansing gravelly silt loam, 15 to 25 percent slopes. Lansing gravelly silt loam, 25 to 35 percent slopes.	(4)	2 to 5 feet of well-drained soils that contain gravel overlying clayey material; formed in glacial till derived from sandstone, siltstone, limestone, and coarse-textured shale; soils occur mainly on rolling, complex slopes in valley plugs between the uplands and bottom lands; contain stones and gravel throughout the soil profile; depth to clayey layer varies; till beneath clayey layer slightly permeable; soils on steeper slopes erodible; soils formed on terminal moraine deposited in valleys have undulating slopes.	0-27 27-40 40-56	Gravelly silt loam Gravelly silty clay loam. Gravelly silt loam

See footnotes at end of table.

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML-CL	A-6	50-65	60-80	65-85	Moderately slow	Medium crumb or thin platy.	1. 8-2. 0	5. 4-5. 7
ML-CL	A-4	45-55	65-85	75-95	Slow	Subangular blocky		6. 0-7. 0
ML	A-4	55-70	60-80	65-85	Moderate to moderately slow.	Massive	2. 0-2. 3	5. 0-5. 4
GM-SM	A-4	35-45	45-50	65-80	Rapid	Massive		5. 4-5. 5
ML-CL	A-4	60-70	70-80	75-90	Moderate	Coarse crumb	1. 8-2. 0	6. 2-6. 5
CL	A-6	60-70	65-75	70-80	Moderate to moderately slow.	Subangular blocky		6. 4-6. 6
GM-GC; SM-SC; SM.	A-2-4 or A-1-6	15-35	30-50	40-70	Rapid	Single grain		7. 5-7. 8
GM; GM-GC	A-2-4; A-1-6	15-25	25-35	25-50	Rapid	Coarse crumb to medium, subangular blocky.	1. 6-2. 0	5. 2-6. 5
GM-GC	A-1 to A-2-4	15-30	25-35	25-50	Moderate to moderately slow.	Subangular blocky		6. 5
GM-GC; SM-SC; SM.	A-1 to A-2-4	10-20	25-35 60-80	25-40 65-90	Rapid	Single grain	1. 2-1. 6	6. 5-7. 0
ML-CL	A-4	60-70	65-75	70-80	Moderate	Coarse crumb	1. 6-2. 5	6. 5-7. 0
ML-CL	A-6	55-65	60-70	65-75	Moderate to moderately slow.	Subangular blocky		6. 4-6. 7
ML-CL	A-4	45-55	50-65	55-70	Moderate	Massive or thick platy.		6. 5-7. 0
ML-CL	A-4	50-60	60-70	65-75	Moderately slow	Weak, subangular blocky.	1. 8-2. 5	5. 0-5. 2
ML-CL	A-4	45-60	50-75	60-80	Moderately slow to slow.	Weak, medium, blocky to massive.		6. 5-7. 0
ML-CL	A-4	60-70	65-75	70-80	Moderate	Fine, subangular blocky.	1. 6-1. 8	5. 2-5. 5
CL	A-6	60-70	65-75	70-80	Moderate	Medium, subangular blocky.		5. 5-5. 8
ML-CL; GM-GC.	A-4	50-55	40-50	45-65	Moderate	Weak, thick platy		6. 8-7. 0

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
LcA	Lobdell silt loam, 0 to 2 percent slopes.	1–3	2 to 2½ feet of moderately well drained alluvial material over gravel and sand; formed in alluvium containing both acid and alkaline sediments; soil occurs on high and low bottoms along streams in valleys; soil on low bottoms subject to frequent flooding; water table drops to depth of 3 feet during growing season.	0–19 19–38	Silt loam Stratified sand and gravel.
LdB LfC LfD	Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes. Lordstown channery silt loam, 8 to 15 percent slopes. Lordstown channery silt loam, 15 to 25 percent slopes.	1–3	1 to 3 feet of well-drained soils over bedrock; soil material derived from sandstone, siltstone, and coarse-textured shale; soils occur on high ridges in uplands and on steep walls of valleys; soils on steeper slopes erodible; in some places fractured rock occurs at depth between 1 and 3 feet; some areas of Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes, include small, wet areas of Tuller soils.	0–8 8–30 30–36 36	Channery silt loam Channery silt loam Fractured bedrock Bedrock
LeB LgE	Lordstown channery silt loam, shallow, 2 to 8 percent slopes. Lordstown soils, 25 to 55 percent slopes.		Similar to other Lordstown soils just described but shallower to bedrock; in some places bedrock occurs at the surface; soils on steeper slopes erodible; Lordstown soils, 25 to 55 percent slopes, are on very steep walls of narrow valleys.	8–20 20	Silt loam Bedrock
MaB MaC MaC3 MaD	Mardin channery silt loam, 2 to 8 percent slopes. Mardin channery silt loam, 8 to 15 percent slopes. Mardin channery silt loam, 8 to 15 percent slopes, eroded. Mardin channery silt loam, 15 to 25 percent slopes.	1½–2	Moderately well drained soils with 1½ to 2 feet of stony material over a compact, slowly permeable layer that extends to a depth of 5 feet; occur on gentle to steep slopes in uplands; formed on glacial till derived from sandstone, siltstone, and shale; have stones on the surface and in the profile; in places consist of stony or gravelly silt loam; some areas contain small inclusions of Chippewa soils, which are poorly drained and have water at or above the surface for long periods, mainly because of seepage from surrounding soils.	0–17 17–72	Silt loam Channery silt loam or gravelly silt loam.
MbA	Middlebury silt loam, 0 to 2 percent slopes.	0	Moderately well drained soil with 2 to 2½ feet of alluvium over gravelly material; formed from acid sediments; occur along streams in valleys on first (low) bottoms and at bases of alluvial fans; has stones on surface and in profile; subject to frequent flooding during growing season; streambank erosion a serious problem.	0–30 30–50	Silt loam Gravelly silt loam
PbA PbB PbC PbD PaA	Palmyra gravelly silt loam, 0 to 3 percent slopes. Palmyra gravelly silt loam, 3 to 8 percent slopes. Palmyra gravelly silt loam, 8 to 15 percent slopes. Palymra gravelly silt loam, 15 to 25 percent slopes. Palmyra cobbly loam, 0 to 3 percent slopes.	(4)	Well-drained soils with 1 to 1½ feet of gravelly material over gravelly, clayey material 10 to 14 inches thick; below this is gravelly, cobbly, and sandy material that is rapidly permeable to water; soils formed in gravelly outwash material; occur on level outwash plains and terraces in valleys; subject to erosion and droughty; Palmyra cobbly loam, 0 to 3 percent slopes, contains large amounts of cobblestones, 3 to 10 inches in diameter; cobblestones derived from granite and sandstone; Palmyra gravelly silt loam, 3 to 8 percent slopes, occurs on terrace faces and slopes that are short and steep.	0–18 18–29 29–144	Gravelly silt loam Gravelly clay loam Stratified sand and gravel.
PcA	Papakating silt loam, 0 to 1 percent slopes.	0	10 to 12 inches of highly organic material over alluvium made up of silt, clay, gravel, and sand; soil occurs in basins and depressions near streams; has a permanently high water table and is wet throughout the year.	0–10 10–30 30–40	Silt loam Silty clay loam Gravelly to sandy loam.

See footnotes at end of table.

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML	A-4	50-60	60-80	65-85	Moderate	Massive to subangular blocky.	2.0-2.3	5.8-6.3
GM or SM	A-4	35-45	45-60	70-90	Very rapid	Single grain		6.3-6.6
ML	A-5 or A-7	55-70	65-85	70-80	Moderate	Weak crumb		4.8-5.0
ML	A-4	50-70	60-80	65-85	Moderate	Weak crumb	1.8-2.2	5.0-5.2
GM-GC	A-4	35-40	40-50	50-65	Moderate	Weak blocky and thick platy.		5.4-5.8
ML	A-4	55-60	60-80	65-90	Moderate	Weak crumb	1.6-1.8	5.0-5.2
GM-MH	A-5 or A-7	45-55	60-70	65-70	Moderate to moderately rapid.	Crumb to medium platy.	2.0-3.0	4.8-5.1
ML-CL or GM-GC.	A-4	45-55	45-65	50-70	Moderately slow to slow.	Massive or platy	1.5-2.0	5.5-6.5
ML	A-4	50-70	60-80	65-85	Moderately rapid	Subangular blocky to massive.	2.0-2.3	5.0-5.2
GM-SM	A-4	35-45	45-50	50-65	Rapid	Massive		5.2-5.5
GM; GM-GC	A-2-4	15-25	25-35	30-40	Moderate	Crumb to subangular blocky.	1.5-2.0	5.7-6.4
GM-GC	A-2 or A-4	30-40	35-45	40-60	Moderate to moderately slow.	Subangular blocky		6.8
GM-GC	A-1-b or A-2-4.	20-30	35-45	40-60	Rapid	Single grain		6.0-6.8
ML	A-4	60-70	65-75	70-80	Moderate	Coarse crumb		5.5-5.7
ML-CL	A-4	55-70	60-80	65-85	Moderate to moderately slow.	Massive		5.5-5.7
GM-SM	A-4	35-45	45-50	50-70	Rapid	Single grain		5.5-5.8

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
PdA	Phelps gravelly silt loam, 0 to 3 percent slopes.	1–1½	Dominantly moderately well drained soil with 1 to 2 feet of gravelly material containing some fine-grained material; below this is stratified sand and gravel, derived mostly from siltstone, sandstone, coarse-textured shale, and limestone; this material is permeable and loose in place; soil formed in glacial outwash; occurs in valleys on nearly level to slightly convex ridges of outwash terraces; in places drainage is a problem because of the high water table and the accumulation of runoff water.	0–21 21–40	Gravelly silty clay loam. Stratified sand and gravel.
RaA	Red Hook silt loam, 0 to 3 percent slopes.	1–1½	Poorly drained to somewhat poorly drained soil with a slowly permeable silty layer, about 6 to 24 inches thick, at depths of 1 to 1½ feet; at depths of about 2½ to 3 feet are stratified sand and gravel, derived from siltstone, sandstone, and coarse-textured shale, that are loose in place; soil formed from glacial outwash material; occurs on outwash terraces in valleys.	0–23 23–40	Silt loam Stratified sand and gravel.
RbB RbC RbD	Rhinebeck silt loam, 3 to 8 percent slopes. Rhinebeck silt loam, 8 to 15 percent slopes. Rhinebeck silt loam, 15 to 25 percent slopes.	(4)	Dominantly moderately well drained soils with slowly permeable, clayey material at depths of 2 to 2½ feet; formed in lacustrine clay; occur in valleys on level to sloping areas.	0–10 10–22 22–32	Silt loam Silty clay loam Silty clay
SaB	Scio silt loam, 0 to 4 percent slopes.	2–3	Moderately well drained soil containing about 1½ to 2½ feet of alluvium with a high percentage of silt; this overlies a slowly permeable layer, generally 1 to 2 feet thick; stratified sand and gravel begin at depths of from 20 to 36 inches; soil formed in alluvium deposited in valleys; occupies terraces between bottom lands and outwash terraces.	0–29 29–48	Silt loam Stratified sand and gravel.
SbA	Sloan silt loam, 0 to 1 percent slopes.	0	Very poorly drained soil with 9 to 12 inches of highly organic material over 1 to 3 feet of alluvium; below this is a layer of silty clay that is slowly permeable to water; gravelly material occurs at depths of about 3 to 3½ feet; soil occurs on recent flood plains near present streams; has a permanently high water table.	9–34 34–45	Silty clay loam Stratified sand and gravel.
TaB	Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes.	(4)	Well-drained alluvial soil containing high percentage of coarse fragments; occurs on alluvial fans at point where small streams enter valleys; not subject to flooding from main streams, but sheet flooding and erosion accompany heavy rains; has stones and fragments of shale on the surface and throughout profile.	0–32	Channery silt loam
TbA TcA TdA	Tioga gravelly loam, 0 to 2 percent slopes. Tioga silt loam, 0 to 2 percent slopes. Tioga silt loam, high bottom, 0 to 3 percent slopes.	(4)	Well-drained alluvial soils that have stratified sand and gravel at depths of 2½ to 3 feet; formed in alluvium deposited on low and high bottoms along streams in valleys; depth to gravel varies, but gravel generally occurs at a depth of 3 feet; Tioga gravelly loam, 0 to 2 percent slopes, and Tioga silt loam, 0 to 2 percent slopes, are subject to periodic flooding during growing season; Tioga silt loam, high bottom, 0 to 3 percent slopes, is subject to occasional flooding; streambanks are subject to severe erosion.	0–33 33–60	Silt loam and gravelly silt loam. Stratified sand and gravel.

See footnotes at end of table.

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
GM; GM-GC	A-4	35-45	50-60	65-75	Moderate to moderately rapid.	Weak, subangular blocky with clay-coated peds.	1. 8-2. 0	5. 8-6. 6
GM-GC	A-2-4	25-35	40-50	50-60	Rapid	Single grain		6. 0-7. 0
ML-CL	A-4	50-65	60-80	65-85	Moderate to moderately slow.	Weak, subangular blocky.	1. 8-2. 0	5. 0-5. 8
GM-SM	A-2-4	20-35	40-50	50-70	Rapid	Single grain		5. 0-5. 5
ML-CL	A-4	70-80	90-100	100	Moderate	Crumb	1. 5-2. 5	6. 0-6. 2
CL	A-6	80-85	95-100	100	Slow	Strong, coarse blocky with clay-coated peds.		6. 5-6. 8
CH	A-7	90-95	90-95	95-100	Very slow	Thick platy		6. 8-7. 0
ML	A-4	55-70	60-80	65-85	Moderate to moderately slow.	Weak blocky	2. 0-2. 6	5. 0-5. 9
GM-SM	A-4	35-45	45-60	60-80	Rapid	Fine blocky to massive.		5. 0-5. 3
CL	A-6	60-70	65-80	70-90	Moderate to moderately slow.	Medium blocky to massive.	1. 8-2. 3	6. 9-7. 0
GM-SM	A-4	35-45	45-60	50-65	Rapid	Single grain		6. 9-7. 0
GM or GP-GM.	A-1 or A-2-4	10-20	20-35	25-40	Moderate to moderately rapid.	Weak blocky	1. 8-2. 3	5. 0-5. 2
ML-CL and GM.	A-4	45-70	50-75	65-85	Moderate to moderately rapid.	Weak blocky	1. 6-2. 0	5. 0-5. 2
GM-SM	A-4	35-45	45-50	50-65	Rapid	Single grain	1. 8-2. 3	5. 4-6. 0

TABLE 29.—*Estimated physical properties*

Symbol on map	Soil	Depth to seasonally high water table	Descriptions	Depth from surface (typical profile)	Classification
					USDA texture
		Feet		*Inches*	
TeB	Tuller channery silt loam, 2 to 8 percent slopes.	½–1	Poorly drained soil that has a tight, slowly permeable layer at depths of 6 to 10 inches; this layer is 6 to 12 inches thick; some stones within soil profile; bedrock occurs at depths ranging from 10 to 24 inches; soil formed from glacial till; occurs in depressions on highest ridges in uplands.	0–18 18	Channery silt loam Bedrock.
UaB	Unadilla silt loam, 0 to 4 percent slopes.	([4])	Well-drained soil formed in 2 to 3 feet of alluvium over stratified layers of gravel, sand, and fine-grained material; alluvial sediments, which have washed from soils of the uplands, were derived from sandstone, siltstone, and coarse-textured shale; soil occurs in nearly level parts of valleys; occupies stream terraces above bottom lands but below outwash terraces; depth to gravel ranges from 3 to 5 feet.	0–29 29–42	Silt loam Stratified sand and gravel.
VaB VaC VaD VaE	Valois-Howard gravelly loams, 3 to 8 percent slopes.[5] Valois-Howard gravelly loams, 8 to 15 percent slopes.[5] Valois-Howard gravelly loams, 15 to 25 percent slopes.[5] Valois and Howard gravelly loams, 25 to 40 percent slopes.[5]	([4])	Soils formed in glacial till mixed with glacial outwash deposits; Howard soils are the same as the Howard gravelly loams that are mapped separately; Valois soils are well drained; they have a firm layer at depths of 24 to 48 inches that is moderately permeable (instead of rapidly permeable); stones and gravel are on surface and throughout the soil profile; Valois-Howard soils occur in areas between uplands and bottom lands.	0–24 24–52	Gravelly silt loam Channery silt loam
VbB VbB3 VbC VbC3 VbD VbD3	Volusia channery silt loam, 2 to 8 percent slopes. Volusia channery silt loam, 2 to 8 percent slopes, eroded. Volusia channery silt loam, 8 to 15 percent slopes. Volusia channery silt loam, 8 to 15 percent slopes, eroded. Volusia channery silt loam, 15 to 25 percent slopes. Volusia channery silt loam, 15 to 25 percent slopes, eroded.	½–1	Somewhat poorly drained soils that have very firm, hard, impervious layer at depths of 8 to 14 inches; this layer is 2½ to 3½ inches thick; excess seepage water accumulates along top of impervious layer and comes to the surface in some depressions; in these places water is at or above the surface for long periods; soils formed in uplands in glacial till derived from siltstone, sandstone, and coarse-textured shale; some stones occur on the surface and throughout the soil profile.	0–13 13–30 30–57	Channery silt loam Channery silt loam Channery silt loam
WaA	Wallington silt loam, over gravel, 0 to 3 percent slopes.	0	Poorly drained lacustrine soil formed in sediments, washed from soils of the uplands; sediments derived from sandstone, siltstone, and coarse-textured shale; soil occurs in depressions and in basins of valleys; stratified gravel, sand, and fine-grained material occur at a depth of 40 inches.	0–40 40–48	Silt loam to silty clay loam. Stratified sand and gravel.
WbA	Wayland silt loam, 0 to 1 percent slopes.	0	Dominantly poorly drained soil formed in 2 to 3 feet of alluvium over stratified sand and gravel; occurs on bottom lands beside streams; subject to frequent flooding during growing season; has permanently high water table.	0–38 38–50	Silt loam Stratified sand and gravel.

[1] Terms used to describe permeability of the soil are based on percolation rate of water in inches per hour, as follows: Very slow—less than 0.05; slow—0.05 to 0.20; moderately slow—0.20 to 0.80; moderate—0.80 to 2.50; moderately rapid—2.50 to 5.00; rapid—5.00 to 10.00; and very rapid more than 10.00.

[2] Refers to the amount of capillary water in soil wet to field capacity; if soil is "air dry," the amount of water indicated will wet the soil to a depth of 1 foot.

[3] The pH values were determined by measurements made in the field with a colorimetric test kit; material with a pH of 6.6 to 7.3 is

and brief descriptions of the soils—Continued

Classification		Percentage passing sieve—			Permeability [1]	Structure	Available moisture [2]	Reaction [3]
Unified	AASHO	No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)				
							Inches per foot of depth	*pH*
ML-CL	A-4	55–65	65–80	75–85	Moderately slow	Weak, subangular blocky.	1. 5–2. 0	5–0–5. 4
ML	A-4	55–70	60–80	65–85	Moderate	Weak blocky to crumb.	2. 0–2. 3	5. 0–5. 2
GM-SM	A-4	35–45	45–50	50–65	Rapid	Single grain		4. 5–5. 0
ML	A-4	50–55	60–70	65–75	Moderately rapid to moderate.	Weak crumb and weak blocky.	1. 6–2. 0	5. 0–5. 5
ML-CL	A-4	45–55	55–65	60–70	Moderately slow to slow.	Very weak, coarse blocky to massive.		6. 6–7. 0
MH	A-7-5	50–65	60–75	65–80	Moderately slow	Weak, coarse crumb	1. 5–2. 5	5. 0
ML-CL	A-4	45–55	55–65	60–70	Slow to very slow	Subangular blocky		5. 4–5. 8
ML-CL	A-4	45–55	50–75	50–75	Very slow	Blocky, massive, and platy.		5. 0–6. 0
CL-CH to ML-MH.	A-6 or A-7	60–70	65–75	70–90	Moderately slow	Weak, subangular blocky.	2. 0–2. 3	4. 8–5. 4
GM-GC and SM-SC.	A-1-b or A-2-4.	20–30	25–45	40–75	Rapid	Single grain		5. 0–5. 5
ML-CL	A-4	55–70	60–80	65–85	Moderately slow	Massive	2. 0–2. 3	6. 5–6. 8
GM-SM	A-4	35–45	45–50	50–75	Rapid	Massive		7. 0–7. 5

neutral; that with a pH of less than 6.6 is acid; and that with a pH of more than 7.3 is alkaline. Extremes in pH affect soil used for structural materials and the treatment needed to make the soil stable.

[4] Below 5 feet.

[5] Information given applies only to the Valois soils. For the Howard gravelly loams, see the estimates of physical properties given elsewhere on this table for Howard soils.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Susceptibility to frost action	Suitability of soil material for— Winter grading	Road subgrade	Road fill	Suitability as source of— Topsoil	Sand and gravel	Soil features affecting suitability for— Vertical alinement in highways
Alden and Birdsall silt loams (AaA).	High	Poor	Not suitable	Fair when dry; easily eroded.	Not suitable (too wet) in natural state; good when dry.	Not suitable	Permanently high water-table; moderately slow internal movement of water; natural outlets for surface drainage inadequate.
Arnot channery silt loam (AcB).	Bedrock at depths of 18 to 22 inches.						
Atherton silt loam (AdA).	Moderate	Poor	Fair below depth of 32 inches.	Good when dry.	Not suitable (too wet) in natural state; good when dry.	Fair (dirty sands and gravel).	Permanently high water table.
Bath channery silt loam (BaB, BaC, BaD).	High	Poor	Not suitable	Good, but easily eroded on strong slopes.	Not suitable (stony).	Not suitable	Slowly permeable, compact layer at depths of 18 to 30 inches; seepage along top of layer; cut slopes subject to sloughing.
Bath-Chenango gravelly loams (BbB, BbC, BbD, BbE).	High	Poor	Poor	Fair	Not suitable	Not suitable	Lenses of sand and gravel; cut slopes subject to slides because of internal erosion.
Bath and Mardin soils (BcE).	See Bath channery silt loam and Mardin channery silt loam.						
Birdsall silt loam (BdA).	Moderate	Poor	Not suitable	Good when dry.	Not suitable (too wet) in natural state; good when dry.	Not suitable	Permanently high water table; natural outlets for surface drainage inadequate.
Chagrin channery silt loam (CaB).	Low	Good	Good	Good	Not suitable (stony).	Fair; highly variable, stratified material; high percentage of flat fragments.	May contain pockets of fine sand subject to piping when saturated.

interpretation of soils

Soil features affecting suitability for—Continued						
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Stability fair to poor compacted; permeability slow for core.	May contain sand lenses; permanently high water table.	Stability fair to poor compacted; permeability slow.	Permanently high water table; slow internal movement of water; natural outlets for surface drainage inadequate.	Water-intake rate fair; moisture-holding capacity fair to good.	Subject to prolonged flow.	Permanently high water table; subject to prolonged flow.
Permanently high water table; when compacted, stability good; permeable below a depth of 32 inches.	Permanently high water table; permeable below a a depth of 32 inches.	Permeable below a depth of 32 inches.	Permanently high water table; natural outlets for surface drainage inadequate; ditchbanks subject to sloughing; fine sands unstable when saturated.	Limited root depth.	Subject to prolonged flow.	Permanently high water table; subject to prolonged flow.
Stability good compacted; permeability slow.	Permeability slow.	Stability fair to good; when compacted, permeability slow.	Slowly permeable, compact layer at depths of 18 to 30 inches.	Water-intake rate and moisture-holding capacity good.	Compact layer at depths of 18 to 30 inches.	Highly erodible on steep slopes.
Stability fair; permeable below depths of 24 to 48 inches.	Mixtures of silts, sands, and gravel; may be permeable.	Adequate shear strength and stability; foundation subject to slips because of internal erosion.	Sand and gravel lenses; cut slopes subject to seepage and sloughing.	Water-intake rate fair; moisture-holding capacity good.	Undulating topography.	Subject to prolonged seepage.
Stability good when compacted; permeability slow, but permeable below depths of 24 to 36 inches; permanently high water table.	Permanently high water table; permeable at depths of 24 to 36 inches.	Fair to good shear strength and stability when coarse-grained material is mixed with fines.	Permanently high water table; natural outlets for surface drainage inadequate; cut slopes unstable.	Water-intake rate fair to low in top 24 inches; moisture-holding capacity fair.	Subject to prolonged flow.	Subject to prolonged flow.
Stability good; permeable below depth of 34 inches.	Permeable below depth of 34 inches; at depths of 5 to 6 feet may consist entirely of coarse fragments.	Excellent shear strength and stability for outside shell.	Stony; may contain pockets of fine sand subject to piping when saturated.	Water-intake rate high and moisture-holding capacity fair to low.	Stony; permeable.	Stony.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Suscepti-bility to frost action	Suitability of soil material for—			Suitability as source of—		Soil features affecting suitability for—
		Winter grading	Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alinement in highways
Chagrin silt loam (CbA, CcB).	Moderate to high for top 2 or 3 feet.	Poor in Chagrin silt loam, 0 to 2 percent slopes (CbA), because of frequent flooding; good in Chagrin silt loam, high bottom, 0 to 4 percent slopes (CcB).	Fair to good	Fair to good	Good	Fair; highly variable, stratified material (dirty sands and gravel).	Chagrin silt loam, 0 to 2 percent slopes (CbA), subject to flooding.
Chenango gravelly loam (CdA, CdB, CdC).	Low	Good	Good	Good	Not suitable	Very good; some large stones throughout profile.	May contain pockets of fine sand subject to piping when saturated.
Chippewa channery silt loam (CeA, CeB).	High	Poor	Poor	Not suitable (too wet) in natural state; good when dry.	Not suitable	Not suitable	High water table subject to prolonged seepage from surrounding soils.
Conesus gravelly silt loam (CfB, CfC).	High	Fair	Not suitable	Good	Not suitable	Not suitable	Slowly permeable layer at depths of 24 to 30 inches; cut slopes subject to seepage.
Dunkirk silt loam, over gravel (DaB, DaC).	Low to high for top 2 feet.	Good	Fair below depths of 36 inches.	Good but easily eroded on stronger slopes.	Good	Not suitable	May contain pockets of fine sand subject to piping when saturated.
Ellery channery silt loam (EaA, EaB).	High	Poor	Not suitable	Not suitable (too wet) in natural state.	Not suitable	Not suitable	High water table most of the year; subject to seepage; bedrock may be 8 to 10 feet below surface.

interpretation of soils—Continued

Soil features affecting suitability for—Continued						
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Fair to good stability when coarse-grained material is mixed with the fines; permeable below depths of 24 to 36 inches.	Permeable below depths of 24 to 36 inches.	Fair to good shear strength and stability when coarse-grained material is mixed with fines; when compacted, permeability slow.	Chagrin silt loam, 0 to 2 percent slopes (CbA), subject to frequent flooding; ditchbanks unstable; fine sands subject to piping when saturated.	Water-intake rate high; moisture-holding capacity good.	Chagrin silt loam, 0 to 2 percent slopes (CbA), subject to frequent flooding.	Chagrin silt loam, 0 to 2 percent slopes (CbA), subject to frequent flooding.
Very stable for outside shells; permeable.	Permeable______	Good shear strength and stability for outside shell; permeable.	May contain pockets of fine sand subject to piping when saturated.	Water-intake rate high; moisture-holding capacity moderate.	Permeable; stony; Chenango gravelly loam, 8 to 15 percent slopes (CdC), is very undulating.	Stony.
Stability fair; when compacted, permeability slow.	High water table; permeability slow.	Fair to good stability when compacted; permeability slow.	High water table; slow internal movement of water; subject to prolonged seepage from surrounding soils; water stands on surface for long periods.	Water-intake rate very slow; moisture-holding capacity good; limited root depth.	Channels subject to prolonged seepage; very compact layer at depths of 8 to 12 inches.	Subject to pro longed seep age.
Adequate stability; moderately permeable.	Moderately permeable.	Adequate shear strength and stability; when compacted, permeability slow.	Slowly permeable layer at depths of 24 to 30 inches; internal movement of water moderately slow.	Water-intake rate fair to good; moisture-holding capacity good	Compact layer at depths of 24 to 30 inches.	Conesus gravelly silt loam, 8 to 15 percent slopes (CfC), very erodible.
Permeable below depths of 24 to 36 inches; stability fair to poor.	Permeable below depths of 24 to 36 inches.	Stability fair to poor; permeable below depths of 24 to 36 inches.	May contain pockets of fine sand subject to piping when saturated.	Top 24 inches has good moisture-holding capacity; water-intake rate moderate to slow.	Very erodible; Dunkirk silt loam, over gravel, 8 to 20 percent slopes (DaC), on very undulating topography.	Very erodible.
Stability fair to good; permeability slow.	May contain sand lenses; seasonally high water table.	Stability fair to good; compacted; permeability slow.	Slowly permeable layer at depths of 14 to 26 inches; subject to seepage.	Water-intake rate moderate, moisture-holding capacity good.	May contain sand lenses; subject to prolonged seepage.	Subject to prolonged seepage.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Susceptibility to frost action	Suitability of soil material for—			Suitability as source of—		Soil features affecting suitability for—
		Winter grading	Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alinement in highways
Erie channery silt loam (EbB, EbC).	High	Poor	Not suitable	Fair but erodible on stronger slopes.	Not suitable	Not suitable	Firm, slowly permeable layer at depths of 12 to 18 inches; slow internal movement of water; bedrock may be 8 to 10 feet below surface.
Holly silt loam (HaA)	Moderate	Poor	Fair below depth of 36 inches.	Not suitable (too wet) in natural state.	Not suitable (too wet) in natural state, but good when dry.	Fair; highly variable, stratified material (dirty sands and gravel).	Subject to occasional flooding; high water table; natural outlets generally inadequate.
Homer silt loam (HbA)	Moderate	Poor	Fair below depth of 36 inches.	Not suitable (too wet) in natural state.	Not suitable	Good (dirty sands and gravel).	High water table; natural surface outlets generally inadequate.
Howard cobbly loams (HcA, HcB); Howard gravelly loams (HdA, HdB, HdC, HdD).	Low	Good	Fair to good	Suitable	Not suitable	Good; may contain some secondary lime cementation.	Suitable
Kendaia silt loam (KaB).	High	Poor	Not suitable	Not suitable (too wet) in natural state.	Not suitable	Not suitable	Subject to surface ponding; internal movement of water moderately slow to slow; bedrock may be 8 to 10 feet below surface.
Langford channery silt loam (LaB, LaC, LaD).	Moderate	Fair	Not suitable	Suitable	Not suitable	Not suitable	Slowly permeable layer at depths of 15 to 18 inches; internal movement of water moderately slow to slow; bedrock may be 8 to 10 feet below the surface.
Lansing gravelly silt loam (LbB, LbC, LbD, LbE).	Moderate	Fair	Not suitable	Suitable	Not suitable	Not suitable	Cut slopes subject to erosion; bedrock may be 8 to 10-feet below surface.

interpretation of soils—Continued

Soil features affecting suitability for—Continued						
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Stability fair; permeability slow.	Permeability slow; may contain sand lenses; subject to seepage.	Stability fair to good; when compacted permeability slow.	Very slow internal movement of water; firm, slowly permeable layer at depths of 12 to 18 inches; may contain sand lenses.	Water-intake rate and moisture-holding capacity moderate; limited root depth.	Firm, slowly permeable layer at depths of 12 to 18 inches; may contain sand lenses.	Erodible on steep slopes; subject to prolonged seepage.
Stability good; may be permeable below depths of 18 to 30 inches.	Subject to occasional flooding; permanently high water table.	Adequate shear strength and stability when coarse-grained material is mixed with fines; when compacted, permeability slow.	Permanently high water table; stratified sands subject to piping; cut banks unstable; outlets generally inadequate.	Water-intake rate and moisture-holding capacity fair to good when soil drained.	Subject to prolonged flow.	Subject to occasional flooding and prolonged flow.
Stability good; permeable below depths of 12 to 18 inches.	High water table; permeable below depths of 12 to 18 inches.	Adequate shear strength and stability for outside shell; permeable.	High water table; slowly permeable layer at depths of 8 to 12 inches; cut banks unstable; outlets generally inadequate.	Water-intake rate and moisture-holding capacity fair to good when soil drained.	High water table.	High water table.
Stability good; permeable.	Permeable	Adequate shear strength and stability for shell; permeable.	Stony	Water-intake rate high; moisture-holding capacity fair.	Undulating topography; permeable; stony.	Stony.
Stability fair to good; permeability moderately slow to slow.	Permeability moderately slow to slow; may contain sand lenses; subject to seepage or piping.	Top 24-inch layer high in organic matter; when compacted, stability fair to good; permeability moderately slow to slow.	High water table because of ponding of surface runoff; internal movement of water moderate to slow; stony; sand lenses subject to piping.	Water-intake rate fair to low; moisture-holding capacity fair.	Irregular topography; subject to ponding of surface runoff.	Prolonged flow.
Stability good; permeability slow.	Permeability moderately slow to slow; may contain sand lenses; subject to seepage or piping.	Adequate shear strength and stability; when compacted, permeability slow.	Compact layer at depths of 15 to 18 inches; internal movement of water slow; contains sand lenses; subject to piping when wet.	Water-intake rate low; moisture-holding capacity fair; limited root depth.	Contains sand lenses; subject to seepage; slowly permeable, compact layer at depths of 15 to 18 inches.	Erodible on steep slopes; subject to seepage.
Stability good; moderately permeable.	Moderately permeable.	Adequate shear strength and stability; when compacted, permeability slow.	Cut slopes subject to erosion.	Water-intake rate high; moisture-holding capacity good.	Irregular topography; stony.	Erodible on steep slopes.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Susceptibility to frost action	Suitability of soil material for—			Suitability as source of—		Soil features affecting suitability for—
		Winter grading	Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alinement in highways
Lobdell silt loam (LcA).	Moderate	Poor	Not suitable	Not suitable (too wet) in natural state.	Good when dry.	Fair; highly variable, stratified material.	High water table; subject to frequent flooding.
Lordstown channery silt loam (LdB, LeB, LfC, LfD); Lordstown soils (LgE).	Bedrock at depths of 10 to 40 inches.						
Mardin channery silt loam (MaB, MaC, MaC3, MaD).	High	Poor	Not suitable	Good but erodible on stronger slopes.	Not suitable	Not suitable	Slowly permeable layer at depths of 18 to 20 inches; internal movement of water very slow; wet spots in soils at bases of slopes; bedrock may be 8 to 10 feet below surface.
Middlebury silt loam (MbA).	Moderate	Poor	Not suitable	Not suitable (too wet) in natural state.	Good when dry.	Fair; highly variable, stratified material (dirty sands and gravel).	Subject to frequent flooding; high water table.
Palmyra cobbly loam (PaA); Palmyra gravelly silt loam (PbA, PbB, PbC, PbD).	Low	Good	Suitable	Suitable	Not suitable	Fair for gravel; may contain some secondary lime cementation.	Suitable
Papakating silt loam (PcA).	Moderate	Poor	Not suitable	Not suitable (too wet) in natural state; surface soil high in organic matter.	Very good when dry.	Not suitable	High water table; subject to flooding; cut slopes unstable; inadequate natural outlets for surface drainage.
Phelps gravelly silt loam (PdA).	Moderate	Poor	Fair when dry.	Good when dry.	Not suitable	Fair; may contain some secondary lime cementations.	Seasonally high water table.
Red Hook silt loam (RaA).	Moderate	Poor	Fair below depth of 30 inches.	Fair when dry.	Not suitable	Fair; may contain some secondary lime cementations.	Seasonally high water table.

interpretation of soils—Continued

Soil features affecting suitability for—Continued							
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Stability fair; permeable below depths of 24 to 30 inches.	High water table; subject to flooding; permeable below depths of 24 to 30 inches.	Adequate shear strength and stability; when compacted, permeability slow.	Subject to frequent flooding; cut slopes unstable; high water table.	Water-intake rate and moisture-holding capacity fair to good.	High water table.	High water table; subject to flooding.
Stability good; permeability slow.	Permeability slow; stony.	Adequate shear strength and stability when coarse-grained material is mixed with fines; when compacted, permeability slow.	Compact layer at depths of 18 to 20 inches; contains small wet areas subject to prolonged seepage.	Limited depth for roots; water-intake rate low; moisture-holding capacity moderate.	Compac layer at depths of 18 to 20 inches; contains wet areas subject to prolonged seepage.	Local wet areas subject to prolonged seepage.
Stability fair; subject to frequent flooding; permeable below depth of 30 inches.	High water table; subject to frequent flooding; permeable below depth of 30 inches.	Adequate shear strength and stability; when compacted, permeability slow.	High water table; subject to frequent flooding; cut slopes very erodible.	Water-intake rate moderate; moisture-holding capacity good.	High water table.	High water table; subject to frequent flooding.
Stability good; permeable.	Permeable	Adequate shear strength and stability for outside shell; permeable.	Stony	Water-intake rate high and moisture-holding capacity moderate.	Undulating topography; permeable; stony.	Erodible on steep slopes; stony.
Stability fair to poor; subject to flooding; surface soil high in organic matter.	Subject to flooding; permanently high water table.	Shear strength and stability fair to poor; high in organic matter.	Subject to flooding; high water table; cut slopes unstable; inadequate natural outlets for surface drainge.	Water-intake rate and moisture-holding capacity fair to good when soil drained.	High water table.	Subject to prolonged flow.
When compacted, stability adequate; permeable.	Permeable; seasonally high water table.	Adequate shear strength and stability; may be permeable.	Seasonally high water table; accumulation of runoff on surface; cut slopes unstable; stratified sands subject to piping.	Water-intake rate good; moisture-holding capacity fair to low when soil drained.	High water table.	Seasonally high water table.
When compacted, stability adequate; permeable below depth of 24 inches.	Permeable below depth of 24 inches; seasonally high water table.	Adequate shear strength and stability; when compacted, permeability moderate.	Seasonally high water table; slowly permeable, compact layer at depths of 12 to 24 inches; stratified sands susceptible to piping; cut slopes unstable.	Limited root depth.	High water table.	Seasonally high water table.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Suscepti-bility to frost action	Suitability of soil material for—			Suitability as source of—		Soil features affecting suitability for—
		Winter grading	Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alinement in highways
Rhinebeck silt loam (RbB, RbC, RbD).	High	Poor	Not suitable	Not suitable	Fair to good in surface layer.	Not suitable	Internal movement of water slow; clay material below depths of 24 to 30 inches subject to high volume change with change in moisture content.
Scio silt loam (SaB)	Moderate to high.	Good	Not suitable	Suitable	Suitable to depths of 20 to 35 inches.	Good (dirty sands and gravel).	Moderately permeable layer at depths of 15 to 20 inches.
Sloan silt loam (SbA).	High	Poor	Not suitable	Not suitable (too wet) in natural state; surface soil high in organic matter.	Not suitable (too wet) in natural state; good when dry.	Fair to poor; highly variable, stratified material.	Subject to flooding; permanently high water table.
Tioga channery silt loam (TaB).	Low	Good	Suitable	Suitable	Not suitable	Fair to poor; highly variable, stratified material; contains high percentage of flat fragments.	Suitable
Tioga gravelly loam (TbA); Tioga silt loam (TcA, TdA).	Low	Poor in Tioga gravelly loam, 0 to 2 percent slopes (TbA), and in Tioga silt loam, 0 to 2 percent slopes (TcA), because of frequent flooding; good in Tioga silt loam, high bottom, 0 to 3 percent slopes (TdA).	Suitable	Suitable	Suitable in Tioga silt loam, 0 to 2 percent slopes (TcA), and in Tioga silt loam, high bottom, 0 to 3 percent slopes (TdA); not suitable in Tioga gravelly loam, 0 to 2 percent slopes (TbA).	Fair to poor; highly variable, stratified material (dirty sands and gravel).	Tioga gravelly loam, 0 to 2 percent slopes (TbA), and Tioga silt loam, 0 to 2 percent slopes (TcA), subject to flooding.

interpretation of soils—Continued

Soil features affecting suitability for—Continued						
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Poor stability; impermeable for core.	Permeability slow.	Shear strength and stability poor; subject to shrinking and swelling; impermeable to core.	Slowly permeable at depths of 18 to 24 inches; cut banks subject to erosion; internal movement of water slow.	Limited depth for roots; water-intake rate and available moisture-holding capacity low.	Compact layer at depths of 18 to 24 inches.	Very erodible on steep slopes.
Stability fair; permeable below depths of 20 to 36 inches.	Permeable below depths of 20 to 36 inches.	Stability fair; when compacted, permeability moderate.	Compact layer at depths of 15 to 20 inches.	Limited depth for roots; water-intake rate moderate to low; moisture-holding capacity good.	Compact layer at depths of 15 to 20 inches.	Subject to seepage.
Stability fair to poor; permeable below depth of 36 inches; surface soil high in organic matter; subject to occasional flooding.	Permeable below depth of 36 inches; permanently high water table; subject to occasional flooding.	Stability fair to poor; when compacted, permeability slow.	Subject to flooding; permanently high water table; outlets generally inadequate.	Water-intake rate fair and moisture-holding capacity good when soil drained.	High water table.	Subject to flooding; permanently high water table.
Stability adequate; permeable.	Permeable------	Adequate shear strength and stability for shell; permeable.	Stony; cut slopes subject to erosion.	Water-intake rate high; moisture-holding capacity moderate.	Stony; permeable.	Stony.
Stability good; permeable below a depth of 30 inches; subject to flooding.	Permeable below a depth of 30 inches; subject to flooding; height of water table varies.	Adequate shear strength and stability; may be permeable depending on the amount of fine material available.	Subject to flooding; cut slopes subject to erosion and sloughing.	Water-intake rate high; moisture-holding capacity moderate to low.	Permeable------	Subject to flooding.

TABLE 30.—*Engineering*

Soil types and symbols for mapping units	Susceptibility to frost action	Suitability of soil material for—			Suitability as source of—		Soil features affecting suitability for—
		Winter grading	Road subgrade	Road fill	Topsoil	Sand and gravel	Vertical alinement in highways
Tuller channery silt loam (TeE).	Bedrock at depths of 10 to 24 inches.						
Unadilla silt loam (UaB).	Moderate to high for top 2 to 3 feet.	Fair to poor for top 2 to 3 feet.	Not suitable	Fair to poor; erodible material.	Suitable	Fair; may contain layers of fine-grained material (dirty sands and gravel).	Suitable
Valois-Howard gravelly loams (VaB, VaC, VaD); Valois and Howard gravelly loams (VaE).[1]	High	Poor	Not suitable	Good with gentle slopes.	Not suitable	Not suitable	Valois soils have compact layer at depths of 24 to 48 inches.
Volusia channery silt loam (VbB, VbB3, VbC, VbC3, VbD, VbD3).	High	Poor	Not suitable	Suitable	Not suitable	Not suitable	High water table; bedrock may be 8 to 10 feet below surface.
Wallington silt loam (WaA).	High	Poor	Not suitable	Good when dry.	Not suitable (too wet) in natural state; good when dry.	Fair below a depth of 4 feet, but wet.	High water table.
Wayland silt loam (WbA).	High	Poor	Not suitable	Good when dry.	Not suitable (too wet) in natural state; good when dry.	Fair; highly variable, stratified material.	Subject to flooding; high water table; natural outlets for surface drainage inadequate.

[1] Information given applies only to the Valois soils; for the Howard gravelly loams, see information given for Howard soils elsewhere on this table.

interpretation of soils—Continued

Soil features affecting suitability for—Continued						
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Diversion terraces	Waterways
	Reservoirs	Embankments				
Stability fair; permeable below depth of 30 inches.	Permeable below depth of 30 inches.	Stability fair; when compacted, permeability moderate to low.	Stratified sands susceptible to piping.	Water-intake rate moderate to low; available moisture-holding capacity high.	Permeable below a depth of 30 inches.	Erodible.
Stability fair; compacted permeability slow.	Permeability slow.	Fair shear strength and stability; when compacted, permeability slow.	Moderately permeable, compact layer at depths of 24 to 48 inches; subject to surface runoff from adjoining areas.	Water-intake rate high and moisture-holding capacity good.	Moderately permeable compact layer at depths of 24 to 48 inches.	Erodible on steep slopes.
Adequate stability; permeability slow.	Permeability slow.	Adequate shear strength and stability; permeability slow.	Slowly to very slowly permeable layer at depths of 8 to 14 inches; high water table; surface ponding of water; internal movement of water very slow; stony.	Limited depth for roots; water-intake rate low; available moisture moderate to low.	Slowly to very slowly permeable layer at depths of 8 to 14 inches; seepage along top of this layer; stony.	Subject to prolonged seepage.
Stability fair; subject to shrinking and swelling.	Permeable below depth of 40 inches; high water table.	Adequate shear strength and stability when fine-grained material is mixed with coarse material; when compacted, permeability slow.	High water table; cut slopes unstable; stratified sands; may be subject to piping.	Water-intake rate moderately slow; moisture-holding capacity fair.	High water table.	High water table.
Stability fair; high water table.	High water table; subject to frequent flooding; permeable at depths of 36 to 40 inches.	Adequate shear strength and stability when fine-grained material is mixed with coarse material; when compacted, permeability slow.	Subject to flooding; natural outlets for surface drainage inadequate.	Water-intake rate moderately slow; moisture-holding capacity fair.	High water table.	High water table.

Highway Construction

In building highways the engineer encounters many problems that make construction difficult. One of the more difficult of these is frost action. Also, some of the soils have a perched water table, others are shallow to bedrock, and still others are mucky or otherwise unsuitable for use as a roadbed.

Suspension of earthwork during the winter to prevent use of frozen soil material for embankments may not be economically feasible, although it may be desirable. In table 30 the soils are rated according to their suitability for winter grading. Also, susceptibility of the soil material to frost action has been considered in rating the soils as sources of sand and gravel. In general, for a soil to be nonsusceptible to frost action, less than 10 percent of the soil material should pass through a No. 200 sieve. Even if a soil is rated as "good," it may be necessary to explore extensively to find material that meets this criterion. In table 30 the ratings given the soils as sources of topsoil apply only to nonstony soils. Normally, only material from the uppermost layer is used as topsoil for slopes of embankments, ditches, and cut slopes.

Some of the glacial till underlying the soils consists of particles of fine sand and silt that are susceptible to frost heave. Where such material occurs, a sufficient thickness of free-draining material should be used in the highway subgrade to prevent detrimental heaving of the pavement. If there are pockets of fine-textured material in the coarse-grained material, differential frost heave can be prevented either by mixing the fine-textured with the coarse-textured material so that heaving will be uniform, or by using a sufficient thickness of very permeable sandy gravel or coarse sand in the upper part of the subgrade.

The glacial till soils that have a compact, platy layer, slowly permeable to water, have a perched water table. Seepage may occur along the top of this slowly permeable layer. If roads are to be constructed on such soils, a survey should be made to determine the need for underdrains. In highway cuts some underdrains will be needed in the roadway sections.

Seepage in back slopes of roadcuts may cause the overlying material to slump or slide. If the perched water table is at a shallow depth below the pavement, differential volume change may occur, particularly within the depth of freezing, and the decrease in bearing capacity of the saturated or thawed foundation material may cause the pavement to deteriorate. Pockets of wet, fine-grained soil material should be removed and replaced by coarser material.

In deep glacial till bedrock may be exposed in deep cuts. In shallow glacial till the gradeline should be kept high so that excavation of the bedrock will be minimized, and seepage, which occurs at the point where the till and bedrock meet, will be avoided. Adequate systems of surface drainage and underdrainage should be provided, and coarse-grained soil material should be used in the upper part of the subgrade.

Gravelly soils, if properly compacted, form good subgrades for roads. Underdrains may be needed where glaciolacustrine or marine sediments underlie this coarser textured material and where the roadcuts are deep enough to reach the underlying fine-textured material. Road construction in glacial outwash generally requires somewhat less earthwork than construction in other deposits.

All topsoil that contains a detrimental amount of organic matter should be removed in constructing embankments 5 feet or more in height. If the surface layer is mucky, it should be removed from the roadway cut and wasted or placed on embankment slopes.

Glaciolacustrine materials and marine silts and clays do not make good foundations for roads because they are fine textured and the water table is near the surface. Roads should be built on embankments over such soils, but this may not be practical, especially if good material is not available. If the wet, fine-textured soil material is used in subgrades or embankments, the moisture content must be reduced so that it is only slightly above the optimum moisture content; otherwise, adequate compaction cannot be obtained. The gradeline should be kept above the water table.

Muck is not suitable for use as foundations for roads or for other engineering structures because of the low strength of the material and because the water table is normally high. Also, Muck is subject to subsidence and shrinkage. Roads should be alined to avoid areas of deep Muck. Muck within a cut section of a roadway and at embankment sites should be wasted or removed and replaced by suitable soil material. Some areas of Muck may be too small to be shown on the detailed soil map.

Construction of roads on river terraces ordinarily involves a minimum of earthwork, except where the road ascends onto a high terrace or into the uplands. The gradeline should be kept above the highest level reached by floods on terraces and on alluvial bottom lands.

Conservation Engineering

The principal engineering practices used to conserve soil and water in Cortland County are agricultural drainage, irrigation, farm ponds, dikes and levees, diversion terraces, and waterways.

When installing open ditches or subsurface drains, care is necessary in places where there are layers of ungraded silts, fine sands, or sands that are subject to erosion, sloughing, and slumping. Subsurface drainage systems installed in these layers must be protected against plugging by silts and fine sands. Some of the soils formed from glacial till are underlain by a compact, platy layer that retards the movement of water. Seepage usually occurs along the top of the compact layer and causes wet spots. In these places both diversion terraces and subsurface drains may be required.

Before installing irrigation systems in soils that contain a compact layer or in soils that are shallow to bedrock, careful investigation is necessary because of the limited thickness of tillable soil. Soils formed from glacial outwash or alluvium are normally droughty and have low moisture-holding capacity. This should be considered when planning an irrigation system.

In this county most of the soils formed from glacial till are suitable for the construction of farm ponds because they are slowly permeable. The Ellery, Erie, Kendaia, and Langford soils, however, contain lenses of sand that may allow seepage from the reservoir. The sand lenses may also cause piping and unstable conditions for drainage.

As a rule, soils formed in glacial outwash or alluvium are composed of larger particles than soils formed from glacial till; consequently, they are more permeable. If farm ponds for storing water above ground are planned, a sealing agent should be used to prevent the water from seeping from the reservoir. Where the water table is close to the surface of these soils, dug ponds for storing water below the natural ground surface have been successful.

Woodland Conservation[4]

The first part of this section describes the original forests of the area and tells something of the development of the woodland economy. Statistics are given concerning the land in forests, and forest production is discussed briefly for both the State and for Cortland County. After this, the present forests of the county are described and conservation of woodland is discussed. Most of the information on tree growing is given in table 31 in which the soils are arranged according to woodland suitability groups.

History

At the time of the first settlement, in the 1790's, the area that is now Cortland County was covered by an almost continuous stand of northern hardwoods mixed with many white pines of excellent quality. In 1791, an area near the present village of Homer was cleared and settled, and the following year the first clearing was made at the present site of Virgil. In 1808, Cortland County was formed from part of Onondaga County.

By 1860, all parts of the county had been settled, but, even before that time, the proportion of rural population in relation to urban population had begun to decline. At first, farming was diversified; in winter farmers obtained additional income by selling wood, maple sugar, and other forest products.

The first sawmill in the county was located at Virgil. Later, other mills were established at Willet, Taylor, and Marathon. By 1844, a total of 103 sawmills, 22 tanneries, 24 gristmills, and 17 asheries were in operation.

By 1910, a large volume of pulp, lumber, and round wood was being cut annually, mostly from hemlock and spruce. After that, the total annual cut declined. An estimated 5 million to 7 million board feet of timber was cut in 1958.

The planting of trees in the county started slowly but has increased greatly through the years. Only 200 trees were sent to the county from the State nursery in 1911, but in 1958 a total of 473,000 trees was supplied. Landowners planted about 94 percent of the trees furnished in 1958.

Land in forests

About 97,300 acres, or nearly 31 percent of the acreage in the county, is covered by forests. Of this, 27,723 acres is within State forests, which are made up largely of plantations. Well over half of the wooded acreage is within the area where northern hardwoods predominate. Large tracts and many small areas of forest lie in the northeastern, east-central, and southeastern parts of the county.

The average farm woodlot is 36 acres in size. Farms near Virgil have an average of 16 acres of woodland, but those near Preble have an average of 65 acres. On some farms as much as 25 to 30 percent of the acreage is in woodland.

Forest production

Cortland County, an important producer of hardwoods, is within a State nearly half of which is covered by forests. New York ranks sixth among the States in volume of hardwood timber cut. It supplies one-fifth of the sugar maple and yellow birch sawtimber produced in the United States. Approximately half of the growing stock in New York is made up of sugar maple, beech, and yellow birch. Although most of the forests are well stocked, many of the trees are of low quality; only 7 percent of the trees are in quality class I (50 percent or more grade 1 or 2 logs).

Large amounts of forest products originate in Cortland County. In 1949, a total of 12,944 gallons of maple sirup was produced. This was an average of about 11 gallons for each commercial farm. In 1953, sugar maple was the principal kind of tree harvested, and more than 587,000 cubic feet was cut. Beech ranked second with 60,000 cubic feet cut.

In 1958, there were 26 sawmills and several miscellaneous woodworking plants in the county. Mills and plants used more than 2 million cubic feet of all sizes of lumber and 7,954,000 board feet of sawtimber. Since mill prices for logs exceeded roadside prices, it paid the owner of a farm woodlot to haul logs to nearby mills in his truck.

Woodland Physiographic Areas

The forests of the county lie in either the Northeastern subregion or in the Chenango Hills subregion. These are described as follows:

Northeastern subregion.—This area stretches southward from the level lake plain and the Mohawk Valley. In general, it is rolling to steep and elevations range from 400 to 2,000 feet above sea level. The Northeastern subregion covers all of Cortland County, except a small strip along the eastern boundary. Typically, the soils are medium textured and moderately well drained.

Forests cover about one-third of this subregion in Cortland County. Sugar maple, beech, white ash, black cherry, basswood, hemlock, and other northern hardwoods predominate. Hard maple and basswood attain superior form and quality in this area. The northern part of this subregion has nearly pure stands of sugar maple, which replaced the mixed forests that were cut for fuel during World War I.

Chenango Hills subregion.—A small strip of land along the eastern side of the county is in this subregion. Once, this area was farmed extensively. Because of the cool climate, short growing season, and, in some places, long distance to market, however, much of the land is now idle or has reverted to forest. A large acreage has been reforested by the State. About 40 percent of this subregion is now in forests consisting mostly of natural stands that have grown up in areas previously farmed.

Logging was heavy in 1930 and has remained active since then. Beech trees of low quality are numerous in

[4] This section by C. Erwin Rice, Soil Conservation Service, Syracuse, N.Y.

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the present forests, but there are good stands of hemlock on the deep, moist soils. Because forests provide a principal source of income in this area, they need to be improved so that they will provide a sustained source of income.

Forest Cover Types and Species

The forests of Cortland County occur primarily in the northern hardwoods zone. Following is a discussion of the principal types of forests in the county.

Sugar maple.—The trees of this forest cover type grow in almost pure stands of sugar maple with a small amount of white ash, basswood, and, in places, white or red oak. The trees are in small woodlots, mainly on deep, well drained or moderately well drained, fertile or moderately fertile soils that have good capacity to supply moisture and nutrients. Many stands of sugar maple have been established as the result of "sugarbush" development.

Beech-sugar maple.—Beech and sugar maple, the dominant trees of this forest cover type, have as their principal associates red and white oak, hemlock, elm, basswood, hickory, and black cherry. These trees commonly grow on Lordstown, Mardin, Arnot, Valois, and Lansing soils. Beech-sugar maple is considered a climax type of forest when moisture conditions remain constant. If more than 10 percent of a stand is in hemlock, the forest type is known as beech-sugar maple-hemlock.

Black ash-American elm-red maple.—In this cover type black ash is rarely as abundant as American elm and maple. The important associate trees are white ash, slippery elm, swamp white oak, white oak, silver maple, sycamore, willow, northern white-cedar, white pine, hemlock, and basswood. Stands of this forest type are on poorly drained to very poorly drained soils in swamps, along streams, and in gullies.

Hemlock.—This forest cover type might be called more precisely white pine-hemlock. There are some pure stands of hemlock, however, and in places hemlock dominates a particular site. In some places hemlock is associated chiefly with beech, sugar maple, birch, black cherry, white pine, and red and white oak. This forest cover type occupies cool areas on slopes facing north and northeast or in sheltered ravines. In places it may be considered a climax forest. It is often found in abandoned fields. The hemlock type may also arise as the result of grazing of farm woodlots, where it may grade into the beech-sugar maple type, or a subtype of beech-sugar maple-hemlock.

Northern red oak-basswood-white ash.—The chief associates of the northern red oak-basswood-white ash forest cover type are white, black, and chestnut oak, some red maple, and a smaller number of sugar maple, beech, and yellow birch trees. In some places the stands are made up entirely of northern red oak. Other areas contain a few black cherry, butternut, American elm, and hemlock trees.

In a few stands of this forest type, hickory has become a principal species. These few stands might be referred to more precisely as of the red oak-hickory type. When oaks are cleared as the result of fire or cutting, the subsequent natural restocking often establishes hickory as the dominant tree with aspen, black cherry, butternut, and white ash the principal associates. Where the red oak-hickory type of forest grows on shallow or moderately deep, eroded soils on rocky outcrops and ridges, it contains a few scarlet oaks.

The major trees (natural or planted) in Cortland County are as follows:

Scientific names	*Common names*
Abies balsamea	Balsam fir.
Acer negundo	Boxelder.
A. rubrum	Red maple.
A. saccharinum	Silver maple.
A. saccharum	Sugar maple.
Alnus incana	Speckled alder.
Betula lenta	Black birch.
B. lutea	Yellow birch.
B. populifolia	Gray birch.
Carya cordiformis	Bitternut hickory.
C. ovata	Shagbark hickory.
Crataegus sp.	Hawthorn.
Fagus grandifolia	American beech.
Fraxinus americana	White ash.
F. nigra	Black ash.
Gleditsia triacanthos	Honeylocust.
Juglans cinerea	Butternut.
J. nigra	Black walnut.
Juniperus virginiana	Eastern redcedar.
Larix decidua	European larch.
L. leptolepis	Japanese larch.
Liriodendron tulipifera	Yellow-poplar.
Ostrya virginiana	Eastern hophornbeam
Picea abies	Norway spruce.
P. glauca	White spruce.
Pinus banksiana	Jack pine.
P. nigra	Austrian pine.
P. resinosa	Red pine.
P. rigida	Pitch pine.
P. strobus	Eastern white pine.
P. sylvestris	Scotch pine.
Populus sp.	Hybrid poplar.
P. deltoides	Eastern cottonwood.
P. eugenei	Carolina poplar.
P. grandidentata	Bigtooth aspen.
P. tremuloides	Quaking aspen.
Prunus pennsylvanica	Pin cherry.
P. serotina	Black cherry.
Pseudotsuga menziesii	Douglas-fir.
Quercus alba	White oak.
Q. bicolor	Swamp white oak.
Q. palustris	Pin oak.
Q. prinus	Chestnut oak.
Q. rubra	Northern red oak.
Q. velutina	Black oak.
Robinia pseudoacacia	Black locust.
Salix nigra	Black willow.
Thuja occidentalis	Northern white-cedar.
Tilia glabra	American basswood.
Tsuga canadensis	Eastern hemlock.
Ulmus americana	American elm.
U. rubra	Slippery elm.

Basic Principles in Tree Growing

The environment for trees in Cortland County is typified by the following: (1) The climate is generally favorable—much of the county has an average growing season of 135 to 150 days with 18 to 21 inches of rainfall during that time; (2) the soils in the uplands are mostly acid and moderately productive of trees, and the soils in the valleys are currently highly productive or potentially so; and (3) in only a few places is the topography unfavorable for trees.

The two primary goals of woodland conservation are the development of satisfactory stands of natural timber and the establishment and maintenance of areas planted to trees. To accomplish either goal, one must understand how the forest site is related to the kind of tree.

Forest site.—The site consists of the soil, the atmosphere, and living things, all of which are interdependent and interrelated. Because of the many combinations of these factors, it is difficult to be precise in discussing a site. Soil is perhaps the end product or tally sheet of the other site factors—atmosphere and living things. Atmospheric factors include temperature, light, humidity, precipitation, wind, lightning, water vapor, and gases. Living things refer to all forms of animal and plant life.

The soil gives stability to trees; it anchors their roots and provides them with nutrients and moisture. To be suitable for a specific kind of tree, the soil must meet the tree's requirements for support and nutrients.

The depth, texture, and structure of the soil, as well as its content of moisture and minerals, are important to the growth of trees. Also important is the thickness of the various soil horizons. Information concerning these characteristics can be obtained in the descriptions of the soil profiles in the section, Descriptions of Soil Series and Mapping Units. Some factors that affect the future use of the soil are its fertility, past use, degree of erosion, percentage of slope, degree of exposure, and local climate.

Forest site quality, as used here, is a measure of the ability of soils to produce trees under a given set of conditions. The following is a description of the principal forest sites recognized in Cortland County (see table 31).

Site A (or I).—This site consists of soils that are good for tree growth. The soils are deep and well drained or moderately well drained, and they have good soil-water relationships. They have fair to excellent ability to hold and supply plant nutrients. The A horizon is generally medium textured, and the B horizon is medium textured to moderately fine textured. Slopes generally range from 0 to 20 percent, but some are steeper.

Site B (or II).—This site is made up of soils that are fair for trees. The soils are mainly somewhat poorly drained and are 20 inches or thicker over a fragipan or bedrock. They are poor to excellent in fertility. Their A and B horizons are generally moderately fine textured to medium textured. In general, slopes range from 0 to 25 percent.

Site C (or III).—This site is made up of soils that are poor for the growing of trees. Most of the soils are shallow, low in fertility, and poorly drained to very poorly drained. Some of the soils, however, are droughty, and many are excessively drained. On the wet soils the slopes seldom are more than 1 or 2 percent, but on the dry soils the slopes are as much as 40 to 50 percent.

A knowledge of site factors is needed to measure the quality of the site and to predict yields of trees. In turn, a knowledge of yields and site quality are necessary to the selection of suitable trees and conservation practices for a given locality. The existing forest is the best indicator of the kinds of trees that will grow on a site; the present growth rates and potential yields should also be considered, along with the time required for trees to reach acceptable merchantable size. The site quality can be determined only after trees have reached a certain age. In addition, changes in the forest cover or in the soil need to be known if the site quality is to be estimated.

Woodland suitability groupings.—Woodland potential is not generally determined for individual soils and trees. The soils of the county can be placed in woodland suitability groups, however, to provide a means of using soil information to rate site quality of woodland and to determine the suitability of groups of soils for specific kinds of trees. This is done in table 31. Characteristics of the soils of each woodland suitability group are given in the table. Also, the kinds of forest cover types, useful trees in order of volume cut, and trees suitable for planting are listed for each group, along with guides and remarks helpful in growing wood crops.

The primary characteristics considered in placing a soil in a woodland suitability group were drainage, texture, structure, fertility, content of lime, location, elevation, and gradient, shape, and aspect of slopes. The groups are arranged in numerical order according to the tree-growing ability of member soils. Thus group 1 is rated best for growing trees, and group 12, poorest. The suitability groups correspond to the estimated site quality classes, which are shown by symbols A, B, and C or a combination of these symbols. For example, in table 31, group 1, consisting of the best soils for woodland, is shown to be in estimated site quality class A, considered a good site for woodland; group 12, consisting of soils least suitable for woodland, is in estimated site quality class C, a poor site for woodland.

In table 31 larches are mentioned as a suitable tree for soils of different suitability groups. These trees should be grown only on moist slopes if the gradient exceeds 30 percent. Plant Austrian pine, jack pine, Scotch pine, redcedar, and black locust for cover on the driest slopes. Austrian pine has not been planted in this locality until recently, and its long-time growth habits and probable yields are not known.

The windthrow hazard is moderate on the soils of group 8 and high on the soils of group 11. Equipment limitations are moderate on soils of group 8 and severe on the poorly drained soils of group 9 and on the steep soils of group 12. The soils of group 9 should be avoided wherever feasible in locating access roads.

Wildlife[5]

The abundance and welfare of wildlife depend primarily on the way different soils of an area are used and on the kind of vegetation. All the soils of Cortland County are suited to use as habitats for wildlife.

Use of the land for wildlife is especially worth the consideration of landowners whose properties include a large acreage of wet or very wet Homer, Kendaia, Red Hook, Birdsall, Wallington, Atherton, Alden, Chippewa, Ellery, Tuller, Holly, Wayland, Papakating, or Sloan soils, as well as Muck and some areas of Alluvial land. The shallow or rocky Arnot, Lordstown, Volusia, and Mardin soils are also favorable for wildlife. Owners of large acreages of these soils should consider developing wildlife preserves and leasing them to hunters.

[5] By PHILIP F. ALLAN, northeast biologist, Soil Conservation Service.

TABLE 31.—*Summary of information*

Woodland suitability group, map symbol, and soil name	Estimated site quality class	Kind of soil material and location	Dominant depth	Dominant drainage class	Range of slope	Average permeability
					Percent	
Group 1	A	High bottoms in valleys; glacial till in valleys and intermediate uplands; post glacial lake deposits; outwash terraces.	Deep	Good	Mostly 0 to 25.	Moderate to rapid.
(CcB) Chagrin silt loam, high bottom, 0 to 4 percent slopes.						
(CfB) Conesus gravelly silt loam, 2 to 8 percent slopes.						
(CfC) Conesus gravelly silt loam, 8 to 15 percent slopes.						
(DaB) Dunkirk silt loam, over gravel, 0 to 4 percent slopes.						
(DaC) Dunkirk silt loam, over gravel, 8 to 20 percent slopes.						
(HdA) Howard gravelly loam, 0 to 3 percent slopes.						
(HdB) Howard gravelly loam, 3 to 8 percent slopes.						
(HdC) Howard gravelly loam, 8 to 15 percent slopes.						
(HdD) Howard gravelly loam, 15 to 25 percent slopes.						
(LbB) Lansing gravelly silt loam, 3 to 8 percent slopes.						
(LbC) Lansing gravelly silt loam, 8 to 15 percent slopes.						
(LbD) Lansing gravelly silt loam, 15 to 25 percent slopes.						
(LbE) Lansing gravelly silt loam, 25 to 35 percent slopes.						
(PbA) Palmyra gravelly silt loam, 0 to 3 percent slopes.						
(PbB) Palmyra gravelly silt loam, 3 to 8 percent slopes.						
(PbC) Palmyra gravelly silt loam, 8 to 15 percent slopes.						
(PbD) Palmyra gravelly silt loam, 15 to 25 percent slopes.						
(PdA) Phelps gravelly silt loam, 0 to 3 percent slopes.						
(VaB) Valois-Howard gravelly loams, 3 to 8 percent slopes.						
(VaC) Valois-Howard gravelly loams, 8 to 15 percent slopes.						
(VaD) Valois-Howard gravelly loams, 15 to 25 percent slopes.						
Group 2	A to B	Alluvial fans and glacial outwash.	Deep	Good	0 to 15	Moderately rapid.
(CaB) Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes.						
(HcA) Howard cobbly loam, 0 to 3 percent slopes.						
(HcB) Howard cobbly loam, 3 to 8 percent slopes.						
(PaA) Palmyra cobbly loam, 0 to 3 percent slopes.						

See footnotes at end of table.

for woodland suitability groups

Reaction	Probable type of forest	Useful trees in order of volume that can be cut	Suitable trees: Hardwoods	Suitable trees: Conifers planted for— Long-term sawtimber	Suitable trees: Conifers planted for— Christmas trees
pH[1] 5.8 to calcareous.	Sugar maple. Beech-sugar maple.	Sugar maple. American beech. Black cherry. White ash. Basswood. Hemlock. White oak. Red oak.	All kinds grown in the county: Black walnut and butternut (especially on moist, well-drained slopes).	White pine. Japanese larch and European larch (on moist slopes only if more than 30 percent gradient). Douglas-fir and balsam fir (only on moist slopes where air drainage is good). Hemlock. Red pine (best above 1,500 feet; do not plant if pH of surface soil is more than 6.5 or if soil at depths of 30 to 40 inches is calcareous). Jack pine. Pitch pine. Scotch pine. Austrian pine. Norway spruce and white spruce (on moist slopes only if more than 30 percent gradient). White-cedar and red-cedar (mostly for cover).	All kinds grown in the area with these limitations: Scotch pine and Austrian pine (use on soils having pH of more than 7.0). Scotch pine, red pine, and Austrian pine (to be planted on southeast-southwest slopes of 25 to 35 percent).
6.2 to calcareous.	Various hardwoods (only a few acres in forest).	Black cherry and basswood in small amounts.	All kinds grown in the county: Black locust (for posts and poles).	All kinds grown in area with these limitations: Red pine (best planted above 1,500 feet; do not plant if the pH of the surface soil is more than 6.5 or if the soil at depths of 30 to 40 inches is calcareous). Douglas-fir and balsam fir (to be planted only on moist slopes where air drainage is good). White-cedar and red-cedar (mostly for cover).	White pine. Scotch pine. Austrian pine.

TABLE 31.—*Summary of information*

Woodland suitability group, map symbol, and soil name	Estimated site quality class	Kind of soil material and location	Dominant depth	Dominant drainage class	Range of slope	Average permeability
					Percent	
Group 3	A to B	High bottoms of valleys	Deep	Good	0 to 4	Moderate
(TdA) Tioga silt loam, high bottom, 0 to 3 percent slopes.						
(UaB) Unadilla silt loam, 0 to 4 percent slopes.						
Group 4	B to A	Outwash terraces and alluvial fans.	Deep	Good	0 to 18	Rapid
(CdA) Chenango gravelly loam, 0 to 3 percent slopes.						
(CdB) Chenango gravelly loam, 3 to 8 percent slopes.						
(CdC) Chenango gravelly loam, 8 to 15 percent slopes.						
(TaB) Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes.						
Group 5	B	Alluvium of low bottoms, flats, and slight depressions.	Deep	Good to moderately good.	0 to 2	Moderate
(CbA) Chagrin silt loam, 0 to 2 percent slopes.						
(LcA) Lobdell silt loam, 0 to 2 percent slopes.						
(MbA) Middlebury silt loam, 0 to 2 percent slopes.						
(TbA) Tioga gravelly loam, 0 to 2 percent slopes.						
(TcA) Tioga silt loam, 0 to 2 percent slopes.						

See footnotes at end of table.

for woodland suitability groups—Continued

Reaction	Probable type of forest	Useful trees in order of volume that can be cut	Suitable trees		
			Hardwoods	Conifers planted for—	
				Long-term sawtimber	Christmas trees
pH[1] 5.0	Little or no forest cover.	Black cherry. Black walnut. Butternut.	All kinds grown in area except black locust.	All kinds grown in area with these limitations: Red pine (best planted above 1,500 feet; do not plant if the pH of the surface soil is more than 6.5 or if the soil at depths of 30 to 40 inches is calcareous). White-cedar and red-cedar (mostly for cover).	Scotch pine. White pine. Red pine. Norway spruce. White spruce. Balsam fir.
4.9	Sugar maple in various amounts.	Sugar maple. Oak. Other trees.	All kinds grow in the area with these limitations: American beech, black walnut, and butternut (should not be grown on Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes).	All kinds grown in the area with these limitations: Red pine (best planted above 1,500 feet; do not plant if the pH of the surface soil is more than 6.5 or if the soil at depths of 30 to 40 inches is calcareous). Douglas-fir and balsam fir (to be planted only on moist slopes where air drainage is good).	Scotch pine. White pine. Red pine. White spruce. Norway spruce.
5.3 to 6.6	Black ash-American elm-red maple (only a few acres in forest).	American elm. Basswood. Swamp white oak. White oak. White-cedar. Sugar maple. Red maple. Basswood and swamp white oak.	American elm. Black ash. Swamp white oak. Black ash.	All kinds grown in the area with these limitations: Red pine (best planted above 1,500 feet; do not plant if the pH of the surface soil is more than 6.5 or if the soil at depths of 30 to 40 inches is calcareous). Douglas-fir and balsam fir (to be planted only on moist slopes where air drainage is good). White-cedar and red-cedar (mostly for cover).	White pine. Scotch pine. Austrian pine Norway spruce. White spruce. Douglas-fir.

TABLE 31.—*Summary of information*

Woodland suitability group, map symbol, and soil name	Estimated site quality class	Kind of soil material and location	Dominant depth	Dominant drainage class	Range of slope	Average permeability
					Percent	
Group 6 [2]	B to A	Firm glacial till (soils with or without a pan); neutral till (soils with a pan); weathered bedrock in upland ridges; glacial till of uplands; slightly firm alluvium.	Deep to moderately deep.	Good	Mostly 0 to 25.	Moderate to slow.
(BbB) Bath-Chenango gravelly loams, 3 to 8 percent slopes.						
(BbC) Bath-Chenango gravelly loams, 8 to 15 percent slopes.						
(BbD) Bath-Chenango gravelly loams, 15 to 25 percent slopes.						
(BaB) Bath channery silt loam, 3 to 8 percent slopes.						
(BaC) Bath channery silt loam, 8 to 15 percent slopes.						
(BaD) Bath channery silt loam, 15 to 25 percent slopes						
(LaB) Langford channery silt loam, 3 to 8 percent slopes.						
(LaC) Langford channery silt loam, 8 to 15 percent slopes.						
(LaD) Langford channery silt loam, 15 to 25 percent slopes.						
(LdB) Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes.						
(LfC) Lordstown channery silt loam, 8 to 15 percent slopes.						
(LfD) Lordstown channery silt loam, 15 to 25 percent slopes.						
(MaB) Mardin channery silt loam, 2 to 8 percent slopes.						
(MaC) Mardin channery silt loam, 8 to 15 percent slopes.						
(MaD) Mardin channery silt loam, 15 to 25 percent slopes.						
(SaB) Scio silt loam, 0 to 4 percent slopes.						
Group 7	B to C	High-lime glacial till of valleys; outwash in valleys; clay deposited in lakes.	Deep	Moderately good to poor.	Mostly 0 to 6.	Moderately to slow.
(HbA) Homer silt loam, 0 to 2 percent slopes.						
(KaB) Kendaia silt loam, 1 to 6 percent slopes.						
(RbB) Rhinebeck silt loam, 3 to 8 percent slopes.						
(RbC) Rhinebeck silt loam, 8 to 15 percent slopes.						
(RbD) Rhinebeck silt loam, 15 to 25 percent slopes.						
Group 8 [3]	C and C to B	Upland till and rock material; upland till (soils with a pan); glacial till or fractured rock; extensive areas of firm till in the uplands.	Shallow to moderately deep	Somewhat poor.	2 to 8	Moderately slow to slow.
(AcB) Arnot channery silt loam, 2 to 8 percent slopes.						
(EbB) Erie channery silt loam, 2 to 8 percent slopes.						
(EbC) Erie channery silt loam, 8 to 15 percent slopes.						
(TeB) Tuller channery silt loam, 2 to 8 percent slopes.						
(VbB) Volusia channery silt loam, 2 to 8 percent slopes.						
(VbC) Volusia channery silt loam, 8 to 15 percent slopes.						
(VbD) Volusia channery silt loam, 15 to 25 percent slopes.						
(VbD3) Volusia channery silt loam, 15 to 25 percent slopes, eroded.						

See footnotes at end of table.

for woodland suitability groups—Continued

Reaction	Probable type of forest	Useful trees in order of volume that can be cut	Suitable trees		
			Hardwoods	Conifers planted for—	
				Long-term sawtimber	Christmas trees
pH[1] 5.1 to 6.5	Sugar maple. Beech-sugar maple. Hemlock. Northern red oak-basswood-white ash.	Sugar maple. American beech. Black cherry. Red oak. White ash. Basswood. Red maple. Elm. Hemlock. White pine.	Red oak. White oak. Chestnut oak. Pin oak. Sugar maple (plant with caution); American beech, hickory, and black locust (plant with caution on Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes, and on Lordstown channery silt loams on slopes of 8 to 15 percent and 15 to 25 percent).	Pitch pine. Scotch pine. White pine. Red pine. European larch, Japanese larch, Norway spruce, and white spruce (to be planted with caution).	Scotch pine. White pine. Austrian pine. Norway spruce. White spruce. Douglas-fir (on Lordstown channery silt loams on slopes of 2 to 8 percent and 8 to 15 percent). Red pine (on Lordstown channery silt loam, 15 to 25 percent slopes).
7.5 to calcareous.	Black ash-American elm-red maple. Some beech-sugar maple.	Elm. Basswood. Black cherry. Sugar maple. Hemlock. Red maple. White pine. White-cedar. Black ash and aspen.	Black ash. American elm. Swamp white oak. Red maple. Silver maple. Yellow birch. Gray birch. Hybrid poplar. White oak. White-cedar Honeylocust (on Rhinebeck soils).	Japanese larch. European larch. White spruce. Norway spruce. Scotch pine. White pine. White-cedar. Austrian pine. Hemlock.	White pine. Scotch pine. White spruce. Norway spruce. Balsam fir.
5.0 to 7.0 at depths of 16 to 20 inches.	Beech-sugar maple. Hemlock.	Sugar maple. American beech. Hemlock. White pine. White ash. Black cherry. Basswood. Aspen. Yellow birch. Black birch.	Red maple. Sugar maple. Yellow birch. Aspen. American beech. White ash. Hickory.	White pine. Scotch pine. Norway spruce. White spruce. Japanese larch. European larch. Austrian pine. Jack pine.	Scotch pine. Austrian pine. Norway spruce. White spruce. White pine. Red pine (best on Arnot soil). Douglas-fir and balsam fir (doubtful on Tuller and Volusia soils).

TABLE 31.—*Summary of information*

Woodland suitability group, map symbol, and soil name	Estimated site quality class	Kind of soil material and location	Dominant depth	Dominant drainage class	Range of slope	Average permeability
Group 9	C to B and C.	Upland till (consisting mostly of channery fragments); low areas in valleys.	Deep	Poor	0 to 3	Moderate to slow.
(EaA) Ellery channery silt loam, 0 to 3 percent slopes.						
(EaB) Ellery channery silt loam, 3 to 8 percent slopes.						
(HaA) Holly silt loam, 0 to 1 percent slopes.						
(RaA) Red Hook silt loam, 0 to 3 percent slopes.						
(WaA) Wallington silt loam, over gravel, 0 to 3 percent slopes.						
(WbA) Wayland silt loam, 0 to 1 percent slopes.						
Group 10	C	Upland depressions; drainageways on valley flats and basins.	Deep	Very poor	0 to 3	Moderate
(AaA) Alden and Birdsall silt loams, 0 to 3 percent slopes.						
(Ab) Alluvial land.						
(AdA) Atherton silt loam, 0 to 3 percent slopes.						
(BdA) Birdsall silt loam, over gravel, 0 to 1 percent slopes.						
(PcA) Papakating silt loam, 0 to 1 percent slopes.						
(SbA) Sloan silt loam, 0 to 1 percent slopes.						
(CeA) Chippewa channery silt loam, 0 to 3 percent slopes.						
(CeB) Chippewa channery silt loam, 3 to 8 percent slopes.						
(Mc) Muck.						
Group 11	C to B and C.	Highest ridges in uplands; firm till of the uplands.	Shallow to deep.	Moderately good.	2 to 15	Rapid to slow.
(LeB) Lordstown channery silt loam, shallow, 2 to 8 percent slopes.						
(MaC3) Mardin channery silt loam, 8 to 15 percent slopes, eroded.						
(VbB3) Volusia channery silt loam, 2 to 8 percent slopes, eroded.						
(VbC3) Volusia channery silt loam, 8 to 15 percent slopes, eroded.						
Group 12 [4]	C	Glacial till and outwash on narrow, very steep valley walls.	Shallow to deep.	Moderately good to good.	Mostly 25 to 40.	Rapid to slow.
(BbE) Bath-Chenango gravelly loams, 25 to 40 percent slopes.						
(BcE) Bath and Mardin soils, 25 to 40 percent slopes.						
(LgE) Lordstown soils, 25 to 55 percent slopes.						
(VaE) Valois and Howard gravelly loams, 25 to 40 percent slopes.						

[1] Unless otherwise specified, pH taken at a depth of 30 inches.

[2] See the section, Descriptions of Soil Series and Mapping Units, for names of soils included within individual mapping units of group 6.

[3] Large wooded areas (more than 50 acres in size) of these mapping units include mixtures of Lansing gravelly silt loam, 15 to 25 percent slopes, and Arnot channery silt loam, 2 to 8 percent slopes; they also include some acreage of Mardin channery silt loam, 2 to 8 percent slopes; Mardin channery silt loam, 8 to 15 percent slopes;

for woodland suitability groups

Reaction	Probable type of forest	Useful trees in order of volume that can be cut	Suitable trees		
			Hardwoods	Conifers planted for—	
				Long-term sawtimber	Christmas trees
5.0 to calcareous.	Black ash-American elm-red maple.	American elm. Basswood. Red maple. Silver maple. White-cedar. Black ash. Swamp white oak. White pine. Sugar maple. Hemlock. Yellow birch.	Sugar maple. Hybrid poplar. Willow. Red oak.	White pine. Norway spruce. White spruce. European larch. Japanese larch. Pitch pine. White-cedar (if the pH of the surface soil is between 6.0 and 7.0).	White pine. Norway spruce. White spruce. European larch. Japanese larch. Pitch pine. White-cedar (if the pH of the surface soil is between 6.0 and 7.0).
5.0 to calcareous.	Black ash-American elm-red maple.	American elm. Red maple. Black ash. White pine. White-cedar.	American elm. Red maple. Swamp white oak. Willow.	White pine. White-cedar (if the pH of of the surface soil is between 6.0 and 7.0).	White pine. White-cedar (if the pH of the surface soil is between 6.0 and 7.0).
5.0 to 5.8 at depths of 20 inches.	Northern red oak-basswood-white ash. Hemlock.	Basswood. White ash. White oak. Black oak. Red oak. Red maple. Hemlock. Sugar maple. Hickory. American beech. White pine. Black cherry.	Oak. Maple. American beech and hickory (suitable in places).	White pine. Red pine. Pitch pine. Jack pine. Scotch pine. Austrian pine. Redcedar. Douglas-fir (on moist slopes where air drainage is good). European larch (on Lordstown soil). Norway spruce and white spruce (on Mardin and Volusia soils).	Scotch pine. Pitch pine. White pine. Red pine, Austrian pine, and Douglas-fir (on Lordstown soil). Douglas-fir (only on moist slopes where air drainage is good). Norway spruce, white spruce, and balsam fir (on Mardin and Volusia soils).
5.0 to 7.0	Northern red oak-basswood-white ash. Hemlock. Beech-sugar maple.	Oak. White pine. Red maple. White ash. Hemlock. Sugar maple. American beech. Basswood. Black cherry. Hickory.	Sugar maple, hybrid poplar, black locust (on Bath-Chenango gravelly loams, 25 to 40 percent slopes, and Valois and Howard gravelly loams, 25 to 40 percent slopes). Red oak (on other soils of this group).	Redcedar. Pine. European larch. Douglas-fir (on moist slopes where air drainage is good). White-cedar (if the pH of the surface soil is between 6.0 and 7.0).	Pine. Douglas-fir (only on moist slopes where air drainage is good).

Chippewa channery silt loam, 0 to 3 percent slopes; and Chippewa channery silt loam, 3 to 8 percent slopes.

[4] A considerable acreage of these soils is wooded; large wooded areas of Bath-Chenango gravelly loams, 25 to 40 percent slopes, may include the following soils: Bath and Mardin soils, 25 to 40 percent slopes; Arnot channery silt loam, 2 to 8 percent slopes; Volusia channery silt loam, 8 to 15 percent slopes; and Lordstown soils, 25 to 55 percent slopes.

The principal kinds of game in the county are the ring-necked pheasant, ruffed grouse, woodcock, various kinds of waterfowl, cottontail rabbit, white-tailed deer, and gray squirrel. The hunting of rabbits, pheasants, and deer is especially popular in this county.

A number of practices used to conserve soil and water contribute to the welfare of wildlife. Winter cover is needed on the better farmland that consists mainly of Bath, Mardin, Valois, Langford, Lordstown, Lansing, Conesus, Chenango, Howard, Palmyra, Phelps, Unadilla, Tioga, Chagrin, Middlebury, and Lobdell soils. This can be furnished by hedgerows that develop naturally or that are planted across the slope.

Cultivated fields and meadows are habitats of the ring-necked pheasant, which needs shelter in winter. Winter cover and supplemental food for pheasants can be provided on small areas of Arnot, Tuller, Volusia, and Erie soils that are inaccessible for farming. Small, wet spots of Chippewa, Alden, Ellery, Homer, Red Hook, Atherton, Birdsall, Wallington, Holly, Wayland, Papakating, and Sloan soils that are intermingled with cultivated soils can also be used for that purpose. Well-managed pastures and woodlands usually provide little winter food and shelter for wildlife. Living fences and plantings around ponds where stock is watered will provide food and shelter in the pastures and will attract cottontail rabbits and pheasants. Borders, established back into the edge of the woodlands or planted in the poor crop zone that commonly lies next to the woods, meet the needs of wildlife and provide more efficient use of the poor cropland. Ruffed grouse, rabbits, and deer find these borders attractive.

A number of trees and shrubs are being planted for wildlife habitats in Cortland County. Plantings can be made on almost all of the soils, except those that are very wet or very dry. Natural vegetation valuable to wildlife can be developed on all the soils. Information about the management of native plants can be obtained from an agricultural technician of the State or Federal Government.

Fishing provides another source of recreation in this county. Many farm ponds are stocked with fish. In managed ponds at higher elevations and in other places where the water is cool, brook trout is the principal kind of fish. Largemouthed bass and bluegill sunfish are common in warmer waters. The production of bait fish is profitable in wet areas that are suitable for impounding water.

Furbearers once provided an important source of income, but they are no longer of great economic value. Nevertheless, with the spread of city people to rural areas, often only for the pleasures of country life, the furbearers and other nongame species contribute to the enjoyment of rural living.

Formation and Classification of Soils

This section contains information about how the soils were formed, about some characteristics that are common to several soils and thus give a basis for grouping them, and about how the soil series are classified into broader and more inclusive classes.

Soil is the natural material at the surface of the earth, in which plants grow, that is composed of mineral and organic materials and living forms. One kind of soil has characteristics that make it different from other kinds of soil. A body of one kind of soil, as a rule, has irregular length and breadth and characteristic shape and thickness. It is bounded on its edges by other soils, land types, or bodies of water. Its upper surface is in contact with the atmosphere, and it rests on rock material of one kind or another.

Nearly all soils consist of layers, called horizons, that have been formed by processes of soil formation at or near the surface. These layers, to the depth that the soil has been influenced by soil-forming processes, are collectively called the soil profile. The five major soil-forming factors are parent material, climate, living organisms, relief of the land surface, and time. The soil at any given point is the result of the combined influence of these five factors.

Soil-Forming Factors

Parent material

All of Cortland County has been covered by glaciers, and rock materials from which the soils were formed have been moved about somewhat by ice or by water. The rock materials came chiefly from acid sandstone, siltstone, or coarse-grained shale. In a few places some limestone was also present. Because lime has a great effect on soil-forming processes, we can classify the rock materials loosely into those that contained a considerable amount of lime and those that contained little or no lime. These are sometimes called high-lime and low-lime parent materials.

Transported rock materials are also classified according to the way they were laid down and the degree to which they were sorted. Glacial till is an unsorted mass of soil material and rock fragments left by melting ice. Glacial outwash is material that was carried by water flowing from a melting glacier and laid down in the form of a plain, delta, kame, or other feature. Outwash deposits generally are stratified as a result of sorting and of deposition at different times by the flowing water. Where bodies of water were impounded for some time, stratified deposits of clay and silt settled out from them. These are called lacustrine deposits. In the valleys there are also alluvial deposits that were laid down by streams since the last glacial period.

Thus, the soil materials consist of glacial till from various rocks, some that had a high content of lime and some that were low in lime; outwash, some high and some low in lime; lacustrine silts and clays; old alluvium; and recent alluvium. There is also in the county some muck, which contains more plant remains than any of the mineral soils.

Climate

The climate of Cortland County is cool and temperate. Average annual precipitation is 39.8 inches at Cortland and 40.6 inches at nearby De Ruyter in Madison County. More than three-fourths of the precipitation falls during the growing season. Other climatic data are given in the section, General Information About the County. Temperature and precipitation have had a great influence on the soils that were formed in different places from different materials. They influence directly the rate and kind of weathering and of leaching that help to produce soils, and they affect soils indirectly by their influence on plant and animal life.

Living organisms

The native vegetation in the county was forest. Hard maples were the dominant trees; in some places considerable numbers of yellow birch, white pine, and hemlock trees were also present. Most of these trees contain in their leaves and twigs some lime and other bases that come from the soil. Because of the leaching, however, nearly all of the bases obtained from the decomposed leaves and twigs are leached out of the soil; as a result, most soils developed under these conditions eventually tend to become strongly to very strongly acid. Vegetation furnishes organic material, which living organisms, such as bacteria and fungi, break down into simpler compounds. Small animals, insects, worms, and roots may make the soil more permeable to water by making channels in it. The animals also cause mixing of the soil materials.

Time

Because the processes of soil formation take place slowly, a long time is needed to form most of the soils that have distinctive characteristics. Most of the soil materials in the county are glacial drift and outwash left by the latest glaciers or by water that flowed away as the glaciers melted, and thus were laid down at about the same time. Alluvial materials are more recent, and soils in the most recent alluvium are not likely to have strongly developed horizons.

Relief

The shape of the land surface, slope, and position with reference to the water table have had a great influence on soils of the county. Because climate and vegetation are fairly uniform throughout the county and most of the soil materials have been exposed to soil-forming processes for about the same length of time, local differences in soils are largely the results of differences in parent material and relief. Important differences between soils in this county and those of other regions, however, are the results of differences in climate and vegetation.

Great Soil Groups

The soil series and mapping units in Cortland County are described in the section, Descriptions of Soil Series and Mapping Units. A soil series is a group of soils that have similar profiles and that came from similar parent materials; they can differ in texture of the surface soil and in some of the external features, such as slope and stoniness. Each soil series is given a name derived from the place where it was first identified and described.

Soil series are classified at a higher level in great soil groups. Each great soil group consists of a large number of soils that have several internal features in common. The soils in a great soil group have the same number and kinds of definitive horizons in their profiles, although the horizons need not be of the same thickness nor expressed to the same degree.

Most of the mineral soils of Cortland County can be placed definitely in one or another of five great soil groups. A few have characteristics of more than one group and are classed as intergrades. Organic soils, which occupy only 1,442 acres in this county, are members of a great soil group known as Bog soils.

Brief descriptions of the great soil groups in which mineral soils of the county are classified will be given next. A few series are mentioned as representatives of each great soil group. The complete classification of soil series in the county is given later, however, after some discussion of soil drainage classes, formation of fragipans, the influence of parent material, and the influence on the soils of different combinations of these factors.

Gray-Brown Podzolic soils have thin layers of leaf litter and mild humus on their surface in the virgin state; a thin, dark A_1 horizon; a lighter colored, leached A_2 horizon; and a B horizon that contains more clay and has blocky or subangular blocky structure. The A and B horizons are acid in reaction unless the surface soil has been limed. The B horizon is more or less mottled if the soil is moderately well drained or somewhat poorly drained. Palmyra soils and Conesus soils are examples of Gray-Brown Podzolic soils. This great soil group is not nearly so extensive in the county as the one described next, but, because it was recognized first and the soils have strongly expressed horizons, it affords a good beginning in explaining the subject.

Sols Bruns Acides are more acid and have a much less distinct B horizon than the Gray-Brown Podzolic soils. The B horizon contains little or no more clay than the A_2 horizon, and there is little other evidence that clay has accumulated. Some soils considered to be members of this great soil group contain a fragipan in the lower B horizon; if a fragipan is present, it is likely to contain more clay than the horizons above. Bath, Lordstown, Chenango, Mardin, Volusia, Erie, and several other soil series of the county are classified as Sols Bruns Acides. The name came from Belgium and was first applied to soils in the United States in about 1953.

Alluvial soils consist of geologically recent alluvium and do not have evident horizons in their profile. In most places the surface soil has gained some organic matter. The alluvium, as a rule, is stratified. Chagrin soils and Lobdell soils are examples of the great group of Alluvial soils in this county.

Soils on alluvial sediments that have a dark-colored A horizon produced by organic matter from swamp vegetation are classified in one of the next two groups described, rather than in the Alluvial great soil group.

Humic Gley soils have a thick, black or nearly black A horizon over a gray or mottled B or C horizon. They are poorly or very poorly drained and were formed under vegetation that is characteristic of wet land. Examples in Cortland County are the Alden, Birdsall, and Sloan soils.

Low-Humic Gley soils have a thinner A horizon than the Humic Gley soils, but are very similar deeper in the profile. Examples of this great soil group in Cortland County are the Chippewa, Homer, and Wayland soils.

Soil Drainage Classes

Water takes a great part in the processes of soil formation. The amounts of water that reach a soil, percolate through it, and remain in it depend on climate, permeability of the soil and materials under it, position in the landscape, and the depth to ground water or to a perched water table.

Soils that have formed from similar parent materials under different degrees of natural drainage and, hence, under different moisture regimes make up what is called in the United States a soil catena. Ordinarily, at least 5 and in some places 6 or 7 classes of natural drainage can be distinguished. (See figure 11 in the section, Use and Management of Soils.)

Excessively drained soils are free from mottling throughout their profile and, as a rule, allow water to percolate rapidly and have low moisture-holding capacity. No soil in the county has been described as excessively drained, although the characteristics of gravelly Chenango and Howard soils would approach those of this drainage class. Another class, somewhat excessively drained, also has been described elsewhere but has not been applied to any soil in this county.

Well-drained soils are likely to be mottled in the C horizon or below a depth of several feet. The profile does not contain any evidence, however, that the soil is wet for long periods of the year. Bright, uniform colors in the A and B horizons are characteristic. Medium textures, or fine textures and good structure, are common in the B horizon. The moisture-holding capacity is likely to be greater than in excessively drained soils.

Moderately well drained soils are characterized by mottling in the lower B horizon. The mottling is evidence that this part of the profile is wet for a small but significant part of the time. Moderately well drained soils commonly have a slowly permeable layer within or immediately beneath the solum, a high water table part of the time, additions of water through seepage, or some combination of these conditions.

Somewhat poorly drained soils are generally grayish, brownish, or yellowish in the upper A horizon and commonly have mottlings below depths of 6 to 16 inches in the lower A and in the B and C horizons. The soil is wet for significant periods, but not all the time, and growth of crops is restricted to a marked degree unless artificial drainage is provided. Soils of this drainage class that formed from a given kind of parent material are likely to belong to the same great soil group as the well-drained and the moderately well drained soils; those of the wetter classes take on characteristics of wet soils—characteristics ordinarily overshadow the influence of parent material.

Poorly drained soils are gray from the surface downward as a result of wetness. Some are mottled but many are not. In most years the large amount of water that remains in and on the soil prevents growing of the usual crops without artificial drainage.

Very poorly drained soils have water at or on the surface most of the time and generally have a deep, black or nearly black A horizon. Most of them occupy level or depressed sites and are frequently ponded. Some have a mucky surface soil, and many have distinct evidence of gleying (gray color that is caused by compounds of reduced iron).

Characteristics that distinguish soils of the five drainage classes in this part of New York State, and some further notes about the influence of a fragipan, are summarized in table 32.

TABLE 32.—*Some prominent profile characteristics associated with soils in each class of drainage*

[The typical well-drained profile, described in the column on the left, extends to a depth of about 42 inches; depth in inches to the upper boundary of each horizon is indicated by figures in parentheses. The depth of aeration and the normal root zone (without artificial drainage) decreases from left to right]

Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
(0) Grayish brown to dark yellowish brown.	Dark grayish brown.	Dark grayish brown.	Dark-gray mottling from surface downward. Surface of peds is light gray to grayish brown.	Very dark gray to black surface soil.
(9) Yellowish brown	Faint mottling in lower part of B horizon.	Prominent mottling just below the surface soil.	Fragipan, if present, at depths of 8 to 10 inches.	Gray peds. Mottling likely to be absent; if present, mottles are few, large, and grayish brown.
(18) Pale brown or brown	Fragipan, if present, begins at depths of 14 to 18 inches.	Fragipan, if present, begins at depths of 10 to 14 inches.		
(24) Faint mottlings if fragipan is present. Fragipan, if present, normally begins at depths of 22 to 28 inches.				

Fragipan Horizons

Many soils that are medium textured and acid contain a horizon called fragipan—one that is compact, generally contains a high proportion of silt or fine sand (or both), is hard when dry, and softens when moistened but remains firm. The fragipan is brittle when either dry or moist; that is, it sustains pressure without breaking until a critical pressure is reached, and then it shatters. In many soils the fragipan consists of large polygonal prisms that are separated by thin coatings of gray silty material; and it is overlain by a gray, silty layer that appears to have many of the characteristics of an A_2 horizon. In many soils that contain fragipan, the fragipan and its overlying gray layer appear to be related horizons. The gray layer has some characteristics of an A_2 horizon, even though it lies under a different A horizon, or in some soils under an upper sequence of an A horizon at the surface and a related B horizon just under it. Each sequence of related horizons is called a sequm, and a soil that contains two of them is called a bisequal soil.

Fragipan is prominent in the profiles of the Volusia and Mardin soils of the county and has been described in several other soils. None has been observed, however, in any of the Gray-Brown Podzolic soils.

The relationship of fragipan to other horizons in Mardin, Volusia, and Chippewa soils is shown by the diagram in figure 12. Horizons of the lower sequm in the profile are shown by the symbols A′ (A prime) and B′ (B prime).

Catenas and Great Soil Groups in the County

Soil series of the county are listed by catenas and great soil groups in table 33.

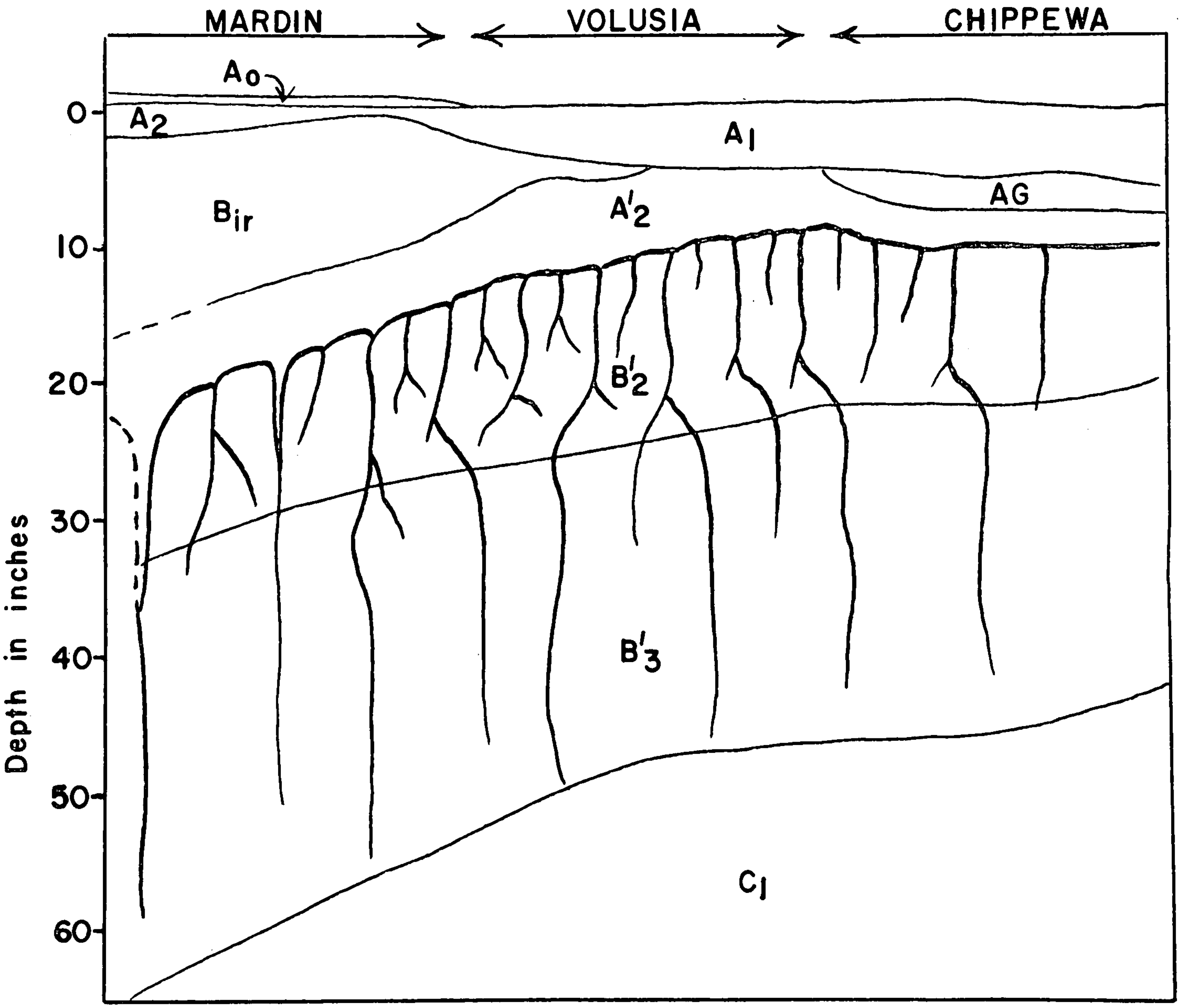

Figure 12.—Schematic diagram showing sequence of horizons in three soils that have fragipan. Vertical branching lines, superimposed on B'_2 and B'_3 horizons, indicate location of polygonal prisms in the fragipan and the intensity with which the fragipan is impressed on the profile.

Table 33.—*Key to the soils*

Parent material	SOLS BRUNS ACIDES (Yellowish-brown, very weak, subangular blocks in a B_{ir} horizon) and GLEYED SOILS (very wet)				
	Sols Bruns Acides			Low-Humic Gley Soils [1]	Humic Gley Soils [1]
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Material predominantly from sandstone, siltstone, and shale—					
Glacial till:					
Strongly acid soils with fragipan	Bath	Mardin	Volusia	Chippewa	Alden.
Moderately acid to strongly acid soils with fragipan.	Valois	Langford	Erie	Ellery	
Strongly acid, shallow to moderately deep soils.	Lordstown	Arnot [2]		Tuller [2]	
Outwash:					
Strongly acid soils	Chenango			Red Hook [2, 3]	Atherton.
Old alluvium:					
Strongly acid soils	Unadilla	Scio [2, 3]			
	GRAY-BROWN PODZOLIC SOILS (clayey B horizons) and GLEYED SOILS (wet)				
	Gray-Brown Podzolic Soils			Low-Humic Gley Soils	Humic Gley Soils
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Material predominantly from sandstone, siltstone, shale, and limestone—					
Outwash high in lime	Palmyra	Phelps [2]		Homer [2]	
Till high in lime		Conesus	Kendaia [4]		
Acid lacustrine silts over gravel	Dunkirk			Wallington [2]	Birdsall.
Clays high in lime		Rhinebeck [2]			
	GRAY-BROWN PODZOLIC-SOLS BRUNS ACIDES INTERGRADES (Bisequal profile: the upper part is yellowish-brown, and the lower part has clayey horizons)				
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Material predominantly from sandstone, siltstone, and shale—					
Glacial till:					
Moderately acid soil	Lansing				
Outwash:					
Moderately acid soil	Howard				
	ALLUVIAL SOILS (weak horizons) and ASSOCIATED GLEYED SOILS (wet)				
	Alluvial soils			Low-Humic Gley soils	Humic Gley soils
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Material predominantly from sandstone, siltstone, shale, and limstone—					
Recent alluvium:					
Mainly moderately acid soils	Chagrin	Lobdell [2]		Wayland [2]	Sloan.
Strongly acid soils	Tioga	Middlebury [2]		Holly [1, 2]	Papakating.[1]

See footnotes at end of table.

TABLE 33.—*Key to the soils*—Continued

Parent material	BOG (ORGANIC) SOILS				
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
Predominantly from woody peat and the remains of sedges and deciduous trees.	----------	----------	----------	----------	Muck.

[1] These soils are less leached and less acid than better drained soils ln the same catena.
[2] Includes some areas of somewhat poorly drained soils.
[3] Soils appear to have weakly expressed fragipan.
[4] Includes some areas of poorly drained soils.

Each catena contains soils that developed from one kind of parent material. Most catenas, if they are complete, contain soils of three great soil groups. The well drained, moderately well drained, and somewhat poorly drained soils of each catena fall in a great soil group of zonal soils; that is, soils that reflect the influence of factors (climate and living organisms) that operate rather uniformly over a broad zone. The poorly drained soils belong to the Low-Humic Gley group, and the very poorly drained soils, to the Humic Gley group. These two groups contain intrazonal soils, which reflect the dominating influence of some local factor, such as relief or parent material. Soils of these two intrazonal groups have developed in areas that are wet because of the local relief.

Soils on material that is medium to high in lime lie mostly in the valleys near and north of Cortland and near Cuyler and Scott. The Palmyra soils have parent material with the highest content of lime. The Howard soils and Lansing soils have formed on material with a medium content of lime. Their profiles have some features of Gray-Brown Podzolic soils and some of Sols Bruns Acides. Some features of these two great soil groups and intergrades between them are shown by the diagram in figure 13. The Bath, Lordstown, Chenango, Mardin, Volusia, and several other soils of the uplands are Sols Bruns Acides, as listed in table 33.

Sols Bruns Acides make up the most extensive great soil group in the county. These soils in New York State were for some time classified as weak Podzols, Brown Podzolic soils, or Acid Brown Earths. Work published by Baur and Lyford in 1957 (*2*), however, showed them to be nearly identical with the soils called Sols Bruns Acides by scientists in Belgium.

Analytical data for two soils of the Sols Bruns Acides group are given in table 34. These soils were observed in Tioga County, which adjoins Cortland County on the south.

The percentage of clay less than 2 microns in diameter in the B_2 horizon, excluding fragipan horizons, is approximately the same as in the A_2 horizon. In no case does the clay in the B_1 horizon exceed that in the A_2 by more than 1.4 percent. The percentage of free iron oxides remains about the same in the A_2 and B_2 horizons. Organic carbon is high in the A_1 horizon of the Mardin soil, but it decreases sharply in the A_2 and generally decreases successively in each lower horizon of both soils. All of the A and B_2 horizons are strongly to very strongly acid and low in base status.

TABLE 34.—*Physical and chemical data for profiles of Lordstown and Mardin soils, examples of Sols Bruns Acides* (*2*)

Soil type and location	Horizon	Depth	Silt 0.05–0.002 mm.	Clay <0.002 mm.	Free iron oxides	Organic carbon	pH	Base saturation
		Inches	*Percent*	*Percent*	*Percent*	*Percent*		*Percen*
Lordstown channery silt loam, Tioga County, N.Y.	A_p	0–8	56. 0	13. 4	1. 44	2. 64	4. 8	12
	A_2	8–12	57. 2	12. 2	1. 20	. 49	5. 1	14
	B_1(or B_2)	12–22	58. 6	13. 6	1. 44	. 33	5. 2	15
	B_{21}(or B_3)	22–48	54. 1	9. 6	1. 04	. 16	5. 2	20
	B_{22}(or C_1)	48–72	54. 4	8. 8	1. 20	. 03	5. 2	38
	C	72–84	48. 4	7. 8	1. 20	. 14	5. 3	44
Mardin channery silt loam, Tioga County, N.Y.	A_1	0–4	65. 0	23. 4	1. 60	7. 30	4. 9	23
	A_2	4–6	66. 9	21. 9	1. 92	1. 19	4. 8	12
	B_1	6–10	64. 1	22. 6	1. 84	. 63	4. 7	14
	B_{21}	10–16	63. 1	20. 5	1. 60	. 46	4. 7	17
	B_{22}(m$_3$) [1]	16–24	55. 3	25. 9	1. 84	. 16	4. 8	18
	B_2(3m) [1]	24–48	53. 3	26. 9	1. 84	. 15	5. 2	39
	B_2(4m) [1]	48–54	54. 1	27. 2	2. 00	. 24	5. 7	52

[1] The letter "m" indicates a fragipan horizon.

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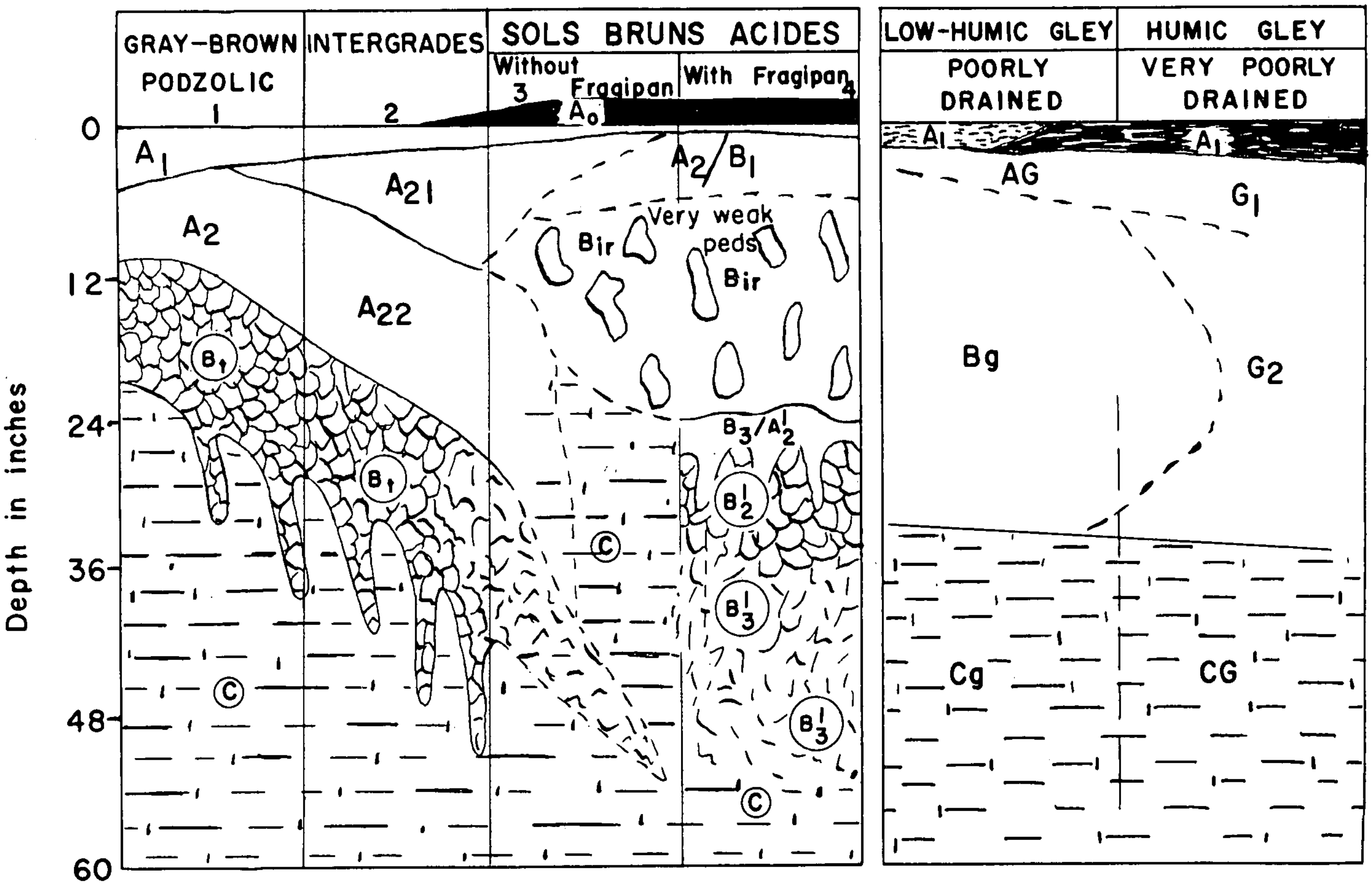

Figure 13.—Left-hand diagram—schematic drawing showing horizon relationships between Gray-Brown Podzolic soils and Sols Bruns Acides and intergrades between them. Right-hand diagram shows horizon relationship between Low-Humic Gley and Humic Gley soils.

The Gray-Brown Podzolic soils are leached of lime to a depth of 20 to 30 inches below the surface. The upper part of the profile, however, is only slightly acid. Here, the A_2 horizon is leached and grayish brown. Between this leached horizon and the high-lime parent material is a clayey B_{2t} horizon. This horizon causes soils developed in gravelly outwash deposits to hold more water in the profile for plant use. The clayey horizon is one of the major differences between these soils and the Sols Bruns Acides.

Formed in medium-lime parent material, the Howard and Lansing soils are more deeply leached of lime than soils formed in high-lime material, and depth to the clayey horizon is greater. Column 2, in figure 13, shows the kind of profile that these soils have. The leached horizon is thicker than in the Gray-Brown Podzolic soils, and it is strongly to very strongly acid. This horizon consists of two subhorizons; the upper one (A_{21}) is more nearly yellowish brown in color than the lower one (A_{22}). The yellowish-brown color of the A_{21} is due to the iron compounds that coat the soil particles.

Just below this leached horizon in these intergrade soils, there is a horizon of clay accumulation, B_t, like the one in the soils formed from high-lime material. This clayey horizon appears to have more clay in the lower part, just above the parent material, than in the upper part, just under the A_{22} horizon. The upper part of this horizon appears to be losing clay; the center parts of the peds contain more clay than the outer parts. Cline (*3*) has suggested that while this horizon is being destroyed by loss of clay, another kind of solum is forming within soil material that was formerly the A_2 horizon and B horizon of a Gray-Brown Podzolic soil. For these reasons, these soils are considered to be intergrades between Gray-Brown Podzolic soils and the Sols Bruns Acides.

Near Virgil and Harford and west of Cortland, there are parent materials that have a content of lime intermediate between that of the most acid material in the uplands and the medium-lime materials from which the Howard and Lansing soils have formed. Soils here have profiles free from lime to a depth of 5 or 6 feet beneath the surface. The most acid materials, in most places, do not have free lime closer than 6 or 7 feet below the surface. The profiles have horizons like those in column 3 in figure 13.

In these leached soils the upper part of the profile is strongly to very strongly acid. In a forest dominated by maples, the soil commonly has a very thin A_0 horizon that consists mostly of partly decayed leaves and twigs. The A_1 horizon is dark grayish brown. In some places it is 1 or 2 inches thick. Under it is a horizon, A_2 or B_1, that is 6 to 8 inches thick and a little paler than the next horizon below, which is light yellowish brown and very strongly acid. In plowed fields these horizons generally have been mixed; in some places an inch or two of the light yellowish-brown horizon remains beneath the plowed surface soil.

In forests of white pine and hemlock, the A_0 horizon is thicker than it is under maple trees. There is a thin, highly leached bleicherde instead of the dark grayish-brown A_1 horizon; it appears that under maples a micro-Podzol is developing in the horizon described as A_2 or B_1. The next lower horizon (B_{1r}) is very strongly acid and has very weak, subangular blocky and weak, fine, crumb structure.

Most of the well-drained soils in these deeply leached materials have a fragipan horizon. The fragipan is not so well expressed as that in the profile of the moderately well drained soils.

In soils from parent materials containing some lime, the fragipan commonly is about 24 inches beneath the surface. Acidity is less at greater depths, and the soil at depths of 36 to 45 inches is neutral. In the lowest, least acid part of the fragipan, clayflows are visible on the faces of peds and within them. Beneath the fragipan the soil material is generally neutral or slightly calcareous. The Valois soils have a profile with this kind of fragipan.

A fragipan in a highly acid soil contains less clay, has less clay on the faces of peds, and is more acid than the fragipan just described. Even the most acid pans, however, decrease in acidity with depth; but most of them are acid to a depth of at least 6 feet. The Bath soils have an acid fragipan like the one just described.

As a rule, well-drained soils that are classified as Sols Bruns Acides do not have a strongly expressed A'_2 horizon. The Bath soils, for example, appear to have a B_3 horizon rather than a horizon like the one in the Mardin and Volusia soils that is usually called the A'_2.

The poorly drained member of every catena of soils in the county belongs to the great group of Low-Humic Gley soils. These soils occupy areas where water accumulates in depressions, along drainageways, and at the bottom of steep slopes.

Horizons that are typical in Low-Humic Gley soils are shown in figure 13. The surface soil contains enough organic matter to make it very dark gray or nearly black. The next horizon, which is a few inches thick, is gray or dark gray and mottled. It is generally called an AG horizon. The B horizon (B_{2g}) is mottled, and the surfaces of the peds are gray. The C_g horizon is mottled gray.

Humic Gley soils are very poorly drained and have a thick, black surface soil that is peaty in some places. The subsurface soil and subsoil are gray, strongly gleyed horizons, designated in figure 13 by G_1 and G_2.

Representative profiles of the soils formed in recent alluvium are diagrammed in figure 14.

The chief differences among soils formed in recent alluvium are those caused by differences in internal drainage, although the soils also differ somewhat in lime content and, hence, in degree of acidity.

Well-drained soils in alluvial sediments are on landforms where the water table seldom is closer than 30 inches below the surface of the soil. These areas are slightly higher than the adjacent land, and, as a rule, they are near and parallel to a stream. Along a large stream they are the natural levees. The Chagrin and Tioga soils are well drained and have the characteristics suggested in the first column on the left side of figure 14.

The moderately well drained soils in alluvial sediments lie 10 to 12 inches lower than the well drained soils. The water table in winter and spring is near the surface, and the soil remains wet long enough to cause mottling from a depth of about 16 inches downward. The Middlebury soils and the Lobdell soils have these characteristics. Soils on alluvium in slightly lower places are somewhat poorly drained, and mottling in them begins 10 to 12 inches beneath the surface. They are also classified in the Middlebury or Lobdell series.

Soils in alluvial sediments that are well drained, moderately well drained, or somewhat poorly drained do not have B horizons. The darkened A_1 horizon rests on the C horizon, which is essentially unaltered alluvium. They are young soils in which little development of horizons has taken place, and they are classified in the great soil group of Alluvial soils.

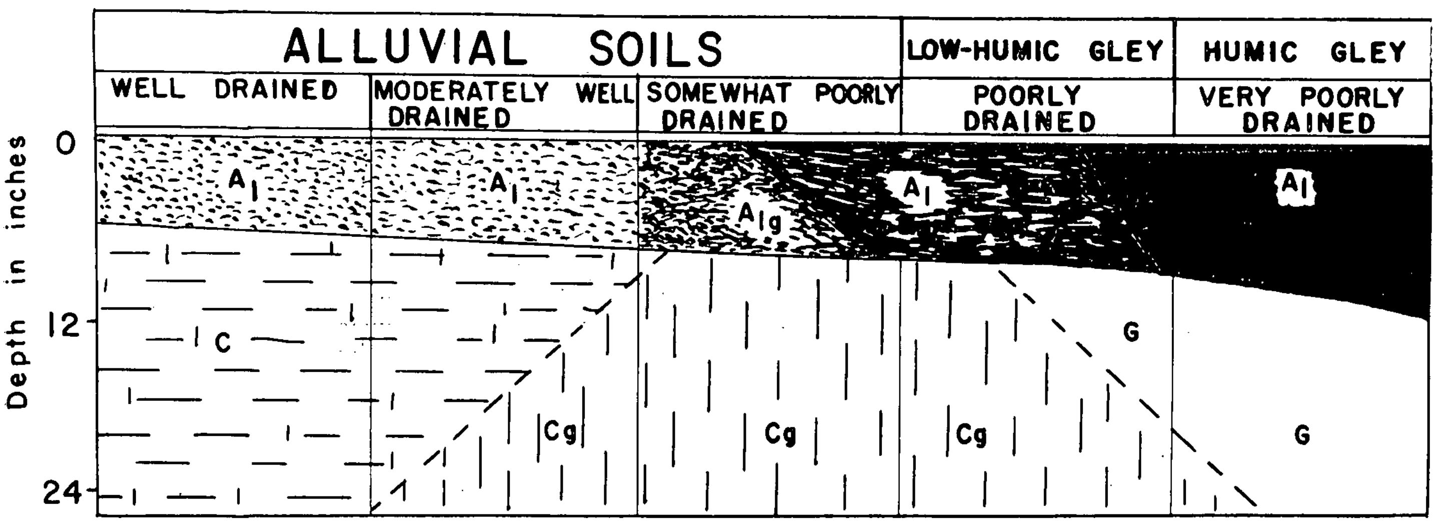

Figure 14.—**Schematic drawing showing drainage relationship between Alluvial soils, Low-Humic Gley soils, and Humic Gley soils that have formed in recent alluvium. Diagram shows that as drainage becomes slower, the color of the A_1 horizon becomes darker.**

Soils in alluvial sediments that are wet for most or all the year have characteristics of the great soil group of Low-Humic Gley or Humic Gley soils. Holly soils and Wayland soils have characteristics of Low-Humic Gley soils as sketched in the diagram in figure 14. Because the somewhat poorly drained soils have not been recognized as separate series, these two series include some soils that have a dark-colored upper horizon and a mottled subsurface soil. These are the wettest of the soils that might be classified as somewhat poorly drained if a series had been defined in the catena for each of the classes of natural drainage.

Soils that are wet throughout the year, and covered with swamp vegetation, develop a thick, black A_1 horizon and a gray (gleyed), probably somewhat mottled subsurface soil and subsoil. Such soils in alluival sediments, as well as those on various kinds of uplands, are classified in the great soil group of Humic Gley soils. The Papakating and Sloan soils are the Humic Gley soils of the bottom lands.

General Information About the County

This section gives information about the settlement and population, agriculture, community facilities, transportation and industries, water supply, climate, and vegetation of the county. It also discusses the physiography, relief and drainage, and glaciation of the area.

Settlement and Population

The first settlers arrived in what is now Cortland County in 1791. Most of the settlers were former soldiers who came from New England and eastern New York to take up land grants given as bonuses for service during the Revolutionary War. The first settlement was located near the present site of Homer. Settlement of the area proceeded rapidly, and by 1797 the villages of Virgil, Cortlandville, Solon, Marathon, Freetown, Preble, and Willet had been formed. Cortland County was formed from part of Onondaga County in 1808.

The population of the county was about 24,000 by 1830, about 26,500 in 1870, nearly 32,000 in 1930, and 37,158 in 1950. Although the population has increased through the years, the population of rural areas has decreased steadily since about 1850.

Some Facts About Agriculture

Much of this area was in forest when the first settlers arrived. Most of the settlers tilled the land, but they also sold timber to help increase their income. Eventually, most of the timber was cut. Then, the growing of crops and the raising of livestock became the only source of income for most farmers.

The kinds of crops grown and the acreages used for different crops has changed considerably over the years. The early settlers grew corn, beans, pumpkins, squash, and wheat for home use. Corn was grown to some extent to provide feed for livestock. By the late 1800's and early 1900's, potatoes and buckwheat were grown intensively. But, as dairying became the dominant type of farming in the years that followed, the acreage in potatoes and buckwheat declined. Hay, corn grown for silage, and other roughage crops have become very important in recent years. At the same time, the acreage in alfalfa, which makes higher yields per acre and contains more proteins than timothy and other grasses, has increased. Oats have always been an important grain crop in the county.

The acreage of principal crops grown in the county in 1954 was as follows:

Crop	*Acres*
Corn for all purposes	10, 776
Harvested for grain	1, 172
Cut for silage	9, 486
Hogged, grazed, or cut for fodder	118
Small grains:	
Grains grown together and threshed as a mixture	2, 104
Wheat threshed or combined	884
Oats threshed or combined	9, 599
Barley threshed or combined	156
Buckwheat threshed or combined	341
Rye threshed or combined	65
Annual legumes:	
Soybeans grown for all purposes	96
Dried field and seed beans harvested for beans	742
Hay, total	46, 722
Alfalfa and alfalfa mixtures	12, 367
Clover and timothy, alone or mixed	28, 478
Small grains cut for hay	297
Other hay cut	3, 610
Grass silage from grasses, alfalfa, clover, or small grains	1, 970
Irish potatoes grown for home use or for sale (does not include acreage for farms with less than 20 bushels harvested)	537

As transportation facilities improved in the county, dairy farming increased in importance; farmers had outlets for milk and milk products in the large cities to the north and in cities along the east coast. In 1954 the kinds and numbers of livestock in Cortland County were as follows:

Livestock	*Number*
Cattle and calves	42, 171
Milk cows	27, 044
Heifers and heifer calves	13, 126
Steers, steer calves, and bulls	1, 799
Horses and mules	1, 027
Hogs and pigs	820
Sheep and lambs	2, 873
Chickens, 4 months old and over	153, 821
Turkeys raised	7, 182

In 1954, 21,907 cattle, hogs, sheep, horses, and mules were sold alive. In the same year, 193,747,416 pounds of whole milk and 10,847 pounds of butterfat were sold and 2,873 pounds of wool was shorn from sheep and lambs.

In Cortland County farms occupy 69 percent of the total land area, or about 221,490 acres. In 1954, the average-sized farm consisted of 195.3 acres in contrast to 132.3 acres in 1930. Full owners operated about 71 percent of the farms, and part owners, 25 percent in 1954; all other farms were operated by tenants or managers. The total cropland was 88,428 acres, and the total land in pasture was about 109,235 acres. Nearly 73 percent of the farms were dairy farms.

Community Facilities

Most of the smaller schools in the county have been closed during recent years. Buses transport students from rural areas to new consolidated schools. A State teachers college is located in the city of Cortland. The 4-H Clubs, Future Farmers of America, and other agricultural groups carry out educational programs and serve as centers for social activities.

There are churches of many denominations throughout the county. Some of the small, rural churches have closed recently.

Sportsmen's clubs are active in the county. Hunting and fishing are the main sports during summer and fall. Skiing is a popular winter pastime; three ski centers are operated in the county. Several youth camps are conducted during the summer.

Nearly all rural homes have telephones and electricity. Most of them receive daily delivery of mail. A radio station is operated in the city of Cortland. A daily newspaper is published in Cortland, and weekly newspapers are published in other communities.

Transportation and Industries

Cortland County has an adequate system of all-weather roads. U.S. Highway 11 crosses the county from north to south. State and county highways make all communities readily accessible throughout the year.

The main railroad serving the county is a branch line of the Delaware, Lackawanna, and Western Railroad. It enters the county northeast of Preble and extends through the city of Cortland and Marathon. A branch line of the Lehigh Valley Railroad serves Cuyler, Truxton, and Harford.

Approximately 3,000 workers are employed in nonagricultural industries in Cortland County. Most of these workers are engaged in manufacturing and other kinds of work in Cortland, Homer, and Marathon.

Climate

The cool, humid, continental climate, common to most of New York State, prevails in Cortland County. Winters are long and cold. Summers are warm, and occasionally there are short periods of high temperature.

Data showing temperature and precipitation in Cortland County are given in table 35. Also given in table 35 are statistics showing average precipitation at De Ruyter in Madison County; these figures are representative for the eastern part of Cortland County.

TABLE 35.—*Temperature and precipitation at Cortland Station, Cortland County, N.Y., and average precipitation at De Ruyter Station, Madison County, N.Y.*

Month	Cortland, elevation 1,129 feet							De Ruyter elevation 1,300 feet
	Temperature [1]			Precipitation [2]				Precipitation [2]
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1934)	Wettest year (1857)	Average snowfall	Average
	° F.	° F.	° F.	Inches	Inches	Inches	Inches	Inches
December	26. 7	65	−30	2. 81	2. 70	3. 29	11. 4	2. 84
January	23. 4	68	−29	2. 60	1. 59	3. 02	13. 8	2. 82
February	22. 6	66	−20	2. 35	. 92	2. 05	13. 7	2. 67
Winter	24. 2	68	−30	7. 76	5. 21	8. 36	38. 9	8. 33
March	31. 5	81	−12	2. 82	3. 48	2. 58	11. 5	3. 14
April	43. 5	92	6	3. 03	2. 32	6. 78	3. 7	3. 14
May	55. 1	94	18	3. 78	. 54	4. 38	. 3	3. 43
Spring	43. 4	94	−12	9. 63	6. 34	13. 74	15. 5	9. 71
June	64. 0	101	29	4. 15	4. 12	12. 55	0	4. 08
July	68. 6	102	32	4. 42	2. 44	2. 39	0	3. 91
August	66. 6	100	31	3. 81	2. 13	5. 40	0	3. 79
Summer	66. 4	102	29	12. 38	8. 69	20. 34	0	11. 78
September	59. 6	99	25	3. 49	4. 88	4. 45	(3)	3. 87
October	48. 7	92	11	3. 52	1. 37	4. 88	. 3	3. 76
November	37. 5	86	0	3. 02	2. 90	3. 48	5. 1	3. 17
Fall	48. 6	99	0	10. 03	9. 15	12. 81	5. 4	10. 80
Year	45. 7	102	−30	39. 80	29. 39	55. 25	59. 8	40. 62

[1] Average temperature based on a 95-year record, through 1955; highest and lowest temperatures based on a 60-year record, through 1952.

[2] Average precipitation for Cortland Station based on a 78-year record, through 1955; wettest and driest years based on a 75-year record, in the period 1851–1955; snowfall based on a 52-year record, through 1952. Average precipitation for De Ruyter Station based on a 48-year record, through 1955.

[3] Trace.

Because of differences in elevation, the length of the growing season varies in various parts of the county. In pockets in some of the valleys, frost commonly occurs 2 or 3 weeks earlier than it does in other areas. A comparison of the length of the growing season at Cortland with that at De Ruyter in Madison County is given in table 36.

TABLE 36.—*Growing season at Cortland, Cortland County, and De Ruyter, Madison County (8)*

Station [1]	Length of growing season			Percentage of growing seasons less than—			
	Longest	Average	Shortest	120 days	130 days	140 days	150 days
	Days	*Days*	*Days*				
Cortland	186	142	83	8	24	47	63
De Ruyter	165	131	83	23	50	68	86

[1] Data at the Cortland station based on a 52-year record, and at the De Ruyter station, on a 22-year record.

The temperature and the amount of precipitation during the growing season are both very important. Records compiled at the Cornell University Agricultural Experiment Station show that during the period from May 1 to September 30 the average temperature at Cortland was 62.8° F. as compared with 61.2° F. at De Ruyter. During the same period the average rainfall was 19.65 inches at Cortland and 19.08 inches at De Ruyter (*8*).

Vegetation

When Cortland County was first settled, the pioneers had to clear timber from most of the land. Only small areas were free of trees. The dominant trees were sugar and red maple, red oak, yellow birch, beech, aspen, elm, white pine, and hemlock. Basswood, chestnut, and white oak grew to some extent. Hemlock and elm grew on wet soils of the uplands and on soils of the valleys in which the water table was within 2 to 4 feet of the surface.

Undoubtedly, all of the forests in the county have been cut over at least two or three times. Most of the present timber consists of second- and third-growth beech and maple growing on steep or wet soils.

In abandoned fields in the uplands are hawthorn, seedling apple, wild blackberry, and small seedlings of maple and beech. The hawthorn and seedling apple trees appear first in these abandoned fields; other plants making up the rest of the cover include cinquefoil, Queen-Anneslace, Indian paintbrush, goldenrod, povertygrass, and ragweed.

More specific information about trees growing in the county is given in the section, Woodland Conservation.

Water Supply

In most places water is readily available throughout the county. In rural areas drilled or driven wells provide water for domestic use and streams and constructed ponds furnish water for livestock. During years when the amount of rainfall is less than normal, the supply of water on a few farms in the uplands may be critically low for short periods.

Most communities obtain water from constructed reservoirs, driven wells, or springs. An abundant supply is available to communities and farms that are near streams and lakes.

Physiography

Cortland County is in the northern part of the Appalachian Plateaus Province (*4*). The area is known in New York State as the Allegheny Plateau. This plateau was referred to by Miller (*7*) as the Southwestern Plateau Province.

The plateau, when seen from a high elevation, presents an even skyline to the viewer. In places, however, a few remnants of hills rise above the rest of the plateau. Most of these remnants represent caps of more resistant rock. The plateau consists of many layers of acid sandstone, siltstone, and coarse-textured shale of the Devonian age (fig. 15).

Formations or beds of the Devonian age:

Ch Chemung: Sandstone and shale in alternating beds; flaggy, coarse textured, and drab in color; contains thin lenses of conglomerate; these rocks commonly cap the highest remnants of the plateau.

It Ithaca: Mostly tough, arenaceous, coarse, blocky shale and thin-bedded, flaggy sandstone; olive to dark olive gray.

Gt { Genesee: Massive, brown to black shale that weathers to fissile flakes. / Tully: Dense, dark-gray limestone containing detrital material. }

Ha Hamilton: Black to blue-gray, calcareous, argillaceous shale with thin layers of limestone.

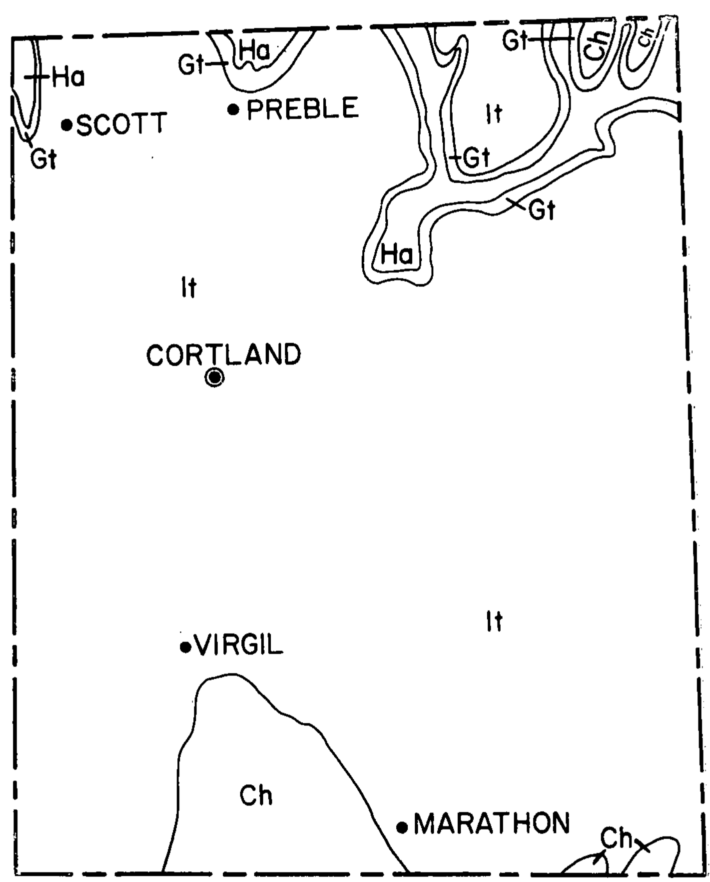

***Figure 15.*—Bedrock geology of Cortland County, N.Y.**

The bedrock is several hundred feet thick, and most of the rocks contain lenses of sediments coarser than the predominant rock in the formation. The rocks have been disturbed but little, even though they have a general dip of 30 to 50 feet per mile toward the south and southwest. The shape of the hills and valleys indicates that they were formed through the movement of water and ice.

The main valleys are about ½ to ¾ mile wide. Their floors are covered predominantly by gravelly fill, and their walls are steep. In only a few places do spurs extend out into the valleys; most of them have been destroyed by glaciers. It has been suggested that glaciers formed the steep sidewalls of the valleys. The floors of the main valleys are about 500 feet lower in elevation than the adjacent uplands.

The tributary valleys are narrow and have floors consisting of alluvium instead of gravelly outwash. Their floors are steeper than those of the main valleys. Between Blodgett Mills and Marathon, where these valleys enter the valley of the Tioughnioga River, they are like gorges. There are a few other gorges in the county. In most of the tributary valleys, the walls are only moderately steep. Some of the walls extending east to west are steeper on the south side than on the north side. At the junction of the tributary valleys and main valleys, a number of large alluvial fans have been built up.

Nearly all the walls of the main valleys and some of those of tributary valleys contain deposits of gravel, or till, or a mixture of the two. This material was deposited in lateral moraines that are long and narrow and that have steep sides facing and paralleling the floor of the valley. Good examples of these kinds of landforms occur in the valley northeast of the city of Cortland and extend to Cuyler. Just above the morainic deposits, in many places there is a steep, narrow wall of bedrock, and then the uplands.

The rolling hills in the uplands were smoothed by glacial ice. Commonly, long, narrow ridges, extending north to south or northeast to southwest, connect one hill or summit to another. The uplands are covered with a thin deposit of glacial till. The till is compact, acid, and medium textured, and it has platy or massive structure; its matrix consists of materials derived mostly from the underlying bedrock. On some of the highest ridges and on the steep walls of valleys, the till is only 1 foot thick, but between the ridges it is 10 to 20 feet thick; along the small tributary streams, it is even thicker.

The north ends of the hills are generally steeper than the south ends. In some areas the ridges resemble steps. Here, the till is seldom thicker than 1 to 2 feet. The step-like landforms are common in the eastern and central parts of the county. In places their elevations vary from 50 to 150 feet within short horizontal distances.

Relief and Drainage

In most of the county, elevations range from 1,100 feet in the valleys to 1,800 feet in the uplands. In the extreme northwestern corner of the county, however, a small area has an elevation of only 880 feet. Mt. Toppin near Preble and hills near Virgil are the highest points in the county. They have elevations of about 1,840 feet.

The Tioughnioga River and its tributaries drain most of the county. The eastern and southeastern parts of the county are drained by the Otselic River and Merrill Creek. Both of these streams are part of the drainage system of the Susquehanna River. A few areas are drained by streams of the drainage system of the St. Lawrence River. One of these areas, near Virgil, is drained by Virgil Creek, which flows westward out of the county toward Cayuga Lake. Another, the area west of Scott, is drained by Skaneateles Inlet, which empties into Skaneateles Lake and eventually into the St. Lawrence River to the north.

Because the bedrock formations are nearly horizontal, the streams have a typically dendritic pattern of drainage. This pattern is characterized by irregular branching of the tributary streams in several directions. Where most of the tributaries enter the main valleys, the streambed has a steep gradient.

Glaciation

The county was completely covered by ice during the period of the Wisconsin glaciation, the last part of the glacial era. Glaciologists classify the Wisconsin age into subdivisions or substages on the basis of the degree of decomposition of the glacial material and the pattern of distribution of end moraines and fossil-bearing interglacial deposits (*5*).

In this area glacial ice deposited material that formed two moraines, the Binghamton and the Valley Heads. Both of these moraines were formed an estimated 13,000 to 16,000 years ago during the Cary substage, or the third substage of the Wisconsin age. The Binghamton moraine is commonly referred to as old Cary, and the Valley Heads, as young Cary. The Binghamton has been leached more deeply of carbonates than the Valley Heads (*6*).

Although most of the county is covered by the Binghamton moraine, two distinct areas thought to be of the Valley Heads moraine are identified as follows:

(1) Areas consisting of valley plugs or terminal moraine deposits at the heads of valleys extending north and south; these deposits are west of Scott, northwest and northeast of Preble, north of Truxton, north and northeast of Cuyler, and near Virgil and Harford. Here, the glacial ice became stagnant and gravel and till or a mixture of the two were deposited. Streams flowing from the ice deposited material forming gravelly terraces or outwash plains. On these deposits the Palmyra and Howard soils formed. The Lansing, Conesus, and Valois soils formed on glacial till.

(2) Areas in the uplands covered by a mantle of till. Most of these areas are along the western border of the county between Harford and Scott. In these areas, Valois, Langford, and Erie soils have formed.

Most of the surface mantle of the county is of the Binghamton moraine. In the valleys and on the valley walls are deposits of gravelly outwash and glacial till or a mixture of the two. These materials were deposited in the same way as those of the Valley Heads moraine. On the outwash deposits the Chenango, Red Hook, and Atherton soils have formed. On the terraces cut by streams are the Unadilla and Scio soils. In the uplands the principal soils are the Bath, Mardin, Volusia, and Lordstown.

Since the glaciers left the area, alluvium has been deposited by streams that flow in the valleys. Chagrin, Lobdell, and Wayland soils, which have formed in the alluvial deposits, occur in the valleys of streams that drain areas of the Valley Heads moraine. In areas of the Binghamton moraine, the principal alluvial soils are the Tioga, Middlebury, and Holly.

The till deposits in the uplands are strongly influenced by material weathered from the underlying bedrock. In the valleys, however, the till and outwash materials contain large amounts of other rocks, including limestone, that were carried into the county by glaciers. As a result, the Valley Heads moraine contains more limestone than does the Binghamton moraine, especially in valleys extending north and south where there was less resistance to the movement of glacial ice. Further information about limestone in the soil parent material can be found in the section, Formation and Classification of Soils.

Glossary

[Terms relating to soils are defined in the Soil Survey Manual (*11*). Terms pertaining to glacial geology are defined by Flint (*5*), and terms pertaining to geomorphology are defined by Thornbury (*10*)]

Aggregate, soil.—A single mass or cluster consisting of many primary soil particles held together, such as a prism, crumb, or granule.

Alluvium.—Soil or rock material, such as gravel, sand, silt, or clay, or a combination of these, deposited on land by a stream of water.

Calcareous.—Refers to soil or material that contains enough calcium carbonate, or magnesium carbonate, or both, to form bubbles when treated with dilute hydrochloric acid.

Catena, soil.—A group of soils formed from the same kind of parent material but with each soil in the group differing in profile characteristics because of differences in drainage or slope.

Channery fragments.—Thin, flat fragments of sandstone, limestone, or schist no longer than 6 inches along the longest axis.

Complex, soil.—An intricate mixture of areas of different kinds of soil, too small to map separately on a map of the scale used, and, therefore, mapped as a unit.

Consistence.—The feel of the soil and the degree of pressure necessary to crush a lump or aggregate of soil. Some of the terms commonly used to describe consistence are:

Loose.—Noncoherent.

Friable.—When moist, soil material crushes easily under moderate pressure between the thumb and forefinger and coheres when pressed together.

Firm.—When moist, soil material crushes under moderate pressure between thumb and forefinger, but resistance is distinctly felt.

Very firm.—Soil material crushes under strong pressure; barely crushable between thumb and forefinger.

Hard.—Soil material moderately resistant to pressure; can be broken in the hands but is barely breakable between thumb and forefinger.

Extremely hard.—Soil material extremely resistant to pressure; cannot be broken by hand.

Slightly sticky.—After pressure is applied, soil material adheres to both thumb and forefinger but comes off one or the other cleanly.

Sticky.—After pressure is applied, soil material adheres to both thumb and forefinger and tends to stretch somewhat and pull apart rather than pulling free from either digit.

Slightly plastic.—Soil material can be formed in the shape of a wire, but the soil mass is easily deformed.

First bottom.—The normal flood plain of a stream, part of which may be flooded at infrequent intervals.

Flaggy soils.—Soils that contain comparatively thin fragments, 6 to 15 inches long, of sandstone, limestone, slate, or shale, or, rarely, of schist. A single piece is a flagstone.

Flood plain.—The nearly level areas, subject to overflow, along the courses of streams.

Fragipan.—A compact horizon, rich in silt, sand, or both, and generally low in clay. The fragipan commonly interferes with root penetration. When dry, the compact material appears to be indurated, but the apparent induration disappears when the soil is moistened. Fragipans occur in soils formed from either residual or transported material. (Most of the fragipan horizons are indicated by the symbols B'_{2gm} or B'_{3gm} in the descriptions of soils of Cortland County.)

Glacial till.—The material picked up, mixed, disintegrated, transported, and deposited through the action of glacial ice, with little or no transportation by water.

Granite.—A light-colored, acid, igneous rock, coarse grained, and composed mostly of quartz and feldspar with some other minerals.

Horizon, soil.—A layer of soil, approximately parallel to the soil surface, with characteristics produced by soil-forming processes. Horizons are identified by letters of the alphabet. They are subdivided by numbers.

Horizon A.—The horizon at the surface. From this horizon the soluble minerals and clay have been removed by percolating water. The major A horizon may be subdivided into A_1, the part that is dark colored because of organic matter, and A_2, the part that is leached and light colored. In woodlands a thin, discontinuous layer of organic matter accumulates on top of the mineral soil; this layer is called an A_0 horizon. Depth of soil is measured from the top of the mineral soil, because the A_0 is rapidly destroyed if fire occurs or if the soil is cultivated.

Horizon A_p.—A surface horizon that has been plowed or otherwise mixed; it extends deeper than the original A_1 horizon. The subscript p indicates disturbance, usually by cultivation.

Horizon B.—The horizon in which clay, iron, or aluminum has accumulated. This horizon may be subdivided into B_1, B_2, and B_3 horizons.

Horizon B'_2 and B'_3.—See Fragipan.

Horizon C.—The material immediately under the true soil; this material is presumed to be similar to that in which the true soil formed.

Horizon D (D layer).—Any stratum underlying the C horizon, or the B if no C is present. The designation D_r is for consolidated parent rock like that from which the C horizon developed or like that from which the parent material of the solum developed if no C horizon is present.

Gleyed horizon.—A layer of intense reduction, characterized by the presence of gray or strongly mottled horizons; gleyed horizons are present in wet soils and are indicated by the letters G or g. The letter G indicates a neutral gray or strongly gleyed horizon, and the subscript g indicates slight to moderate gleying.

Inclusions.—Areas of soil mapped with a soil of a different mapping unit because they were too small to be mapped separately on a map of the scale used.

Mapping unit, soil.—An area enclosed by a boundary line on the soil map. Each area of the mapping unit is identified by the symbol for that mapping unit.

Massive.—Refers to large, uniform masses of soil or soil material that may or may not have cleavage planes. (See also Structure, soil.)

Moraine, terminal.—A ridgelike accumulation of till, or gravel, or both, built up at the margin of a valley glacier or at the margin of an ice sheet. In valleys, terminal moraines are commonly called "valley plugs."

Mottling, soil.—Contrasting color patches that vary in number and size. Descriptive terms are: Contrast—*faint*, *distinct*, and *prominent;* abundance—*few*, *common*, and *many;* and size—*fine*, *medium*, and *coarse*. The size measurements are the following: *Fine*, commonly less than 5 millimeters (about 0.2 in.) in diameter along the greatest dimension; *medium*, commonly ranging from 5 to 15 millimeters (about 0.2 to 0.6 in.) in diameter along the greatest dimension; and *coarse*, commonly more than 15 millimeters (about 0.6 in.) in diameter along the greatest dimension.

Munsell color notation.—A method of designating soil color by a combination of letters and numbers, such as 10R 4/2. Use of the Munsell system is explained in the Soil Survey Manual (*11*).

Outwash plain.—A level area covered by gravelly material swept out, sorted, and deposited, generally beyond the glacial ice front, by streams of melt water. If the outwash plain has been dissected by another stream, valley trains or cut terraces may have formed.

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 the soil mass, expressed in pH values or in words, as follows:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.0 and higher.
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

In this report the terms *weakly calcareous* and *calcareous* have been used to represent pH values between 7.3 and 7.8.

Sedimentary rock.—A rock composed of sediments deposited physically or chemically. Principal kinds of sedimentary rocks are (1) *sandstone* (from sandy sediments), (2) *siltstone* (from deposits containing a predominance of silt-sized sediments), (3) *shale* (from deposits of clay-sized sediments), and (4) *limestone* (from calcium sediments, generally deposited chemically). Siltstone is intermediate in characteristics between sandstone and shale.

Series, soil.—A group of soils that have similar genetic horizons and that have developed in the same kind of parent material. A soil series may consist of one or of more than one soil type; the soil types differ from one another mainly in the texture of the surface soil. See Type, soil.

Solum.—The upper part of the soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons. As a rule, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Soil.—The natural medium, composed of organic and inorganic materials, in which plants can anchor themselves and grow.

Structure, soil.—The arrangement of the soil particles into three-dimensional forms, or aggregates. Structure is described by grade (*weak, moderate,* or *strong*), that is, the distinctness and durability of the aggregates; by the size of the aggregates (*very fine, fine, medium, coarse,* or *very coarse*); and by their shape (*platy, prismatic, columnar, blocky, granular,* or *crumb*). A soil is said to be structureless if there are no observable aggregates. Structureless soils may be massive (*coherent*) or single grain (*noncoherent*). Principal types of structure are:

Blocky, angular.—Aggregates are block shaped and are bounded by relatively sharp angles.

Blocky, subangular.—Aggregates have mixed and plane faces with most of the vertices rounded.

Crumb.—Aggregates are soft and porous and tend to be spheroidal in shape; they closely resemble granular aggregates.

Granular.—Small aggregates that are mostly round and that may be soft or hard.

Platy.—Aggregates are arranged around a plane, generally horizontally.

Texture, soil.—The relative amount and size of particles making up the soil mass. The various proportions of sand, silt, and clay determine the textural class of soil.

Clay.—Very small mineral grains, less than 0.000079 inch in diameter.

Silt.—Small mineral grains, less than 0.002 inch but larger than 0.000079 inch in diameter.

Sand.—Small rock or mineral fragments having diameters ranging from 0.002 to 0.079 inch. The term sand is also applied to soils that contain 90 percent or more sand.

Topsoil (engineering application).—Presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

Type, soil.—A group of soils that have genetic horizons similar as to differentiating characteristics, including texture and arrangement of the soil profile, and developed from a particular type of parent material.

Literature Cited

(1) American Association of State Highway Officials.
1955. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING; THE CLASSIFICATION OF SOILS AND SOIL AGGREGATE MIXTURES FOR HIGHWAY CONSTRUCTION PURPOSES. Designation: M 145–49, AASHO, 7th Ed., illus. Washington, D.C.

(2) Baur, A. J. and Lyford, W. H.
1957. SOLS BRUNS ACIDES OF THE NORTHEASTERN UNITED STATES. Soil Sci. Soc. Amer. Proc. 21: 533–536.

(3) Cline, M. G.
1949. PROFILE STUDIES OF NORMAL SOILS OF NEW YORK: I. SOIL PROFILE SEQUENCES INVOLVING BROWN FOREST, GRAY-BROWN PODZOLIC, AND BROWN PODZOLIC SOILS. Soil Sci. 68: 259–272, illus.

(4) Fenneman, N. M.
1938. PHYSIOGRAPHY OF THE EASTERN UNITED STATES. 714 pp., illus. New York and London.

(5) Flint, R. F.
1947. GLACIAL GEOLOGY AND THE PLEISTOCENE EPOCH. 589 pp., illus. New York and London.

(6) MacClintock, Paul.
1954. LEACHING OF WISCONSIN GLACIAL GRAVELS IN EASTERN NORTH AMERICA. Geol. Soc. Amer. Bul. 65: 369–384, illus.

(7) Miller, W. J.
1924. GEOLOGICAL HISTORY OF NEW YORK STATE. N. Y. State Mus. Bul. 185, 148 pp., illus.

(8) Mordoff, R. A.
1949. THE CLIMATE OF NEW YORK STATE. Cornell Ext. Bul. 764, 72 pp., illus.

(9) New York State College of Agriculture.
1959. CORNELL RECOMMENDS FOR FIELD CROPS. Cornell Univ. 23 pp., illus. Ithaca, N.Y.

(10) Thornbury, W. D.
1954. PRINCIPLES OF GEOMORPHOLOGY. 618 pp., illus. New York and London.

(11) United States Department of Agriculture.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook 18, 503 pp., illus. [Replaces U.S. Dept. Agr. Misc. Pub. 274, *The Soil Survey Manual*, pub. 1937].

(12) Waterways Experiment Station, Corps of Engineers.
1953. UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3–357, v. 1.

GUIDE TO MAPPING UNITS

Map symbol	*Mapping unit*	*Page*	*Capability unit*	*Page*	*Woodland suitability group* [1]
AaA	Alden and Birdsall silt loams, 0 to 3 percent slopes	10	IVw–1	57	10
Ab	Alluvial land	10	VIw–1	60	10
AcB	Arnot channery silt loam, 2 to 8 percent slopes	10	IIe–2	44	8
AdA	Atherton silt loam, 0 to 3 percent slopes	11	IIIw–2	53	10
BaB	Bath channery silt loam, 3 to 8 percent slopes	12	IIe–1	43	6
BaC	Bath channery silt loam, 8 to 15 percent slopes	12	IIIe–1	48	6
BaD	Bath channery silt loam, 15 to 25 percent slopes	12	IVe–1	55	6
BbB	Bath-Chenango gravelly loams, 3 to 8 percent slopes	12	IIe–1	43	6
BbC	Bath-Chenango gravelly loams, 8 to 15 percent slopes	12	IIIe–1	48	6
BbD	Bath-Chenango gravelly loams, 15 to 25 percent slopes	12	IVe–1	55	6
BbE	Bath-Chenango gravelly loams, 25 to 40 percent slopes	13	VIe–1	59	12
BcE	Bath and Mardin soils, 25 to 40 percent slopes	13	VIe–1	59	12
BdA	Birdsall silt loam, over gravel, 0 to 1 percent slopes	13	IIIw–2	53	10
CaB	Chagrin channery silt loam, alluvial fan, 2 to 10 percent slopes	14	IIe–1	43	2
CbA	Chagrin silt loam, 0 to 2 percent slopes	14	IIw–1	46	5

See footnote at end of table.

GUIDE TO MAPPING UNITS—Continued

Map symbol	Mapping unit	Page	Capability unit	Page	Woodland suitability group [1]
CcB	Chagrin silt loam, high bottom, 0 to 4 percent slopes	14	I-1	42	1
CdA	Chenango gravelly loam, 0 to 3 percent slopes	15	I-1	42	4
CdB	Chenango gravelly loam, 3 to 8 percent slopes	15	IIe-1	43	4
CdC	Chenango gravelly loam, 8 to 15 percent slopes	15	IIIe-1	48	4
CeA	Chippewa channery silt loam, 0 to 3 percent slopes	16	IVw-2	58	10
CeB	Chippewa channery silt loam, 3 to 8 percent slopes	16	IVw-2	58	10
CfB	Conesus gravelly silt loam, 2 to 8 percent slopes	17	IIe-3	45	1
CfC	Conesus gravelly silt loam, 8 to 15 percent slopes	17	IIIe-3	50	1
DaB	Dunkirk silt loam, over gravel, 0 to 4 percent slopes	17	I-1	42	1
DaC	Dunkirk silt loam, over gravel, 8 to 20 percent slopes	17	IIIe-1	48	1
EaA	Ellery channery silt loam, 0 to 3 percent slopes	18	IVw-2	58	9
EaB	Ellery channery silt loam, 3 to 8 percent slopes	18	IVw-2	58	9
EbB	Erie channery silt loam, 2 to 8 percent slopes	19	IIIw-1	52	8
EbC	Erie channery silt loam, 8 to 15 percent slopes	19	IIIe-5	51	8
HaA	Holly silt loam, 0 to 1 percent slopes	19	IIIw-3	53	9
HbA	Homer silt loam, 0 to 2 percent slopes	20	IIIw-2	53	7
HcA	Howard cobbly loam, 0 to 3 percent slopes	21	I-1	42	2
HcB	Howard cobbly loam, 3 to 8 percent slopes	21	IIe-1	43	2
HdA	Howard gravelly loam, 0 to 3 percent slopes	21	I-1	42	1
HdB	Howard gravelly loam, 3 to 8 percent slopes	21	IIe-1	43	1
HdC	Howard gravelly loam, 8 to 15 percent slopes	21	IIIe-1	48	1
HdD	Howard gravelly loam, 15 to 25 percent slopes	21	IVe-1	55	1
KaB	Kendaia silt loam, 1 to 6 percent slopes	22	IIIw-2	53	7
LaB	Langford channery silt loam, 3 to 8 percent slopes	22	IIe-2	44	6
LaC	Langford channery silt loam, 8 to 15 percent slopes	22	IIIe-2	49	6
LaD	Langford channery silt loam, 15 to 25 percent slopes	22	IVe-3	57	6
LbB	Lansing gravelly silt loam, 3 to 8 percent slopes	23	IIe-1	43	1
LbC	Lansing gravelly silt loam, 8 to 15 percent slopes	23	IIIe-1	48	1
LbD	Lansing gravelly silt loam, 15 to 25 percent slopes	23	IVe-1	55	1
LbE	Lansing gravelly silt loam, 25 to 35 percent slopes	23	VIe-1	59	1
LcA	Lobdell silt loam, 0 to 2 percent slopes	24	IIw-2	47	5
LdB	Lordstown channery silt loam, moderately deep, 2 to 8 percent slopes	25	IIe-1	43	6
LeB	Lordstown channery silt loam, shallow, 2 to 8 percent slopes	25	IIIs-1	54	11
LfC	Lordstown channery silt loam, 8 to 15 percent slopes	25	IIIe-1	48	6
LfD	Lordstown channery silt loam, 15 to 25 percent slopes	25	IVe-1	55	6
LgE	Lordstown soils, 25 to 55 percent slopes	25	VIe-1	59	12
MaB	Mardin channery silt loam, 2 to 8 percent slopes	26	IIe-2	44	6
MaC	Mardin channery silt loam, 8 to 15 percent slopes	26	IIIe-2	49	6
MaC3	Mardin channery silt loam, 8 to 15 percent slopes, eroded	26	IVe-2	56	11
MaD	Mardin channery silt loam, 15 to 25 percent slopes	27	IVe-3	57	6
MbA	Middlebury silt loam, 0 to 2 percent slopes	27	IIw-2	47	5
Mc	Muck	27	VIIw-1	60	10
PaA	Palmyra cobbly loam, 0 to 3 percent slopes	29	I-1	42	2
PbA	Palmyra gravelly silt loam, 0 to 3 percent slopes	28	I-1	42	1
PbB	Palmyra gravelly silt loam, 3 to 8 percent slopes	28	IIe-1	43	1
PbC	Palmyra gravelly silt loam, 8 to 15 percent slopes	28	IIIe-1	48	1
PbD	Palmyra gravelly silt loam, 15 to 25 percent slopes	28	IVe-1	55	1
PcA	Papakating silt loam, 0 to 1 percent slopes	29	VIw-1	60	10
PdA	Phelps gravelly silt loam, 0 to 3 percent slopes	30	IIw-2	47	1
RaA	Red Hook silt loam, 0 to 3 percent slopes	30	IIIw-2	53	9
RbB	Rhinebeck silt loam, 3 to 8 percent slopes	31	IIe-4	46	7
RbC	Rhinebeck silt loam, 8 to 15 percent slopes	31	IIIe-4	50	7
RbD	Rhinebeck silt loam, 15 to 25 percent slopes	31	IVe-3	57	7
SaB	Scio silt loam, 0 to 4 percent slopes	31	IIw-2	47	6
SbA	Sloan silt loam, 0 to 1 percent slopes	32	VIw-1	60	10
TaB	Tioga channery silt loam, alluvial fan, 2 to 8 percent slopes	33	IIe-1	43	4
TbA	Tioga gravelly loam, 0 to 2 percent slopes	33	IIw-1	46	5
TcA	Tioga silt loam, 0 to 2 percent slopes	32	IIw-1	46	5
TdA	Tioga silt loam, high bottom, 0 to 3 percent slopes	32	I-1	42	3
TeB	Tuller channery silt loam, 2 to 8 percent slopes	33	IVw-1	57	8
UaB	Unadilla silt loam, 0 to 4 percent slopes	34	I-1	42	3
VaB	Valois-Howard gravelly loams, 3 to 8 percent slopes	35	IIe-1	43	1
VaC	Valois-Howard gravelly loams, 8 to 15 percent slopes	35	IIIe-1	48	1
VaD	Valois-Howard gravelly loams, 15 to 25 percent slopes	35	IVe-1	55	1
VaE	Valois and Howard gravelly loams, 25 to 40 percent slopes	35	VIe-1	59	12
VbB	Volusia channery silt loam, 2 to 8 percent slopes	36	IIIw-1	52	8
VbB3	Volusia channery silt loam, 2 to 8 percent slopes, eroded	36	IVe-2	56	11
VbC	Volusia channery silt loam, 8 to 15 percent slopes	36	IIIe-5	51	8
VbC3	Volusia channery silt loam, 8 to 15 percent slopes, eroded	36	IVe-2	56	11
VbD	Volusia channery silt loam, 15 to 25 percent slopes	36	IVe-3	57	8
VbD3	Volusia channery silt loam, 15 to 25 percent slopes, eroded	36	VIe-1	59	8
WaA	Wallington silt loam, over gravel, 0 to 3 percent slopes	37	IIIw-2	53	9
WbA	Wayland silt loam, 0 to 1 percent slopes	37	IIIw-3	53	9

[1] For information about woodland suitability groups, see table 31, page 98.

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