

SOIL SURVEY

Fountain County Indiana



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

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Fountain County, Indiana, 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, ponds, and other structures; aid managers of forest and woodland; add to soil scientists' knowledge of soils; and help prospective buyers and others in appraising a farm or other tract.

Locating the Soils

At the back of this report is an index map and a map consisting of many sheets. On the index map are rectangles numbered to correspond to the sheets of the soil map so that the sheet showing any area can be located easily. On each map sheet, the soil boundaries are outlined and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where it belongs. For example, an area on the map has the symbol ReA. The legend for the set of maps shows that this symbol identifies Reesville silt loam, 0 to 2 percent slopes. That soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding Information

In the "Guide to Mapping Units" at the back of this report, the soils are listed in the alphabetic order of their map symbols. This guide shows where to find a description of each soil and a discussion of its capability unit and woodland suitability group. It also shows where to find the acreage of each soil, the yields that can be expected, and information about engineering uses of soils.

Farmers and those who work with farmers can learn about the soils on a farm by reading the description of each soil and of its capability unit and woodland suitability

group. A convenient way of doing this is to turn to the soil map and list the soil symbols of a farm and then to use the "Guide to Mapping Units" in finding the pages where each soil and its groupings are described.

Foresters and others interested in woodland can refer to the subsection "Woodland." In that subsection the soils in the county are placed in groups according to their suitability for trees, and the management of each group is discussed.

Game managers, sportsmen, and others concerned with wildlife will find information about the main kinds of wildlife and their food and cover in the subsection "Wildlife."

Engineers and builders will find in the subsection "Engineering Properties of Soils" tables that give engineering descriptions of soils in the county; name the soil features that affect engineering practices and structures; and rate the soils according to their suitability for several kinds of engineering work.

Scientists and others who are interested can read about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

Newcomers in Fountain County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information.

* * * * *

Fieldwork for this survey was completed in 1961. Unless otherwise indicated, all statements in the report refer to conditions in the county at the time the survey was in progress. The soil survey of Fountain County was made as a part of the technical assistance furnished by the Soil Conservation Service to the Fountain County Soil and Water Conservation District.

Contents

	Page		Page
General nature of the county	1	Descriptions of the soils—Continued	
History.....	1	High Gap series.....	74
Natural resources.....	2	Huntsville series.....	75
Industry.....	2	Landes series.....	75
Transportation.....	2	Marl beds.....	76
Community facilities.....	2	Miami series.....	76
Agriculture.....	2	Mine pits and dumps.....	77
Land use.....	2	Muskingum series.....	77
Crops.....	2	Ockley series.....	77
Livestock.....	2	Parr series.....	79
Climate of the county	3	Princeton series.....	79
How soils are mapped and classified	6	Ragsdale series.....	80
General soil map	7	Raub series.....	81
1. Fincastle-Reesville-Brookston association.....	8	Reesville series.....	81
2. Westland-Ockley-Fox-Sleeth association.....	8	Rodman series.....	81
3. Russell-Hennepin-Alford association.....	8	Romney series.....	82
4. Ragsdale-Sidell association.....	8	Russell series.....	82
5. Genesee-Eel association.....	9	Shadeland series.....	84
6. Wea-Crane association.....	9	Shoals series.....	84
7. Muskingum-Shadeland-High Gap association.....	9	Sidell series.....	85
Use and management of the soils	10	Sleeth series.....	85
Crops and pasture.....	10	Sloan series.....	86
Basic practices of management.....	10	Stony alluvial land.....	86
Capability groups of soils.....	11	Sunbury series.....	86
Management by capability units.....	13	Tawas series.....	87
Estimated yields.....	25	Tippocanoe series.....	87
Woodland.....	28	Walkkill series.....	87
Kinds of trees.....	28	Warsaw series.....	88
Woodland suitability groups.....	28	Washtenaw series.....	89
Wildlife.....	34	Wea series.....	89
Food and cover.....	35	Westland series.....	90
Wildlife areas in the county.....	35	Whitaker series.....	91
Engineering properties of soils.....	36	Wingate series.....	91
Engineering classification systems.....	37	Xenia series.....	92
Soil data related to engineering.....	37	Formation and classification of soils	92
Engineering interpretations of soils.....	37	Factors of soil formation.....	92
Descriptions of the soils	62	Living organisms.....	92
Alford series.....	63	Parent material and geology.....	93
Ayrshire series.....	66	Time.....	93
Birkbeck series.....	66	Climate.....	94
Brookston series.....	67	Topography.....	94
Camden series.....	67	Processes of soil formation.....	95
Celina series.....	67	Classification of soils.....	96
Chelsea series.....	68	Great soil groups in the county.....	96
Crane series.....	68	Gray-Brown Podzolic soils.....	96
Crosby series.....	69	Brunizems.....	97
Dana series.....	69	Humic Gley soils.....	97
Delmar series.....	69	Low-Humic Gley soils.....	97
Eel series.....	70	Alluvial soils.....	97
Elston series.....	70	Regosols.....	97
Fincastle series.....	71	Brown Forest soils.....	97
Fox series.....	71	Sols Bruns Acides.....	97
Genesee series.....	73	Bog soils.....	98
Gravel pits.....	73	Descriptions of the soil series.....	98
Gullied land, gravelly materials.....	73	Literature cited	119
Gullied land, loamy materials.....	74	Glossary	119
Hennepin series.....	74	Guide to mapping units	Facing 122

SOIL SURVEY OF FOUNTAIN COUNTY, INDIANA

FIELDWORK BY J. DEAL, K. K. HUFFMAN, C. GUERNSEY, SOIL SCIENTISTS, SOIL CONSERVATION SERVICE

REPORT BY RALPH H. STURM, SOIL SCIENTIST, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

FOUNTAIN COUNTY, in the west-central part of Indiana (fig. 1), has an area of 397 square miles, or 254,080 acres. Covington, the county seat, is on the Wabash River at the western boundary of the county, about midway between the northern and southern boundaries. The physiography of the county ranges from broad, level bottom lands and terraces along the Wabash River to broad glacial till and outwash plains in most

other parts. Several large streams that flow into the Wabash River drain the county. Farming is the main enterprise. Grain and livestock farms predominate, but there are several farms that produce specialized crops.

General Nature of the County

The information in this section will help those unfamiliar with the county to learn some facts about it. The section discusses history, natural resources, industry, transportation, community facilities, and agriculture. Immediately following the section is a section on the climate of the county.

History

Fountain County was organized and Covington made its county seat in 1826, 10 years after Indiana was admitted to the Union as a State. The county is in the west-central part of the State; its western boundary is about 4 miles east of the Indiana-Illinois line. The Wabash River borders the county on the north and west. The county is agricultural.

Great forests of oak and walnut along the Wabash River and smaller streams encouraged settlers to establish homesteads in Fountain County. Poplar also grew and was used as finishing lumber. Settlers from Kentucky, the Carolinas, Ohio, and Pennsylvania displaced the Indians. Gristmills were built along Shawnee Creek and the east and north forks of Coal Creek. The Wabash and Erie Canal, which followed the course of the Wabash River, was completed in 1846 and abandoned in 1872. In 1851 roads were cut through the heavy forest, and a plank road from Covington to Crawfordsville, in Montgomery County, was completed.

After the land along the stream and creek bottoms was taken, the fertile Shawnee and Scott prairies were quickly settled. Flat areas, many of which were wet and swampy, were later cleared. At first the wet areas were drained by open ditches and wooden drains, but later clay and concrete tile lines were used for drainage. Livestock and grain farming became important after the land was cleared and drained. Today this kind of farming is the most important enterprise in the county.

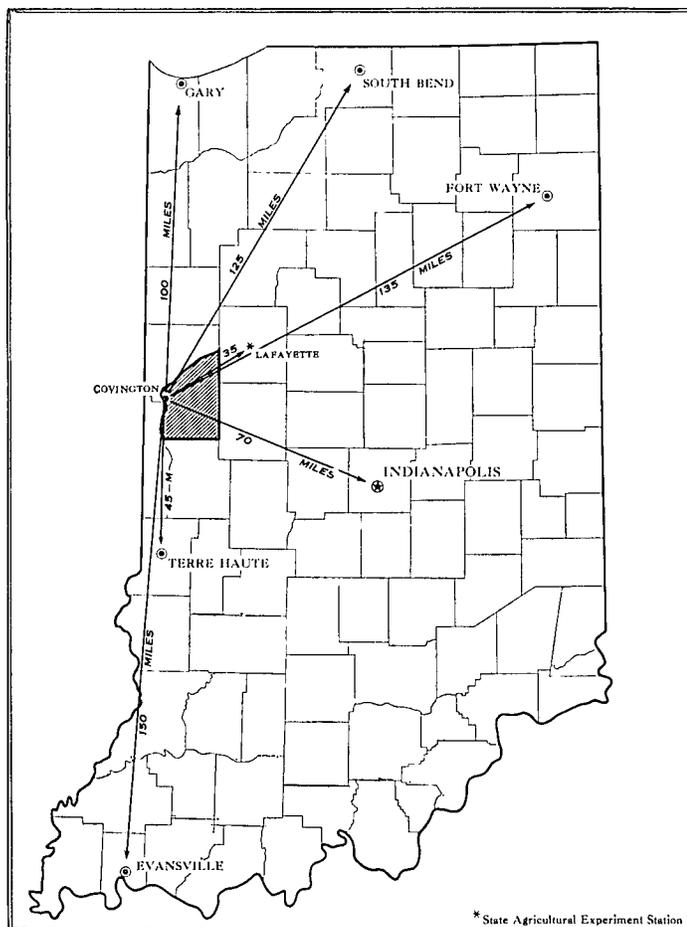


Figure 1.—Location of Fountain County in Indiana.

Natural Resources

The most valuable natural resource in Fountain County is the soil. The county has a variety of soils that range from some of the best agricultural soils in the world to some that are not suitable for farming. The livelihood of Fountain County has, and probably will continue to, come mostly from agricultural soils.

Other resource materials are also important in the county. As the upkeep of county roads became essential, gravel pits were opened throughout the county. Some sand, especially that south of Attica, was found to be suitable for casting molds in foundry work and is now used for that purpose. Shale and fine clay is quarried and made into bricks at Attica and Veedersburg.

Industry

Industry, including manufacturing, is centered around Attica. The largest industrial plant in the county is a steel castings company. Also at Attica are a radio materials company and a brick manufacturing plant. Another brick company is at Veedersburg, and a gravel-producing company is at Covington. The cellophane materials manufacturer west of Covington employs many people from all over the county. Crops grown in the county supply the many local grain elevators. Along the Wabash River and small streams are areas of gravelly and sandy soils that are well suited as industrial sites.

Transportation

Railroads were built in the county early in the 1880's. Operating today, and serving many communities, are lines of the Wabash Railroad System and the New York, Chicago and St. Louis Railroad Company. Bus service is available throughout the county.

Built in 1926, U.S. Highway No. 41 crosses the county from north to south. U.S. Highway No. 136 crosses the county from east to west. Interstate Highway No. 74, a limited access road, is now under construction. The county roads total about 717 miles.

Community Facilities

Fountain County has a variety of cultural organizations and facilities. About 50 church organizations are active in the county, and there are local civic organizations. Also active are 4-H Clubs, Future Farmers of America, and garden clubs. The grade and high schools in the county are reorganizing and consolidating.

Facilities for picnicking are available at parks in Covington, Attica, and Veedersburg and at an attractive roadside park near Hillsboro. Many people use the public swimming pools at Covington and Veedersburg, the golf course at Attica, and the several tennis courts throughout the county. Also popular are fishing and boating in the Wabash River, and fishing in small streams and ponds.

The Shades State Park, in the southeastern corner of the county, is used by people who like the outdoors. Facilities for hiking, camping, and many other things are available at this park.

Agriculture

This subsection discusses land use and gives data on farms, the acreage of principal crops, and the number of livestock in the county. The statistics in this subsection are from the census of agriculture.

Land use

Fountain County is an agricultural area in which about 92 percent of the land is in farms. About 75 percent of these farms are operated by owners or part owners and the rest by tenants. Farms operated by tenants have decreased about 2 percent during the past 5 years.

The farms in the county are following the national trend of increasing in size and decreasing in number. The average farm increased 23 acres in size from 1954 to 1959. Data on the farms in the county are shown in table 1.

TABLE 1.—Data on farms for stated years

	1945	1949	1954	1959
Land area of county—acres—	254, 080	254, 080	254, 080	254, 080
Land in farms—acres—	233, 135	234, 027	231, 074	234, 029
Proportion of county in farms—percentage—	(¹)	(¹)	90. 9	92. 1
Farms—number—	1, 502	1, 514	1, 316	1, 181
Average size of farm—acres—	155. 2	154. 6	175. 6	198. 2
Average value of land and buildings, per farm—dollars—	14, 464	22, 785	38, 981	53, 707
Average value per acre—dollars—	93. 20	143. 61	214. 90	253. 85

¹ Not available.

Of the 1,181 farms in the county in 1959, about 33 percent were miscellaneous and unclassified, about 31 percent were cash-grain farms, about 28 percent were livestock farms other than poultry and dairy, and about 6 percent were general farms. The poultry, dairy, and fruit-and-nut farms amount to only about 2 percent.

Crops

The acreages of principal crops grown in the county in 1945, 1949, 1954, and 1959 are listed in table 2.

Livestock

Much of the farm income in Fountain County comes from the sale of livestock. Since 1945 hogs and pigs have increased steadily in number, but the number of cattle has remained about the same. Table 3 lists the number of the various kinds of livestock in the county in stated years.

TABLE 2.—Acreage of principal crops

Crop	1945	1949	1954	1959
Corn:				
Harvested for grain-----	60, 023	59, 257	59, 578	67, 058
Cut for silage-----	(¹)	299	892	858
Sorghums:				
Harvested for grain or seed-----	(¹)	(¹)	(¹)	97
Cut for silage-----	(¹)	2	4	35
Small grains:				
Wheat-----	12, 692	24, 444	17, 922	18, 227
Oats-----	15, 393	17, 174	14, 097	11, 602
Barley-----	62	(¹)	43	188
Rye-----	1, 242	379	1, 585	529
Soybeans harvested for beans-----	38, 622	27, 470	35, 256	36, 082
Alfalfa and alfalfa mixtures-----	2, 763	2, 988	5, 965	3, 770
Clover, timothy, and mixtures of clover and grasses-----	13, 384	9, 740	10, 870	10, 033
Lespedeza cut for hay-----	120	232	142	21
Small grain cut for hay-----	54	134	466	78
Other hay cut-----	115	226	129	3
Grass silage made from grasses, alfalfa, clover, or small grains-----	(¹)	(¹)	323	104

¹ Not available.

TABLE 3.—Number of livestock on farms in stated years

Livestock	1945	1950	1954	1959
Cattle and calves-----	18, 300	18, 369	24, 451	19, 956
Horses and mules-----	2, 091	966	310	551
Hogs and pigs-----	40, 116	50, 185	63, 414	73, 188
Sheep and lambs-----	7, 512	5, 583	6, 394	5, 459
Chickens, 4 months old and older-----	125, 006	91, 919	89, 392	83, 774

Climate of the County ¹

The climate of Fountain County is continental. The temperature varies widely during the year, but precipitation is consistent through all seasons, compared to large regions of the world that have a dry season. No one month of the year has an average of less than 2 inches of rain. Although evaporation exceeds rainfall in summer, the rainfall in spring and summer usually compensates for the loss of moisture, particularly on agricultural soils that have a high moisture capacity. The temperature varies widely because the county is several hundred miles from the oceans and this distance moderates their influences. Also, solar radiation is about three times greater in summer than in winter. Because the Rocky Mountains usually bar the flow of air from the Pacific Ocean, cold air from the north enters the county at various times in all seasons. The data in this section are from observations that were taken at Veedersburg before 1950 and at Covington after that time.

In most years the rainfall in Fountain County is adequate for farming, but in summer when crops use a lot

¹ By L. A. SCHAAAL, State climatologist, U.S. Weather Bureau.

of water and evaporation is high, a period of low rainfall may cause a reduction in crop yields. Nevertheless, a complete failure of crops is not known.

Table 4 lists, for each week of the year, the chance, in percent, that stated amounts of rain will fall. The data in table 4 were computed from the records of the weather station at West Lafayette in Tippecanoe County, but through a long period, there is no noticeable difference between the rainfall in West Lafayette and that in Fountain County. Weeks during the growing season that have a low average rainfall are those beginning April 19, July 19, and September 20. The week beginning April 5 tends to be the wettest week in the growing season. Because rains at about that time sometimes delay farmwork in fields, a late start in planting increases the risk of crop loss in fall; if the first freezing temperature is early, some crops may not have time to mature. The flooding of bottom land along the Wabash River is an additional hazard caused by heavy rains.

Temperature and the length of the frost-free season are important to the agriculture of the county. The warm or hot summers are excellent for corn and similar crops when moisture is adequate. Usually there are enough days between the last freezing temperature in spring and the first in fall for the crops grown in the county to mature, but occasionally tender crops are killed by a freeze unusually late in spring or unusually early in fall. The following list gives the chance, in percent, for a frost-free season of stated length at Veedersburg:

Percent of chance	Number of days
90-----	142
75-----	152
50-----	163
25-----	174
10-----	184

Based on past records, the shortest growing season at Veedersburg is 127 days and the longest is 190 days. The average length of the growing season is 163 days.

Also computed from the records at Veedersburg, and given in table 5, is the chance, in percent, that specified temperatures will occur after listed dates in spring or before listed dates in fall. These dates differ for different parts of the county because of elevation and landforms. For the readings from which the data in table 5 were computed, the thermometers are about 5 feet above the sod and in a standard shelter.

In a 30-year period at Veedersburg, the earliest freezing temperature recorded in spring was on April 13, 1939, and the latest was on May 26, 1925. In this period the earliest freezing temperature in fall was September 14, 1923, and the latest was on November 8, 1947.

The cold temperatures of winter may damage fruit, forage, and other crops. In some winters the freezing and thawing of the soils may heave, or lift, some of the young plants of a forage or a small grain crop. Snow cover is welcome, for it protects these crops from temperatures below zero. Temperatures have dropped as low as -27° F. in the county. At this temperature, fruit trees are usually killed, but a high frequency of this killing can be avoided by choosing orchard sites with care and by avoiding pockets in low ground where cold air concentrates. Also, by choosing a favorable direction of

TABLE 4.—*Chance, in percent, for stated amount of precipitation, in inches, each week of the year*¹

[Computed from records at West Lafayette in Tippecanoe County]

Week beginning—	0 or trace ²	0.10 or more	0.20 or more	0.40 or more	0.60 or more	0.80 or more	1.0 or more	1.2 or more	1.6 or more	2.0 or more	2.8 or more	More than 4.0
March:												
1.....	11	82	72	51	34	22	14	8	3	1	0.1	0
8.....	6	86	76	60	46	35	27	21	12	7	2.2	.4
15.....	7	87	79	62	47	35	26	19	10	5	1.5	.2
22.....	6	86	77	61	48	37	28	22	12	7	2.4	.5
29.....	7	85	76	60	46	35	27	21	12	7	2.1	.4
April:												
5.....	2	94	88	75	63	52	43	35	23	15	6.1	1.6
12.....	11	84	77	63	50	40	31	24	15	9	3.0	.6
19.....	7	81	71	55	42	32	25	19	11	7	2.2	.5
26.....	9	86	79	66	53	42	33	26	16	9	3.2	.6
May:												
3.....	7	86	78	63	50	39	30	23	14	8	2.7	.5
10.....	6	84	76	63	52	43	36	30	21	15	7.3	2.5
17.....	11	85	80	68	57	47	38	31	20	13	5.1	1.3
24.....	9	83	75	62	51	42	34	28	19	12	5.4	1.6
31.....	4	83	73	57	45	36	28	22	14	9	3.6	1.0
June:												
7.....	13	83	77	66	56	46	39	32	21	14	6.2	1.8
14.....	7	84	76	64	53	44	37	31	22	15	7.4	2.5
21.....	4	90	81	66	52	41	32	24	15	9	2.9	.6
28.....	9	81	72	59	47	38	31	25	17	11	4.9	1.5
July:												
5.....	13	79	72	61	51	43	37	31	22	16	8.3	3.1
12.....	6	84	75	61	50	41	34	28	19	13	5.9	1.9
19.....	24	65	57	44	35	28	22	18	12	8	3.2	.9
26.....	19	75	68	55	44	35	27	21	13	8	2.8	.6
August:												
2.....	7	79	70	54	42	34	27	21	13	9	3.4	.9
9.....	9	80	71	59	48	40	34	28	20	14	7.0	2.5
16.....	9	84	77	62	50	39	31	24	15	9	3.2	.7
23.....	22	70	63	50	41	33	26	21	14	9	3.6	1.0
30.....	17	71	63	50	40	32	26	21	14	9	4.1	1.2
September:												
6.....	15	79	72	59	48	38	31	25	16	10	4.0	1.0
13.....	20	70	63	51	41	33	27	22	14	9	4.1	1.2
20.....	19	71	62	48	37	28	22	17	10	6	2.2	.5
27.....	22	68	61	50	42	35	29	25	18	13	6.8	2.7
October:												
4.....	20	75	69	57	46	37	29	23	14	8	2.9	.6
11.....	19	71	62	49	39	31	25	20	13	9	3.6	1.1
18.....	24	67	59	48	39	31	25	21	14	9	4.1	1.2
25.....	15	69	59	44	34	27	21	16	10	6	2.5	.7
November:												
1.....	17	72	63	48	38	29	23	18	11	7	2.6	.6
8.....	13	81	72	54	38	26	17	11	5	2	.3	0
15.....	17	75	66	50	37	28	21	15	8	5	1.3	.2
22.....	15	74	62	43	29	19	13	8	4	2	.3	0
29.....	7	82	72	54	41	31	24	18	10	6	1.9	.3
December:												
6.....	9	78	65	44	30	20	13	8	4	2	.3	0
13.....	11	72	62	47	36	29	23	18	12	7	3.1	.9
20.....	19	71	61	44	31	21	15	10	5	2	.5	0
27.....	7	78	67	50	38	29	22	17	10	6	2.0	.4
January:												
3.....	7	77	66	50	38	30	23	18	11	7	2.6	.6
10.....	11	74	63	46	34	25	19	14	7	4	1.3	.2
17.....	7	75	64	49	38	29	23	18	11	7	2.9	.8
24.....	20	65	53	35	23	15	10	6	3	1	.2	0
31.....	13	71	59	42	30	22	16	11	6	3	.9	0

TABLE 4.—*Chance, in percent, for stated amount of precipitation, in inches, each week of the year*¹—Continued

[Computed from records at West Lafayette in Tippecanoe County]

Week beginning—	0 or trace ²	0.10 or more	0.20 or more	0.40 or more	0.60 or more	0.80 or more	1.0 or more	1.2 or more	1.6 or more	2.0 or more	2.8 or more	More than 4.0
February:												
7-----	13	72	59	39	26	17	11	7	3	1	0.2	0
14-----	7	78	66	47	34	25	18	13	7	4	1.1	.1
21-----	9	80	69	51	38	27	20	15	8	4	1.1	.1

¹ Calculations from 54 years of data by G. L. BARGER, R. H. SHAW, R. F. DALE, in "CHANGES OF RECEIVING SELECTED AMOUNTS OF PRECIPITATION IN THE NORTH-CENTRAL REGION OF THE UNITED STATES" (2).

² A trace is less than 0.005 inch.

TABLE 5.—*Chance of last critical temperatures in spring and first in fall at Veedersburg*¹

Temperature	Chance of occurrence after date in spring					Chance of occurrence before date in fall				
	90 per-cent	75 per-cent	50 per-cent ²	25 per-cent	10 per-cent	10 per-cent	25 per-cent	50 per-cent ²	75 per-cent	90 per-cent
40----- ^{°F.}	May 7	May 14	May 23	June 1	June 8	Sept. 11	Sept. 17	Sept. 23	Sept. 29	Oct. 5
36-----	Apr. 29	May 6	May 13	May 20	May 27	Sept. 19	Sept. 25	Oct. 2	Oct. 9	Oct. 15
32-----	Apr. 19	Apr. 25	May 2	May 9	May 15	Sept. 25	Oct. 3	Oct. 11	Oct. 19	Oct. 27
28-----	Mar. 28	Apr. 6	Apr. 16	Apr. 26	May 5	Oct. 9	Oct. 17	Oct. 25	Nov. 2	Nov. 10
24-----	Mar. 9	Mar. 18	Mar. 28	Apr. 7	Apr. 16	Oct. 24	Oct. 29	Nov. 5	Nov. 12	Nov. 17
20-----	Mar. 2	Mar. 11	Mar. 20	Mar. 29	Apr. 7	Oct. 29	Nov. 6	Nov. 15	Nov. 24	Dec. 2
16-----	Feb. 18	Feb. 26	Mar. 7	Mar. 16	Mar. 24	Nov. 13	Nov. 21	Nov. 29	Dec. 7	Dec. 15

¹ Official readings are taken from thermometers located about 5 feet above sod in a standard thermometer shelter. Since temperatures on a windless, cloudless night are often lower below the shelter or in a crop, some probabilities are shown for in-shelter above

freezing temperatures. Temperatures below freezing are pertinent relative to hardy crops. From "RISKS OF FREEZING TEMPERATURES—SPRING AND FALL IN INDIANA" (4).

² Dates in this column are average dates.

slope, advantage is taken of solar radiation, which is a low temperature deterrent. Table 6 summarizes by month some of the variation of temperature, precipitation, and snowfall that may be expected.

In winter the snow on the ground often protects soils from deep and frequent freezing, and it also serves as a cover that protects forage crops and winter grains from the cold. Snowfall varies greatly in winter; single months in some years have had as much snow as has fallen all year at other times. One-half of an inch or more of snow covers the soil on the average of 25 days a year.

Winds of high velocity seldom occur in the county, and they do little damage to property or crops. Wind erosion is slight because the soil moisture is adequate most of the time. Extremely high winds may come from intense low pressure centers moving through or near Fountain County, or they may come from severe local thunderstorms. These thunderstorms are brief and localized, but their winds are of higher velocity than those caused by low pressure centers. Tornadoes that have winds of perhaps 200 miles an hour have been reported 5 times in the county between 1916 and 1960. Because tornadoes are small and infrequent, casualties and loss of property from them are unlikely. In all seasons except winter, winds blow from the southwest most of the time. In

winter, winds from the west or northwest may be most frequent. Average wind velocities are highest in March and lowest in August.

Relative humidity affects farming indirectly. On most days relative humidity reaches nearly 100 percent when the temperature is lowest, usually just before sunrise. If 100 percent humidity is reached earlier, heavy dew or frost accumulates and delays some early morning farming operations. At other times high humidity is welcomed because it slows evaporation and lessens the loss of moisture. Humidity decreases as the day warms and on a typical summer afternoon is commonly 40 to 50 percent; it is 10 to 20 percent higher in winter. Radiation fog, a phenomenon associated with high relative humidity, often occurs at night and early in the morning. It is more prevalent near the Wabash River than on higher ground because the cool humid air concentrates in the river bottoms. After a cold front passes, the humidity generally falls. Winds from the south bring higher humidity.

In Fountain County local differences in climate exist because of differences in terrain, including slope, and in soil cover, soil moisture, soil color, and other factors. All of these factors should be considered when estimating the climate of a location so that a suitable kind of farming can be selected.

TABLE 6.—
[All data from

Month	Temperature						
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average	Highest	Lowest
January	°F. 38	°F. 19	°F. 58	°F. -5	°F. 29	°F. 71	°F. -27
February	40	21	61	-1	31	72	-19
March	53	31	74	11	42	87	-14
April	65	40	82	24	52	95	17
May	75	50	89	33	63	99	23
June	84	59	95	42	72	106	35
July	89	63	99	49	76	112	41
August	87	61	96	48	74	106	39
September	81	55	93	37	68	102	25
October	69	44	85	26	57	93	17
November	53	32	72	14	43	83	-7
December	40	23	60	0	31	85	-22
Year	65	42	80	23	53	112	-27

¹ Less than one-half day.

How Soils Are Mapped and Classified

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Miami and Brookston, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that differ in texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a

series, all the soils having a surface layer of the same texture belong to one soil type. Fox silt loam and Fox fine sandy loam are two soil types in the Fox series. The difference in texture of their surface layer is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. In Fountain County soil types are divided into phases primarily on the basis of difference in slope or degree of erosion because these differences affect management. For example, Fox silt loam, 0 to 2 percent slopes, is one of several phases of Fox silt loam, a soil type that ranges from nearly level to moderately sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photographs for their base map because they show woodlands, buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

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

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that

Climate data

records at Veedersburg]

Precipitation					Number of days with—				
Average total	One year in 10 will have—		Snow, sleet		0.01 inch or more of precipitation	Maximum temperatures of—		Minimum temperatures of—	
	Less than—	More than—	Average	Maximum		90° and above	32° and below	32° and below	0° and below
<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>					
2.7	0.8	6.5	3.2	21	8	0	9	26	3
2.0	.8	3.9	4.4	24	7	0	5	23	1
3.2	1.3	5.6	2.0	19	9	0	1	18	(1)
3.5	1.7	6.0	(2)	5	10	(1)	0	7	0
4.4	1.7	6.8	(2)	(2)	11	2	0	1	0
4.3	1.5	8.0	0	0	10	8	0	0	0
3.6	1.2	7.2	0	0	8	15	0	0	0
3.5	1.6	6.0	0	0	8	10	0	0	0
3.5	1.2	6.8	0	0	8	5	0	(1)	0
2.9	.8	5.0	.1	2	7	(1)	0	4	0
2.6	1.2	4.2	.5	9	8	0	1	16	(1)
2.4	.6	3.7	3.0	28	8	0	7	25	
38.6	29.5	48.4	13.2	28	102	40	23	120	6

² Trace.

it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Muskingum stony complex, 2 to 12 percent slopes, is a mapping unit made up of several kinds of Muskingum soils. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Stony alluvial land or Gullied land, gravelly materials, and they are called land types rather than soils.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability or limitations for each specified use is the method of organization commonly used in the soil survey reports. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups, and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved

reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, by colors, the seven general soil areas, or soil associations, in Fountain County. A soil association is a pattern of soils that recurs in a characteristic landscape. It consists of a few major soils and several minor ones and is named for the series of the major soils. Any or all of the soils in any one association may also occur in another association, but their pattern is different.

The kind of soil in any one place cannot be determined on the general soil map, for only the areas covered by the patterns, or soil associations, are shown. The different kinds of soils that make up a soil association are likely to vary in slope, depth, stoniness, drainage, and other important characteristics. For this reason the general soil map is not detailed enough for use in planning management for a particular soil, but it is useful to people who want a general idea of the soils in the county, who want to compare different parts of the county, or who want to know the location of large areas that are suitable for a certain kind of farming or other land use.

Soil associations 1, 3, 4, and 7 are on uplands and are well distributed throughout the county. These associations differ from each other in relief and in texture of their soils. Soil association 2 is on terraces, outwash plains, and uplands. It is in large areas of varied relief and is also well distributed throughout the county. Soil association 6 is on terraces and outwash plains in two areas in the northern half of the county. Soil association 5 is along the nearly level bottom lands of the Wabash River and its tributaries.

1. Fincastle-Reesville-Brookston association: Nearly level and depressional, medium-textured and moderately fine textured soils of uplands

This soil association occurs mainly in the southern half of the county, but there are some areas in the northwestern and northern parts. The association occupies about 107 square miles, or 27 percent of the county. The Fincastle soils are the most extensive soils in the association, and the Reesville and Brookston soils occur in large areas.

The Fincastle and Reesville soils are somewhat poorly drained. They have a dark grayish-brown silt loam surface layer that overlies a silty clay loam subsoil. The lower subsoil of the Fincastle soils developed in till, but the entire subsoil of the Reesville soils developed in silty material that overlies till. The very poorly drained Brookston soils have a black silty clay loam surface layer that overlies a yellowish-brown and gray silty clay loam subsoil.

The Crosby soils are common in this association. They are somewhat poorly drained and are shallower to till than Fincastle and Reesville soils. Also in the association are the poorly drained Delmar and Washtenaw soils.

The soils in this association are farmed intensively to row crops and small grain. Excellent yields are obtained under good management. Because these soils are somewhat poorly drained and very poorly drained, tile and surface drains are needed to insure maximum yields. More lime and fertilizer are needed on the Fincastle, Reesville, and Crosby soils than on the Brookston. Small, scattered woodlots occupy undrained areas of these soils.

2. Westland-Ockley-Fox-Sleeth association: Depressional to steep, moderately coarse textured to moderately fine textured soils of terraces, outwash plains, and uplands

This association occurs along the Wabash River and its tributaries and in an area about 3 miles wide that extends east from Stonebluff to the county line. The association occupies 104 square miles, or about 26 percent of the county. The Westland, Ockley, and Fox soils are the most extensive soils in the association, and the Sleeth soils occur in large acreages.

The Westland soils are very poorly drained. They have a black silty clay surface layer that overlies a dark-gray to olive silty clay loam subsoil. The Sleeth soils are somewhat poorly drained and have a dark grayish-brown silt loam surface layer. Their subsoil is silty clay loam to sandy clay that is predominantly gray.

The Ockley and Fox soils are well drained. The Ockley soils have a dark-brown loam to silt loam surface layer that overlies a silty clay loam to sandy clay loam subsoil. In the Fox soils a dark-brown fine sandy loam to silt loam surface layer overlies a silty clay to gravelly clay loam subsoil. The subsoil of the Ockley soils is thicker than that of the Fox.

All the major soils in this association are underlain by stratified sand and gravel.

Also in this association are the well-drained Rodman, Princeton, and Chelsea soils and the somewhat poorly drained Ayrshire soils.

The soils in this association are farmed intensively to row crops (fig. 2), small grain, and hay. High yields are obtained under good management on all the soils except the sandy Rodman and Chelsea soils, which are generally in permanent pasture or forest. Because some



Figure 2.—Soybeans and corn on poorly drained and well-drained soils on terraces and outwash plains in soil association 2.

of the soils are flat and poorly drained, tile and surface drains are needed to insure maximum yields. Erosion control practices should be used on the sloping, well-drained soils. Additions of lime and fertilizer are generally needed on all the soils in the association.

3. Russell-Hennepin-Alford association: Nearly level to very steep, medium-textured soils of uplands

This association occurs mainly in the southern two-thirds of the county, but it is also in areas of the northwestern and northern parts. The association occupies about 62 square miles, or 16 percent of the county. The Russell soils are the most extensive soils in the association, but Hennepin and Alford soils occupy a considerable acreage.

The Russell and Alford soils are deep and well drained. They have a brown to dark-brown loam surface layer that overlies a silty clay loam subsoil. The lower subsoil of the Russell soils developed from till, but the entire subsoil of the Alford soils developed from silty material that overlies till or stratified fine gravel, sand, and silt. The well-drained Hennepin soils have a very thin, very dark gray to dark-brown loam surface layer and a loam subsoil. The Hennepin soils occur in steep areas of till.

The Miami soils are common in this association. They are well drained and shallower to till than are the Russell and Alford soils. The rest of the association includes the moderately well drained Celina, Xenia, and Birkbeck soils.

The more gently sloping soils of this association are farmed intensively to row crops, small grain, and hay. High yields are obtained under good management. The steeper soils are generally in pasture or forest. Because the soils are generally sloping, practices are needed to control erosion. Also needed is a complete fertilizer program so that maximum yields are obtained.

4. Ragsdale-Sidell association: Depressional and nearly level to sloping, medium-textured and moderately fine textured soils of uplands

This association occurs mainly in the northern half of the county, but a fairly large area is in the southern half east of Steam Corner. This association occupies about 56 square miles, or 14 percent of the county. The

Ragsdale soils account for most of the association, and there is a fairly large acreage of Sidell soils.

The Ragsdale soils are very poorly drained. They have a black silty clay surface layer that overlies a dark grayish-brown and yellowish-brown silty clay loam subsoil. In some places the subsoil of Ragsdale soils developed mostly from till, and in others it developed in silty material overlying till.

The Sidell and Parr soils are fairly common in this association. They are well drained and developed in thin deposits over till. They have a very dark brown to very dark grayish-brown silt loam surface layer that overlies a silty clay loam to clay loam subsoil. The Sidell soils have only their lower subsoil developed in till, but generally the entire subsoil of Parr soils developed in till.

Also in this association are the somewhat poorly drained Sunbury and Raub soils, the very poorly drained Romney soils, and the moderately well drained Wingate and Dana soils.

The nearly level, very poorly drained and somewhat poorly drained soils are farmed intensively, generally to continuous row crops. Excellent yields can be obtained under good management. Because drainage is not good, tile and surface drains are needed to insure maximum yields.

The sloping, moderately well drained and well drained soils are farmed intensively to row crops, small grain, and hay. High yields can be obtained under good management. Practices to control erosion and other good practices are needed to insure maximum yields. All the soils in this association respond well to additions of lime and fertilizer.

5. Genesee-Eel association: Nearly level, moderately coarse textured to moderately fine textured soils of bottom lands

This soil association occurs throughout the county along the Wabash River and its tributaries. It occupies about 32 square miles, or 8 percent of the county. The Genesee soils account for most of the association, and the Eel soils account for a considerable amount.

The Genesee soils are well drained. They have a dark-brown loam to silty clay loam surface layer that overlies a very fine sandy loam to silty clay loam subsoil. The Eel soils are moderately well drained. They have a dark-brown loam to silty clay loam surface layer and a silty clay loam subsoil.

The Landes soils are common in this association. These soils are well drained and are coarser textured than the Genesee soils.

Also in the association are the well-drained Huntsville soils and Stony alluvial land, the somewhat poorly drained Walkkill and Shoals soils, and the very poorly drained Sloan soils.

The soils of this association are generally farmed intensively to row crops. High yields are obtained under good management. Because these soils occur on bottom lands of the Wabash River and smaller streams, they are susceptible to flooding. Permanent pasture is the best use for the soils that are likely to be frequently flooded and for those on dissected bottoms along small meandering streams. On the somewhat poorly drained and very poorly drained soils, tile and surface drains are needed if yields are to be high. The soils in this association respond well to fertilizer, but any fertilizer program should be on a year-to-year basis because flooding is likely.

6. Wea-Crane association: Nearly level to sloping, moderately coarse textured to medium-textured soils of terraces and outwash plains

This association occurs in a large area in the northern third of the county and in a smaller area along the Wabash River north of Covington. The association occupies about 28 square miles, or 7 percent of the county. The Wea soils and the Crane soils have approximately equal acreages in the association.

The Wea soils are well drained. They have a very dark brown silt loam surface layer that overlies a silty clay loam to sandy clay loam subsoil. The Crane soils are somewhat poorly drained. They have a very dark brown silt loam surface layer and a silty clay loam to sandy clay loam subsoil.

The well-drained Tippecanoe soils are common in this association, and the well-drained Warsaw and Elston soils also occur.

The soils of this association are farmed intensively to row crops, small grain, and hay. High yields can be obtained under good management. Tile and surface drains are needed on the somewhat poorly drained soils. Practices are needed to control erosion if yields are to be high on the sloping, moderately well drained and well drained soils (fig. 3). The soils in this association respond well to fertilizer that is added in appropriate amounts.

7. Muskingum-Shadeland-High Gap association: Nearly level to very steep, medium-textured soils of uplands

This association occurs mainly along breaks adjacent to the Wabash River. The association occupies about 8 square miles, or 2 percent of the county. Muskingum soils have a slightly larger acreage than Shadeland soils in this association, and Shadeland soils have a slightly larger acreage than High Gap.

The Muskingum soils are well drained and shallow. They have a dark grayish-brown stony loam surface layer and a loam subsoil that has sandstone fragments throughout. The Shadeland soils are somewhat poorly drained and moderately deep. They have a very dark gray silt loam surface layer that is underlain by a silty clay loam subsoil. The well-drained, moderately deep High Gap soils have a dark-brown silt loam surface

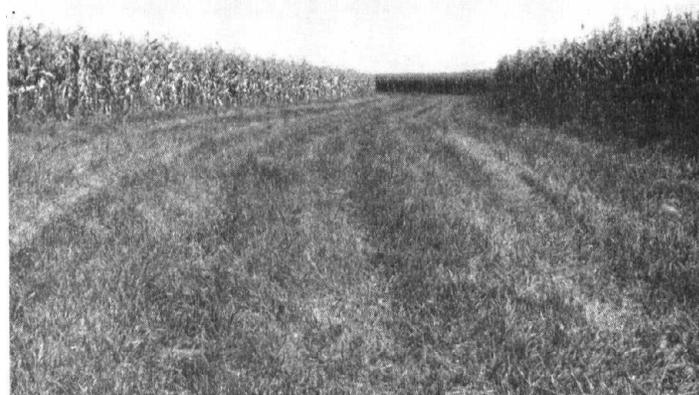


Figure 3.—Grassed waterway used to remove excess surface water from gently sloping soils of soil association 6.

layer and a clay loam subsoil. All of these soils are underlain by sandstone bedrock.

The Muskingum and Shadeland soils are generally in permanent pasture or trees. The High Gap soils are in small grain and hay and generally have low yields.

Use and Management of the Soils

This section discusses the use and management of the soils in the county for crops and pasture, as woodland, for wildlife production, and for engineering works.

Crops and Pasture

This subsection has four main parts. The first part discusses basic practices of management. The second part explains capability grouping. In the third part, the soils of the county are placed in capability units and the use and management of these units are discussed. The fourth part consists of a table that lists the soils in the county and gives estimated yields for the arable soils under two levels of management.

Basic practices of management

An efficient farmer applies basic practices of good management so that yields of crops and pasture are increased.

CROPS

If yields of crops are to be kept high, it is necessary to maintain good tilth, to replenish supplies of organic matter and plant nutrients, to control loss of soil and water, and to improve drainage where needed.

Organic matter.—Organic matter supplied to the soils in the form of green manure, crop residues, or barnyard manure improves the soil in several ways. It improves soils that are fine textured and those that are coarse textured. A heavy clayey soil is hard to work, absorbs water slowly, tends to puddle, and permits rainfall to runoff rather than to soak in. Such a soil is also likely to be poorly aerated. Organic matter added to a clayey soil makes it more friable and easier to work. It also promotes a crumbly structure, while at the same time stabilizing the soil aggregates so that they are held together against the slaking action of the rain. Green-manure and meadow crops help to dry nearly level, fine-textured soils in spring so that they can be worked earlier.

Because permeability is rapid in coarse-textured sandy soils, they do not hold much water. Their capacity to hold water is increased if organic matter is added, and because less water moves through these soils, the leaching of plant nutrients is reduced.

Lime and fertilizer.—Because most of the soils in the county have been farmed for many years, their natural supply of plant nutrients has been greatly reduced. Testing these soils about once every 5 years will determine whether additions of lime and fertilizer are needed and will indicate the amounts that should be applied. Crop yields are increased if these amendments are added in the amounts indicated by the tests.

Erosion control.—Throughout the county, practices are needed to control erosion on sloping soils. Soil erosion removes plant nutrients, cuts gullies, and fills ditches and

low-lying areas with unwanted soil material. By slowing down runoff on sloping soils, contour farming permits water to infiltrate into the soil. Diversions and terraces are used to intercept surface runoff. The flow of the water is interrupted so that some of it soaks into the soils and excess water is carried away slowly in outlets so that it can do no harm. Grassed waterways are important in controlling erosion, for they prevent channels from becoming gullies. The grass controls erosion by slowing the flow of water and by stabilizing the soils. If the waterways are wide and shallow enough, they can be crossed with farm machines and hay in them can be harvested. In winter, cover crops protect the soil against excessive loss.

Drainage.—In Fountain County drainage is a problem on the somewhat poorly drained to very poorly drained soils. A complete system of tile is needed on some of these soils, and surface drains are needed on others. Both surface drains and tile are needed on the very wet soils. The banks and berms of the deep open ditches should be seeded to grasses and legumes for protection.

PASTURE

Good yields of forage can be produced on most of the sloping soils in Fountain County (fig. 4), and in many places forage crops are more profitable than grain crops. Soils suited to cultivated crops are generally kept for 1 to 4 years in pasture that is in rotation with the cultivated crops. Soils not suited to cultivated crops are generally kept in permanent pasture, which is renovated as needed so that good forage is maintained.

Methods and rates of seeding, fertilizing, and other aspects of establishing and managing pasture are discussed in current bulletins of the Purdue Agricultural Extension Service.

Pasture management can be discussed by describing practices needed to establish the pasture and those needed in managing the pasture after it has been established.

Establishing pasture.—In establishing pasture, do these things:

1. Test the soil to determine the need for lime and fertilizer.
2. Apply lime 6 months before seeding.



Figure 4.—Pasture on sloping soils.

3. Remove, where feasible, any stones, stumps, brush, and other obstructions that will interfere with the use of farm equipment.
4. Prepare a good seedbed on the nearly level and gently sloping soils by shallow plowing on the contour. On the steeper soils leave a mulch on the surface, but do not plow. Several weeks before seeding, start preparing the seedbed by eradicating weeds through cultivation, spraying, or both.
5. Seed grasses and inoculated legumes that are best suited to the soil and will be productive at the time the pasture is needed. Seed the pasture mixture in a companion crop that controls erosion; if oats is the companion crop, use not more than 1 bushel of oats per acre. Cover seed of the forage plants lightly by using a cultipacker seeder or similar implement that leaves the seed at the proper depth. A cultipacker helps cover broadcast seed and helps firm the seedbed. Apply phosphate and potash at the time of seeding. If fertilizer is broadcast, work it into the soil before seeding. Drilling the fertilizer in a band 1 inch below the seed is beneficial.
6. Pasture the companion crop when it is about 8 inches high to keep it from competing too strongly with the forage plants.

Managing the pasture.—Important in pasture management is controlling grazing, controlling weeds and brush, and topdressing with lime and fertilizer.

In controlling grazing, (1) keep the livestock off the pasture until the ground is firm and forage growth is well started; (2) avoid overgrazing throughout the season by removing the livestock when the forage has been grazed to a height of 2 to 4 inches; (3) do not graze legume pasture for 1 month before the first hard frost in fall, normally between September 1 and 30; (4) divide the pasture in three or more parts and rotate the grazing so that forage plants have a chance to recover and live longer.

In controlling weeds and brush, (1) mow weeds before they deposit seeds; (2) unless livestock are moved from the pasture daily, mow weeds before the animals are removed because they eat wilted weeds; (3) in places where spraying is more economical and effective than mowing, spray to control weeds and brush.

In topdressing with lime and fertilizer, (1) lime acid soils to encourage white clover and similar legumes so that they furnish nitrogen for grasses in the mixture used; (2) test the soils and apply phosphate and potash to increase productivity and to maintain vigorous, long-lived plants; (3) apply nitrogen to grass in spring if early grazing is needed. If enough moisture is available, nitrogen increases the total yield and the protein content of grass.

Capability groups of soils

The capability classification is a grouping of soils that shows, in a general way, how suitable the soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels; the capability class, subclass, and unit. Eight capability classes are in the broadest grouping and are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products. Soils in class VIII do not occur in Fountain County.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral; for example, II*e*. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony, and *c*, which is used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are susceptible to little or no erosion but have other limitations that restrict their use largely to pasture, range, woodland, or wildlife. Soils in class V do not occur in this county.

Within the subclasses are the capability units, which are groups of soils that are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other response to management. Thus, the capability unit is a convenient grouping of soils about which many statements about management can be made. Capability units are generally identified by numbers; for example, II*e*-1 or III*e*-2. Numbers do not run consecutively in this county, because the capability units are numbered in a broad system and not all groups in the system occur in this county.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use. (No subclasses)

Capability unit I-1. Deep, well drained and moderately well drained soils on nearly level uplands, terraces, and outwash plains.

Capability unit I-2. Nearly level, well-drained soils that are on flood plains and have a fine sandy loam to silty clay loam surface layer.

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

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Capability unit IIe-1. Deep, well drained and moderately well drained, moderately dark colored soils that are gently sloping and are on terraces, till and outwash plains, or moraines.

Capability unit IIe-2. Deep, well drained and moderately well drained, dark-colored soils that are gently sloping and are on till and outwash plains covered with thick loess.

Capability unit IIe-3. Deep, well drained and moderately well drained, moderately dark colored soils that are on gently sloping uplands and are loamy and silty.

Capability unit IIe-5. Deep, well-drained, moderately dark colored soils that are on gently sloping uplands covered with wind-blown coarse silt and fine sand.

Capability unit IIe-9. Deep or moderately deep, well-drained, moderately dark colored and dark colored soils that are on gently sloping terraces and outwash plains and are loamy and silty.

Subclass IIw. Soils that have moderate limitations because of excess water.

Capability unit IIw-1. Deep, nearly level or depressional, moderately dark colored to very dark colored soils that are on uplands, terraces, and outwash plains and are very poorly drained.

Capability unit IIw-2. Deep, nearly level and gently sloping, moderately dark colored and dark colored soils that are on terraces and till and outwash plains and are somewhat poorly drained.

Capability unit IIw-4. Deep or moderately deep, dark-colored, very poorly drained or ponded soils in depressions of nearly level terraces.

Capability unit IIw-5. Moderately deep, dark-colored, very poorly drained soils on flats and in depressions of terraces.

Capability unit IIw-7. Deep, moderately well drained and somewhat poorly drained, moderately dark colored and dark colored soils that are on nearly level flood plains and have a loam to silty clay loam surface layer.

Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.

Capability unit IIs-1. Moderately deep or deep, well-drained, moderately dark colored or dark colored soils on nearly level terraces and outwash plains.

Capability unit IIs-4. Moderately deep, well-drained, moderately dark colored soils that are nearly level and are underlain by shallow drift, sandstone, or shale.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-1. Deep, well-drained, gently sloping and sloping soils that are on till and outwash plains of uplands and are slightly eroded to severely eroded.

Capability unit IIIe-2. Deep, well-drained, dark and moderately dark colored, gently sloping or sloping soils that occur on moraines and on till and outwash plains and are moderately eroded or severely eroded.

Capability unit IIIe-3. Deep, well-drained, moderately dark colored soils that are on uplands and are silty, sloping, and are slightly eroded to severely eroded.

Capability unit IIIe-5. Deep, well-drained, moderately dark colored soils that are on sloping uplands covered with windblown coarse silt and fine sand.

Capability unit IIIe-8. Moderately deep, well-drained, moderately dark colored soils that are on gently sloping uplands and are underlain by sandstone, siltstone, or shale.

Capability unit IIIe-9. Deep or moderately deep, moderately dark colored, well-drained soils that are on gently sloping and sloping, moderately eroded and severely eroded terraces and kames.

Capability unit IIIe-12. Deep or moderately deep, moderately dark colored and dark colored soils that are on gently sloping terraces and have a sandy loam or fine sandy loam surface layer.

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

Capability unit IIIw-5. Deep, light-colored, poorly drained soils on nearly level uplands.

Capability unit IIIw-7. Moderately deep, moderately dark colored, somewhat poorly drained soils on glacial drift, sandstone, or shale of nearly level uplands.

Capability unit IIIw-9. Deep, very poorly drained, dark-colored soils on flood plains.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs-1. Moderately deep or deep, well-drained, moderately dark colored and dark colored soils that are on nearly level terraces and outwash plains and have a sandy loam or fine sandy loam surface layer.

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

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-1. Deep, well-drained, moderately dark colored soils that are on terraces and on till and outwash plains and are sloping to moderately steep and slightly eroded to severely eroded.

Capability unit IVe-2. Deep, well-drained, moderately dark colored and dark colored soils that are on sloping till and outwash plains and are severely eroded.

Capability unit IVe-3. Deep, well-drained, moderately dark colored, silty soils that are on sloping, severely eroded uplands.

Capability unit IVe-5. Deep, well-drained, light-colored to moderately dark colored, loamy soils that are on sloping, severely eroded uplands.

Capability unit IVe-8. Shallow to moderately deep, well-drained, loamy soils that are on gently sloping and sloping, slightly eroded to severely eroded uplands and are underlain by sandstone, siltstone, and shale.

Capability unit IVe-9. Moderately deep or deep, well-drained, moderately dark colored soils that occur on terraces, on scattered knolls, and along the border of outwash plains and are sloping to moderately steep and moderately eroded or severely eroded.

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

Capability unit IVw-3. Organic materials 12 to 42 inches thick over sand, loamy sand, or coarse sandy loam.

Subclass IVs. Soils that have very severe limitations of stoniness, low moisture capacity, or other soil features.

Capability unit IVs-1. Deep, well-drained, moderately dark colored soils that are on gently sloping to sloping, sandy glacial till and have a loamy fine sand surface layer.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover. (No soils in class V occur in this county.)

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

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIe-1. Shallow to deep, well-drained, slightly eroded to severely eroded soils on gently sloping to steep terraces and till and outwash plains.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw-1. Marl covered by mucky loam less than 12 inches thick.

Subclass VIi. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Capability unit VIi-1. Deep, well-drained, sandy soils that are on strongly sloping terraces.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIIe-1. Very shallow or shallow, steep or very steep soils and pits of gravel, coal dumps, and strip-mined areas.

Subclass VIIs. Soil very severely limited by moisture capacity, stones, or other soil features.

Capability unit VIIs-1. Very shallow, very stony, nearly level to very steep soils on bottom lands and terrace breaks.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes. (No soils in class VIII occur in this county.)

Management by capability units

The soils of Fountain County have been placed in 38 capability units, each of which is discussed in the following pages. All the soils in one unit are suitable for the same kinds of crops, and, under the same kind of management, produce similar yields. Discussed for each unit are the characteristics of the soils in the unit, the suitability of these soils for crops, and management suitable for the soils. The crop rotations mentioned are not the only rotations suited to the soils in a group but are given only as examples. Representatives of the Soil Conservation Service will help you select a cropping system that maintains your soils.

CAPABILITY UNIT I-1

This capability unit consists of nearly level, well drained and moderately well drained soils on terraces, uplands, and outwash plains. These soils are deep and have a silt loam or loam surface layer and a silty clay loam to sandy clay loam subsoil. They are moderately dark and dark colored. Limitations to cropping are few. These soils generally hold enough water for crop use. They are—

Alford silt loam, gravelly substratum, 0 to 2 percent slopes.
 Alford silt loam, 0 to 2 percent slopes.
 Birkbeck silt loam, 0 to 2 percent slopes.
 Dana silt loam, 0 to 2 percent slopes.
 Ockley silt loam, 0 to 2 percent slopes.
 Ockley loam, 0 to 2 percent slopes.
 Princeton loam, 0 to 2 percent slopes.
 Sidell silt loam, 0 to 2 percent slopes.
 Tippecanoe silt loam, 0 to 2 percent slopes.
 Wea silt loam, 0 to 2 percent slopes.
 Wingate silt loam, 0 to 2 percent slopes.
 Xenia silt loam, 0 to 2 percent slopes.

These soils generally are in areas too small to manage alone that lie next to larger areas of other soils. Some areas, however, are large enough to manage separately. These are among the best soils for farming in the county. They are moderately acid and generally low in phosphate, low to medium in nitrogen, and medium in potash.

Maintaining and improving fertility and tilth are the main needs.

These nearly level soils are suited to all grain and meadow crops adapted to the area. A mixture of alfalfa, orchardgrass, and ladino clover is good. Bromegrass or timothy may be used instead of the orchardgrass.

These soils respond well to good management. If the level of management is average, a suitable rotation is 2 years of a row crop and 1 year of a small grain followed by a grass or legume intercrop. If the level of management is high, 3 years of a row crop and 1 year of a small grain followed by a grass or legume intercrop are suitable, or a row crop can be grown every year.

These soils do not need tile, but tile mains from nearby soils may have outlets on these soils. To intercept runoff from higher, adjacent soils, it may be desirable to construct diversion ditches.

CAPABILITY UNIT I-2

This capability unit consists of nearly level, well-drained soils on flood plains of the Wabash River and other streams. These soils are deep and uneroded. They have a fine sandy loam to silty clay loam surface layer and a fine sandy loam to silt loam subsoil. They are moderately dark colored. The only limitation is the flooding that usually occurs in winter and early in spring and normally does not damage crops. The soils generally hold enough water for crops. They are—

- Genesee loam.
- Genesee loam, high bottom.
- Genesee silt loam.
- Genesee silty clay loam.
- Huntsville silt loam.
- Landes fine sandy loam.

These soils are generally low in nitrogen. Crops on these soils respond to fertilizer, but fertilization should be on a year-to-year basis because flooding is likely on most soils in the unit. Flooding is infrequent on Genesee loam, high bottom, and planting occasional green-manure or winter cover crops improves that soil.

The soils in this unit are used mostly for corn and soybeans, but Genesee loam, high bottom, is well suited to wheat and alfalfa. The soils can be cropped intensively, and are easily worked; under good management, they produce high yields. Minimum tillage is suitable. Some narrow irregular areas are difficult to cultivate and are best suited to grass, trees, and wildlife.

The main limitation on these soils is flooding early in spring. Random tile lines are needed in many places to drain low spots and seeps that receive water from adjacent soils. Diversions are needed to take away water that flows from higher soils. Sod established in overflow channels and along bare streambanks helps to reduce scouring.

CAPABILITY UNIT II-1

This capability unit consists of deep, gently sloping, moderately well drained and well drained soils that occur on terraces, till and outwash plains, or moraines. These soils are moderately dark colored and have a loam or silt loam surface layer and a sandy clay loam to silty clay loam subsoil. Erosion is slight or moderate and is the major hazard. These soils generally hold more water than crops can use. They are—

- Camden loam, 2 to 6 percent slopes, moderately eroded.
- Celina silt loam, 2 to 6 percent slopes, moderately eroded.
- Miami silt loam, 2 to 6 percent slopes, moderately eroded.
- Ockley silt loam, 2 to 6 percent slopes.
- Ockley silt loam, 2 to 6 percent slopes, moderately eroded.
- Russell silt loam, 2 to 6 percent slopes.
- Russell silt loam, 2 to 6 percent slopes, moderately eroded.
- Nenia silt loam, 2 to 6 percent slopes, moderately eroded.

If phosphate and potash are kept at a high level, these soils produce medium or high yields of legume-grass meadow and small grain. If enough nitrogen is added, the yields of corn are high.

These soils are well suited to all grain and meadow crops adapted to this area. Alfalfa-bromegrass, alfalfa-orchardgrass, or other grass-legume mixtures send their roots down deeper than does red clover or timothy and help to improve soil structure more. During dry weather, deeper root penetration results in high yields of hay and pasture.

If the management of these soils is average, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. If contour tillage is used, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 2 years of meadow. If the level of management is high, but contour tillage is not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 1 year of meadow. If contour tillage is used, and management is at a high level, 3 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT II-2

This capability unit consists of gently sloping, moderately well drained and well drained, dark-colored soils that are eroded or susceptible to erosion. These soils are on till and outwash plains and have a mantle of silt. They are deep and have a silt loam surface layer and a clay loam or silty clay loam subsoil. They generally can hold more water than crops can use. The soils are—

- Dana silt loam, 2 to 6 percent slopes, moderately eroded.
- Parr silt loam, 2 to 6 percent slopes, moderately eroded.
- Sidell silt loam, 2 to 6 percent slopes.
- Sidell silt loam, 2 to 6 percent slopes, moderately eroded.
- Wea silt loam, 2 to 6 percent slopes.
- Wea silt loam, 2 to 6 percent slopes, moderately eroded.
- Wingate silt loam, 2 to 6 percent slopes.
- Wingate silt loam, 2 to 6 percent slopes, moderately eroded.

Although these moderately acid soils were naturally high in fertility before they were cultivated, they are now generally low in phosphate, medium in potash, and medium to high in nitrogen. Corn responds well to additions of nitrogen. If available phosphate is maintained at a high level, a small grain does well.

These soils are well suited to all grain and meadow crops adapted to the area. Legume-grass mixtures, such as alfalfa-bromegrass or alfalfa-orchardgrass, produce high yields of hay.

These soils respond well to good management. If the level of management is average, and contour tillage or other practices to control runoff are not used, a suitable rotation is 2 years of a row crop, 1 year of a small grain, and 2 years of meadow. If contour tillage is used, a suitable rotation is 1 year of a row crop and 1 year of a small grain followed by a grass or legume intercrop. If the level of management is high, but contour tillage or

other practices are not used, a suitable rotation is 2 years of a row crop, 1 year of a small grain, and 1 year of meadow. If contour tillage is used, and management is at a high level, a row crop can be grown every year.

CAPABILITY UNIT IIc-3

This capability unit consists of deep, gently sloping, moderately well drained and well drained soils that occur on uplands covered with windblown silt and fine sand. These soils are moderately dark colored and have a silt loam or loam surface layer and a clay loam or silty clay loam subsoil. Erosion is slight or moderate and is the major hazard. These soils generally hold more water than crops can use. They are—

- Alford silt loam, 2 to 6 percent slopes.
- Alford silt loam, 2 to 6 percent slopes, moderately eroded.
- Birkbeck silt loam, 2 to 6 percent slopes.
- Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded.
- Princeton loam, 2 to 6 percent slopes, moderately eroded.

Although these moderately acid soils were naturally medium in fertility before they were cultivated, they are now generally low in phosphate and nitrogen and medium in potash. A moderate amount of lime is generally needed. Crops respond well to additions of fertilizer and to other good management.

These soils are well suited to all grain and meadow crops adapted to the area. An alfalfa-brome-grass mixture is especially well suited to meadow. Corn, soybeans, small grain, and meadow crops produce medium to high yields if management is good.

If the level of management is average, and contour tillage and other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. If contour tillage is used, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable. If these soils are terraced, and management is at an average level, 2 years of row crops and 1 year of a small grain followed by a grass or legume intercrop are suitable. If management is at a high level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 1 year of meadow. If these soils are tilled on the contour and managed well, 3 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable. Terracing will permit a row crop to be grown continuously.

CAPABILITY UNIT IIc-5

The only soil in this capability unit is Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded. This soil occurs on uplands covered with windblown coarse silt and fine sand and is deep, gently sloping, and well drained. It is moderately dark colored and has a fine sandy loam surface layer and a sandy clay loam to clay loam subsoil. Erosion is moderate and the main hazard. The soil generally holds more water than crops use, but it may be slightly droughty in dry years.

This soil is generally very low in phosphate and nitrogen and is medium in potash. The need for lime is generally moderate. If nitrogen and phosphate are kept at an adequate level, yields of corn are medium.

This soil is suited to all grain and meadow crops adapted to the area. Because of erosion and slight droughtiness, only medium yields can be expected. Or-

chard fruits and other special crops grow well, as does meadow planted to an alfalfa-brome-grass mixture.

If the level of management is average, and contour tillage or other practices to control erosion are not used, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 2 or 3 years of meadow. If contour tillage is used, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable. If management is at a high level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 1 year of meadow. If management is at a high level, and contour tillage is used, a suitable rotation is 2 years of row crops and 1 year of small grain followed by a grass or legume intercrop.

CAPABILITY UNIT IIc-9

This capability unit consists of gently sloping, well-drained soils that are moderately deep or deep and occur on terraces and outwash plains. These soils are dark and moderately dark colored and have a silt loam or loam surface layer and a gravelly sandy loam to gravelly clay loam subsoil. Erosion is the main hazard, but droughtiness is also a problem. These soils generally supply a medium amount of water to crops during the growing season. They are—

- Elston loam, 2 to 6 percent slopes, moderately eroded.
- Fox silt loam, 2 to 6 percent slopes.
- Fox silt loam, 2 to 6 percent slopes, moderately eroded.
- Fox loam, 2 to 6 percent slopes.
- Fox loam, 2 to 6 percent slopes, moderately eroded.
- Warsaw loam, 2 to 6 percent slopes, moderately eroded.

Natural fertility was medium to high before these soils were cultivated. The moderately dark colored Fox soils, however, are now generally low in nitrogen and phosphate and medium in potash; the dark colored Elston and Warsaw soils are low in phosphate. Because the soils in this unit are leached readily, fertilizer should be added on a year-to-year basis rather than added in large amounts for the purpose of carrying some over to future years.

These soils are suited to all grain and meadow crops adapted to the area. They are especially well suited to small grain and to deep-rooted legumes and grasses. If corn or soybeans are planted, a high level of management is needed because erosion is a hazard and the soils tend to be droughty during the latter part of the growing season. Yields of small grain are higher than those of corn or soybeans, but better yields of corn can be expected if early maturing varieties are planted. An alfalfa-brome-grass mixture is best suited to these soils because its deep roots obtain more moisture during dry periods.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. Under average management and contour tillage, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable. If management is at a high level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 2 years of row crops, 1 year of a small grain,

and 3 years of meadow. Under a high level of management and contour tillage, 3 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IIw-1

This capability unit consists of deep, very poorly drained soils that occur on nearly level or depressional flats of uplands, terraces, and outwash plains. They are moderately dark colored to very dark colored and have a silt loam or silty clay loam surface layer and a silty clay loam or clay loam subsoil. These soils are not eroded; their main limitation is wetness. They have slow to very slow runoff and permeability. The capacity to hold water that crops can use is good. The soils are—

Brookston silty clay loam.
Ragsdale silty clay loam.
Ragsdale silty clay loam, till substratum.
Romney silty clay loam.
Romney silty clay loam, gravelly substratum.
Washtenaw silt loam.
Westland silt loam.
Westland silty clay loam.
Westland silty clay loam, loamy substratum.

These soils are generally more deficient in available potash than in phosphate and nitrogen. If the benefits from added fertilizers are to be maximum, drainage systems must be installed. To obtain high yields, add fertilizer in amounts indicated by soil tests.

If these soils are adequately drained, they are suited to row crops, small grain, and meadow. If management, including drainage and fertilization, is good, these soils generally produce high yields. The yields of corn, soybeans, and hay will be high, and those of small grain will be medium. Alfalfa, red clover, ladino clover, brome-grass, and orchardgrass grow well on these soils.

Suitable for draining these soils are deep open ditches (fig. 5), tile drains, shallow surface drains (fig. 6), and diversion ditches. The tile is laid at a depth of 3 to 3½ feet in lines 65 to 100 feet apart. The depth and spacing of the lines depend on the kind of soil and on local conditions.



Figure 5.—Box-notch drop spillway used to control grade and stabilize the soil and to prevent the open ditch from cutting back.



Figure 6.—An open ditch with 3:1 side slopes that have been planted to grasses and legumes to stabilize the banks.

An investigation of the depth to the underlying material is needed in the Westland and other soils that are underlain by gravel, sand, and silty layers. Special construction is required if tile drains are installed in the Westland and Romney soils that are underlain by gravel and sand. In the Westland soil that has a loamy substratum, special construction is also required, for that soil is underlain by interbedded sandstone and fine sand. To learn about this special construction, it is advisable to obtain the assistance of qualified technicians.

In addition to drainage, there are problems of structure and tillage because these soils have a high content of clay. Tillage can be improved by working the soils only when the content of moisture is favorable and, to add organic matter, by using crop residues and by growing hay crops. Also, minimum tillage helps to improve the tillage of these soils.

CAPABILITY UNIT IIw-2

This capability unit consists of nearly level and gently sloping, somewhat poorly drained soils that occur on broad flats of terraces and on till and outwash plains. These soils are moderately dark colored and dark colored and have a silt loam or loam surface layer and a silty clay loam or clay loam subsoil. Wetness is the main limitation, but some of the gentle slopes are susceptible to erosion, and a few of these soils are moderately eroded. The soils in this unit hold more water than crops can use. They are—

Ayrshire loam.
Crane silt loam.
Crosby silt loam, 0 to 2 percent slopes.
Fincastle silt loam, 0 to 2 percent slopes.
Fincastle silt loam, 2 to 6 percent slopes.
Fincastle silt loam, 2 to 6 percent slopes, moderately eroded.
Raub silt loam.
Reesville silt loam, 0 to 2 percent slopes.
Reesville silt loam, 2 to 6 percent slopes, moderately eroded.
Sleeth silt loam.
Sunbury silt loam.
Whitaker loam.
Whitaker silt loam.

The dark-colored Crane, Raub, and Sunbury soils are medium in nitrogen. The rest of the soils in the unit are moderately dark colored and are generally very low in

nitrogen and low in phosphate and potash. All the soils in this unit are generally acid and respond well to additions of lime and fertilizer if drainage is improved.

These soils are suited to all grain and meadow crops adapted to the area if adequate drainage is installed (fig. 7). A mixture of alfalfa, bromegrass, and ladino clover does well as meadow in drained areas, and timothy mixed with birdsfoot trefoil does well in drained or undrained areas.

If the level of management is average, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 1 year of meadow; or 2 years of row crops and 1 year of a small grain followed by an intercrop. If management is at a high level, row crops can be grown continuously.

The slow internal drainage causes the main problems on these soils. Although the gently sloping soils are slightly susceptible to erosion, terracing or contour farming would increase wetness and should be practiced only in tilled areas. In many places a diversion terrace is needed to divert surface runoff that would come in from higher areas. Tile is generally used to drain these soils. It is laid at a depth of 3 to 3½ feet in lines 50 to 80 feet apart. The depth of the tile and the spacing depend on the kind of soil and on local conditions.

Because the surface layer of the moderately dark colored Ayrshire, Crosby, Fincastle, Reesville, Sleeth, and Whitaker soils has extremely weak structure, its soil material tends to run together when it is wet. Tilth can be improved by adding manure, by minimum tillage, and by planting deep-rooted legumes and sod-forming grasses. These practices also improve drainage. Field operations are sometimes delayed in spring because these soils warm up slowly. Wetness also delays field operations.

CAPABILITY UNIT IIw-4

Westland silty clay loam, moderately deep, is the only soil in this capability unit. This soil occurs in depressions of terraces and is moderately deep or deep, nearly level, and very poorly drained or ponded. It is dark colored and has a silty clay loam surface layer and a



Figure 7.—Straight drop spillway constructed to stabilize the grade and to be an outlet for tile.

clay loam to sandy clay loam subsoil. The major hazard is wetness. Surface runoff and permeability are slow or very slow. The soil holds more water than crops can use.

This neutral soil is generally low in available potash and medium in available phosphate and nitrogen. Crops respond well and produce medium yields if fertilizer is added and drainage is good.

Drained areas are suited to all grain and meadow crops adapted to the area. Yields of corn, soybeans, and other row crops are regularly higher than those of small grain. Suitable as meadow, if drainage and fertility are good, are mixtures of ladino clover, alfalfa, and bromegrass and of alfalfa, red clover, and orchardgrass. Fescue and ladino clover do well in undrained areas that are low in fertility.

If management is at an average level, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 1 year of meadow; or 2 years of row crops and 1 year of a small grain followed by an intercrop. If the level of management is high, row crops can be grown continuously.

In many areas of this soil open ditches are needed because the water table is high or a perched water table occurs. The ditches should be 2½ to 4 feet deep and spaced 330 to 600 feet apart. If tile is used alone or to supplement the ditches, the tile lines should be 3 to 4 feet deep and spaced 100 to 150 feet apart. Because this soil is underlain by gravel and sand, special binding or filters are needed to prevent clogging. It is advisable to obtain assistance from qualified technicians if special construction is required.

CAPABILITY UNIT IIw-5

Westland silty clay loam, thin solum variant, is the only soil in this capability unit. This soil occurs on flats and in depressions of terraces and is moderately deep, nearly level, and very poorly drained. It is dark colored and has a silty clay loam surface layer and a silty clay loam or clay loam subsoil. Wetness is the major hazard. Surface runoff and permeability are slow or very slow. The soil holds more water than crops can use.

This soil is generally slightly acid, low in available potash, and medium in phosphate and nitrogen. An adequate drainage system is needed if the benefits from the fertilizer are to be maximum.

If drainage is adequate, this soil is best suited to row crops and clovers, but small grain can be grown. Undrained areas are suited only to permanent pasture. Meadows in fescue or in a mixture of reed canarygrass, ladino clover, and alsike clover do better than meadows in an alfalfa-grass mixture because the alfalfa is less tolerant of moisture.

If the level of management is average, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 1 year of meadow; or 2 years of row crops and 1 year of a small grain followed by an intercrop. Under a high level of management, continuous row crops can be grown.

Shallow surface drains are adequate for drainage. Although tile is not needed to drain this soil, it may be necessary for a tile main from more tillable soils to cross an area of this soil in reaching a suitable outlet. When tile is used, the area should be examined thoroughly, for solid bedrock is at a depth of 25 to 45 inches.

CAPABILITY UNIT IIw-7

This capability unit consists of soils that occur on flood plains and are deep, nearly level, and somewhat poorly drained to moderately well drained. These soils are moderately dark colored and dark colored and have a loam to silty clay loam surface layer and a stratified silty, sandy, or mucky subsoil. They are subject to periodic flooding and are limited mainly by wetness. Surface runoff and permeability are slow. The soils generally hold more water than plants can use. They are—

Eel loam.
Eel silt loam.
Eel silty clay loam.
Shoals silt loam.
Shoals silty clay loam.
Wallkill silty clay loam.

These soils are generally neutral. They contain a small amount of phosphate and potash. The moderately dark colored soils are low in nitrogen. Generally, it is best to fertilize along the rows and later to sidedress with nitrogen so that a large amount of fertilizer is not lost during floods. The response to fertilizer is better in drained areas than in undrained ones.

Broad areas of these soils along the large streams are best suited to continuous row crops. Yields are medium to high if management is good. A few areas along the small streams are severely dissected and are best suited to permanent pasture. The pasture mixtures best suited are reed canarygrass, fescue, or orchardgrass mixed with ladino clover or alsike clover. If these dissected areas are to be used for crops, it is advisable to aline and straighten the channels, to remove brush, and to keep outlets open.

The main hazards are caused by slow drainage in the subsoil and by impounded flood water. On most of the soils, tile should be laid at a depth of 3 to 3½ feet in lines 50 to 80 feet apart. Shallow surface drains, either random or parallel, remove impounded water and at the same time supplement the tile. On the Wallkill soils, first dig open ditches 3 feet deep and spaced 200 feet apart. Allow these ditches to drain the soil for 3 to 5 years, or until the soil has settled. Then lay the tile as suggested for the other soils in this unit. In this way the water table can be held at a depth of about 3 feet. On all the soils in this unit, open ditches dug at the base of adjoining slopes will intercept seepage water.

CAPABILITY UNIT IIb-1

This capability unit consists of moderately deep or deep, well-drained soils that occur on nearly level terraces and outwash plains. These soils are moderately dark colored or dark colored and have a silt loam or loam surface layer and a gravelly sandy loam to gravelly clay loam subsoil. The major hazard is droughtiness. The soils supply a medium amount of moisture to crops during the growing season. They are—

Elston loam, 0 to 2 percent slopes.
Fox silt loam, 0 to 2 percent slopes.
Fox loam, 0 to 2 percent slopes.
Warsaw silt loam, 0 to 2 percent slopes.
Warsaw loam, 0 to 2 percent slopes.

The moderately dark colored Fox soils are generally low in nitrogen and phosphate and medium in potash.

The dark-colored Elston and Warsaw soils are low in phosphate and medium in nitrogen and potash.

These soils are suited to all crops adapted to the area. Because the distribution of rainfall is irregular on these somewhat droughty soils, small grain and deep-rooted legumes have higher, more uniform yields than corn, soybeans, or other row crops. If corn or soybeans are grown, early maturing varieties should be planted so that the droughty period late in summer is avoided. Alfalfa mixed with brome grass or orchardgrass has the highest yields. The roots of the alfalfa penetrate deeply into the soils and obtain moisture in droughty periods.

If management is at an average level, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 2 years of meadow. A suitable rotation at a high level of management is 2 years of row crops and 1 year of a small grain followed by an intercrop.

CAPABILITY UNIT IIb-4

Only High Gap silt loam, 0 to 2 percent slopes, is in this capability unit. This soil occurs on uplands, generally near breaks, and is moderately deep, nearly level, and well drained. It is moderately dark colored and has a silt loam surface soil and a clay loam subsoil. The major hazard is droughtiness. The soil supplies only a small or medium amount of water to plants during the growing season.

This soil is generally very strongly acid, low in nitrogen and phosphate, and medium in potash. Crops, however, respond well to fertilizer applied in appropriate amounts.

This soil is suited to all crops adapted to the area. Because its available moisture capacity is low or medium, the soil is better suited to small grain and meadow than to row crops. A mixture of birdsfoot trefoil and orchardgrass does well as meadow and requires only medium amounts of fertilizer. This mixture is palatable to livestock.

A suitable rotation under an average level of management is 1 year of a row crop, 1 year of a small grain, and 1 or 2 years of meadow. If management is at a high level, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IIIc-1

This capability unit consists of deep, gently sloping and sloping, well-drained soils that occur on till and outwash plains of uplands. These soils are moderately dark colored and have a silt loam to clay loam surface layer and a clay loam subsoil. Erosion ranges from slight to severe and is the major hazard, but drought is likely in years that are drier than normal. These soils generally supply a moderate amount of water to crops during the growing season. They are—

Miami silt loam, 6 to 12 percent slopes.
Miami silt loam, 6 to 12 percent slopes, moderately eroded.
Miami soils, 2 to 6 percent slopes, severely eroded.
Ockley silt loam, 6 to 12 percent slopes.
Ockley silt loam, 6 to 12 percent slopes, moderately eroded.
Ockley soils, 2 to 6 percent slopes, severely eroded.
Russell silt loam, 6 to 12 percent slopes.
Russell silt loam, 6 to 12 percent slopes, moderately eroded.
Russell soils, 2 to 6 percent slopes, severely eroded.

These moderately acid soils are generally low in nitrogen and phosphate and medium in potash. Crops respond well to additions of lime and fertilizer.

These soils are suited to all crops adapted to the area. They are best suited to small grain and meadow because slopes are generally strong and erosion is a hazard. Corn and other row crops can be grown, but normally not more than once every 2 or 3 years. Crop yields are generally low or medium. The yields of small grain and meadow are better and more uniform than those of row crops. Alfalfa mixed with bromegrass and birdsfoot trefoil mixed with timothy are well suited to these soils and produce high yields.

If the level of management is average, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 2 years of meadow. If contour tillage is used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 years of meadow. On terraces under average management, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable. If management is at a high level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 5 years of meadow. Under a high level of management and contour tillage, 1 year of a row crop, 1 year of a small grain, and 2 years of meadow are suitable. On terraces under a high level of management, 3 years of row crops, 1 year of a small grain, and 1 or 2 years of meadow are suitable.

CAPABILITY UNIT IIIe-2

This capability unit consists of deep, well-drained, gently sloping or sloping soils that occur on moraines and till and outwash plains and are moderately eroded or severely eroded. These soils are generally dark colored but are moderately dark colored in places where the original surface soil has been washed away. They have a silt loam to clay loam surface layer and a silty clay loam or clay loam subsoil. The major hazard is erosion. The soils generally supply a moderate amount of water to plants during the growing season. They are—

- Parr silt loam, 6 to 12 percent slopes, moderately eroded.
- Parr soils, 2 to 6 percent slopes, severely eroded.
- Sidell soils, 2 to 6 percent slopes, severely eroded.
- Wea soils, 2 to 6 percent slopes, severely eroded.

These soils are medium acid. They are generally low in phosphate and medium in potash and nitrogen, but in severely eroded areas they are low in all three of these plant nutrients. If management is good, the response to additions of fertilizer is good. Wheat responds especially well to additions of phosphate.

These soils are suited to all crops adapted to the area but are best suited to small grain and meadow. Row crops can be grown, but generally not more than once every 2 or 3 years. Alfalfa mixed with bromegrass or orchardgrass is especially suitable for meadow. In severely eroded areas that are kept in permanent pasture, a mixture of birdsfoot trefoil and timothy does as well as other mixtures and does not require so much fertilizer.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 years of meadow. Under average management and contour tillage, 2 years of row crops,

1 year of a small grain, and 3 years of meadow are suitable. If management is average and terraces are used, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 3 years of meadow. If contour tillage is used, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable. On terraces under a high level of management, 3 years of row crops and 1 year of a small grain followed by an intercrop are suitable.

CAPABILITY UNIT IIIe-3

This capability unit consists of deep, well-drained, sloping soils that occur on uplands covered with a thick layer of windblown silt. These soils are moderately dark colored and have a silt loam or silty clay loam surface layer and silty clay loam subsoil. Erosion ranges from slight to severe and is the major hazard. These soils generally hold more water than crops can use. They are—

- Alford silt loam, 2 to 6 percent slopes, severely eroded.
- Alford silt loam, 6 to 12 percent slopes.
- Alford silt loam, 6 to 12 percent slopes, moderately eroded.

These soils are generally low in phosphate and nitrogen and medium in potash. A moderate amount of lime is generally needed. Crops respond well to fertilizer applied in appropriate amounts.

These soils are suited to all crops adapted to the area. Because they are susceptible to further erosion, the soils are better suited to small grain and meadow than they are to row crops because less intensive management is needed. Row crops generally should not be grown more than once every 2 or 3 years. A mixture of alfalfa and bromegrass is especially well suited as meadow.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 3 years of meadow are suitable. On terraces under average management, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 1 year of meadow are suitable. On terraces managed at a high level, 2 years of row crops and 1 year of a small grain followed by an intercrop are suitable.

CAPABILITY UNIT IIIe-5

The only soil in this capability unit is Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded. This soil is deep and well drained. It occurs on uplands that are covered by windblown coarse silt and fine sand. It is moderately dark colored and has a fine sandy loam surface layer and a sandy loam to clay loam subsoil. Erosion is the major hazard, but droughtiness is also a problem. The soil generally supplies a medium amount of water that plants can use during the growing season.

This soil is generally very low in phosphate and nitrogen and medium in potash. The need for lime is moderate.

The soil is suited to all crops adapted to the area. It is best suited to small grain and deep-rooted legumes and grasses because it is susceptible to further erosion and is slightly droughty during the latter part of the growing season. A meadow in alfalfa mixed with brome grass does well.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 or 5 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 2 years of meadow are suitable. On terraces, if management is average, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 3 years of meadow. If contour tillage is used, and management is at a high level, 2 years of row crops, 1 year of a small grain, and 3 years of meadow are suitable. On terraces, if management is at a high level, 3 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IIIe-8

This capability unit consists of moderately deep, well-drained soils that are next to or near breaks on gently sloping uplands and are underlain by sandstone, siltstone, or shale. These soils are moderately dark colored and have a silt loam surface layer and a clay loam subsoil. They are slightly or moderately eroded and are likely to be droughty. The soils generally supply only a small amount of water to crops during the growing season. They are—

High Gap silt loam, 2 to 6 percent slopes.

High Gap silt loam, 2 to 6 percent slopes, moderately eroded.

These soils are generally very strongly acid, low in nitrogen and phosphate, and low or medium in potash. The response to additions of lime and fertilizer is fair.

These soils are suited to all crops adapted to the area. They are more suitable for small grain and meadow than for row crops. A good mixture for meadow is birdsfoot trefoil and orchardgrass because it grows as well as other legume-grass mixtures and requires only a medium level of fertility. Row crops should not be used in a rotation more than one-third of the time.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 years of meadow. If contour tillage is used, 2 years of row crops, 1 year of a small grain, and 3 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 3 years of meadow. If contour tillage is used, and management is at a high level, 2 years of row crops, 1 year of a small grain, and 2 years of meadow are suitable.

CAPABILITY UNIT IIIe-9

This capability unit consists of deep or moderately deep, gently sloping and sloping, well-drained soils that are on moderately eroded and severely eroded terraces and kames. These soils overlie gravel. They are moderately dark colored and have a silt loam or gravelly clay loam surface layer and a gravelly clay loam subsoil. The major hazards are erosion and droughtiness. The soils generally supply only a little water to crops during the growing season. They are—

Fox silt loam, 6 to 12 percent slopes, moderately eroded.

Fox soils, 2 to 6 percent slopes, severely eroded.

These soils are generally moderately acid, low in nitrogen and phosphate, and medium in potash. Because the soils are leached readily, it is better to apply fertilizer on a year-to-year basis than to add it in large amounts with the purpose of carrying some over to future years.

These soils are suited to all crops adapted to the area. Small grain and meadow produce higher and more uniform yields than row crops. Meadows in alfalfa mixed with brome grass or orchardgrass and in birdsfoot trefoil mixed with timothy do well on these soils because those mixtures are tolerant of drought.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 2 years of meadow. If contour farming is used, 1 year of a row crop, 1 year of a small grain, and 2 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 3 or 4 years of meadow. If contour tillage is used, and the level of management is high, 1 year of a row crop, 1 year of a small grain, and 2 years of meadow are suitable.

CAPABILITY UNIT IIIe-12

This capability unit consists of soils that occur on terraces and are well drained, deep or moderately deep, and moderately eroded. These soils are moderately dark colored and dark colored and have a fine sandy loam or sandy loam surface layer and a gravelly sandy loam to gravelly clay loam subsoil. The underlying material is gravel and sand. Erosion is the major hazard, but droughtiness is also a problem. The soils generally supply a small to medium amount of moisture to plants during the growing season. They are—

Elston sandy loam, 2 to 6 percent slopes, moderately eroded.

Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded.

The moderately dark colored Fox soil is generally moderately acid, low in phosphate and nitrogen, and medium in potash. The dark-colored Elston soil is higher in nitrogen than the Fox soil but has about the same content of phosphate and potash. Because both of these soils are leached readily, it is better to apply fertilizer on a year-to-year basis rather than to apply it in large amounts with the purpose of carrying some over to future years.

These soils are suited to all crops adapted to the area. Yields of small grain and meadow are higher and more uniform than those of row crops. Row crops should not be grown on these soils more than one-third or one-half of the time.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. If contour tillage is used, 2 years of row crops, 1 year of a small grain, and 1 or 2 years of meadow are suitable. If management is at a high level, but contour tillage and other practices to control erosion are not used, a suitable rotation is 2 years of row crops, 1 year of a small grain, and 2 years of meadow. With contour tillage and a high level of management, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IIIw-5

Only Delmar silt loam is in this capability unit. This uneroded, light-colored soil occurs on flats and till plains and is nearly level and poorly drained. It is deep and has a silt loam surface layer and a silty clay loam or clay loam subsoil. The major limitation to its use is wetness, for surface runoff is very slow or ponded and permeability is very slow. The soil can hold more water than crops can use.

This soil generally is very acid, very low in nitrogen, and low in phosphate and potash. An adequate drainage system is needed if maximum benefits are to be obtained from fertilizer. Also needed are practices that improve soil structure and tilth. The soil should be worked only when the content of moisture is favorable. In addition, hay should be grown, crop residues used properly, and minimum tillage practiced.

If this soil is drained, it is best suited to row crops and clovers, but small grain can be grown. Even if drains are installed, crop yields are low. Only trees and water-tolerant grasses are suitable in areas that are not drained. If this soil is used as grassland, a mixture of fescue, ladino clover, and alsike clover; of reed canary-grass, ladino clover, and alsike clover; or of similar grasses and clovers will do better than a mixture of alfalfa and grasses. The clovers are more tolerant of moisture than the alfalfa.

Although this soil is not well suited to tiling, it is tilled in many places because it is in small patches interspersed among large areas of soils that are easier to drain and are well suited to tiling. Managing these small patches differently from the surrounding soils is not practical. Tests for acidity should be made before tiling to determine whether acid-resistant tile is needed.

CAPABILITY UNIT IIIw-7

Shadeland silt loam is the only soil in this capability unit. It occurs on uplands near breaks and is underlain by glacial drift, sandstone, or shale. This soil is moderately deep, nearly level, and somewhat poorly drained. It is moderately dark colored and has a silt loam surface layer and a silty clay loam or clay loam subsoil. Wetness is the major limitation; surface runoff and permeability are slow. The soil generally supplies a medium or large amount of water to plants during the growing season.

This soil generally is strongly acid, very low in nitrogen, and low in phosphate and potash.

The soil is best suited to permanent pasture or to meadow, but under good management, row crops and small grain can be grown. In areas of this soil that

have low fertility and are used for meadow, a mixture of orchardgrass and alsike clover does as well as any. Birdsfoot trefoil mixed with timothy does well if fertility is medium. In wooded areas forest management should favor pin oak, sweetgum, white ash, and tulip-poplar.

If management is at an average level, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 1 to 4 years of meadow. Under a high level of management, 3 years of row crops and 1 year of a small grain and an intercrop are suitable.

Because the depth to bedrock ranges from 18 to 30 inches, tile should not be used to drain this soil. Excess surface water can be removed by shallow surface drains. If a tile main from deeper soils is to cross an area of this soil on its way to an outlet, the route of the main should be investigated thoroughly.

CAPABILITY UNIT IIIw-9

This capability unit consists of deep, nearly level, very poorly drained soils in slight depressions of flood plains. These soils are dark colored and have a silt loam or silty clay loam surface layer and a silty clay loam subsoil. The major hazard is wetness; flooding is likely. Surface runoff and permeability are very low. The soils generally hold more water than plants can use. They are—

- Sloan silt loam.
- Sloan silty clay loam.

These neutral soils are generally very low in available potash and medium in phosphate and nitrogen.

Although the soils are best suited to row crops, and are generally kept in row crops continuously, a crop is occasionally damaged by floods. Meadow crops can be grown if water-tolerant grasses and legumes are used.

To remove water on and in these soils, tile lines and shallow surface drains, random or parallel, are used. The tile is laid at a depth of 36 to 42 inches in lines 50 to 80 feet apart. It is supplemented by the surface drains. Open ditches dug at the base of slopes help to intercept seepage water from higher soils.

The amount of clay in these soils affects tilth and structure. Tilth can be improved by effective use of crop residues, by minimum tillage, and by working the soil only when the content of moisture is favorable.

CAPABILITY UNIT IIIs-1

This capability unit consists of moderately deep or deep, nearly level, well-drained soils that are on terraces and outwash plains. These soils are moderately dark colored and dark colored and have a fine sandy loam or sandy loam surface layer and a gravelly sandy loam to gravelly clay loam subsoil. The major hazard is droughtiness. The soils supply a small or medium amount of water to plants during the growing season. They are—

- Elston sandy loam, 0 to 2 percent slopes.
- Fox fine sandy loam, 0 to 2 percent slopes.

The moderately dark colored Fox soil is generally low in nitrogen and phosphate and medium in potash. The dark-colored Elston soil is generally low in phosphate and potash and medium in nitrogen. Since available

moisture capacity limits production, only moderate applications of fertilizer are needed.

These soils are suited to all crops adapted to the area. Because the soils are droughty, small grain and deep-rooted legumes are better suited than row crops and produce higher, more uniform yields. Plant early maturing varieties of row crops so that the crops mature before they are damaged by drought. Best suited for meadow are alfalfa mixed with bromegrass and birdsfoot trefoil mixed with timothy. Crop yields are low to medium.

If management is at an average level, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 1 to 4 years of meadow. Under a high level of management, 2 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IVe-1

This capability unit consists of deep, sloping to moderately steep, well-drained soils that are on terraces and on till and outwash plains. These soils are slightly eroded to severely eroded. They are moderately dark colored and have a silt loam to clay loam surface layer and a silty clay loam to clay loam subsoil. Erosion is the major hazard, but droughtiness is also a problem. The soils generally supply an adequate amount of water to crops during the growing season. They are—

- Miami soils, 6 to 12 percent slopes, severely eroded.
- Ockley silt loam, 12 to 18 percent slopes.
- Ockley silt loam, 12 to 18 percent slopes, moderately eroded.
- Ockley soils, 6 to 12 percent slopes, severely eroded.
- Russell silt loam, 12 to 18 percent slopes.
- Russell silt loam, 12 to 18 percent slopes, moderately eroded.
- Russell soils, 6 to 12 percent slopes, severely eroded.

These moderately acid soils are low in nitrogen and phosphate and medium in potash. The response to additions of lime and fertilizer is good.

These soils are best suited to small grain and meadow. Best yields are produced in meadows of alfalfa mixed with bromegrass or orchardgrass and of birdsfoot trefoil mixed with timothy.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 4 years of meadow. If contour tillage is used, 1 year of a small grain, and 3 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 3 years of meadow. If contour tillage is used, and the level of management is high, 1 year of a small grain and 2 years of meadow are suitable.

CAPABILITY UNIT IVe-2

This capability unit consists of deep, sloping, well-drained soils that occur on till and outwash plains and are severely eroded. These soils are moderately dark colored and dark colored and have a silt loam to clay loam surface layer and a silty clay loam to clay loam subsoil. Erosion is the major hazard, but droughtiness is also a problem. The soils supply a small or medium amount of water to crops during the growing season. They are—

- Parr soils, 6 to 12 percent slopes, severely eroded.
- Wea soils, 6 to 12 percent slopes, severely eroded.

These moderately acid soils are low or medium in nitrogen, low in phosphate, and medium in potash. The response to additions of lime and fertilizer is good.

These soils are suited to most crops adapted to the area, but they are best suited to small grain and meadow. If used for meadow, these soils are well suited to alfalfa mixed with bromegrass or orchardgrass and to birdsfoot trefoil mixed with timothy. If corn is grown, grasses or small grain should be interseeded between the crop rows and allowed to grow after harvest, so that the fields are protected in winter.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 2 or 3 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 4 or 5 years of meadow are suitable. If management is at a high level, but contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 1 or 2 years of meadow. If contour tillage is used, and the level of management is high, 1 year of a row crop, 1 year of a small grain, and 3 years of meadow are suitable.

CAPABILITY UNIT IVe-3

Alford silt loam, 6 to 12 percent slopes, severely eroded, is the only soil in this capability unit. This soil is deep, sloping, and well drained. It occurs on uplands that are covered by loess. It is moderately dark colored and has a silt loam to silty clay loam surface layer and a silty clay loam subsoil. Erosion is the major hazard. The soil has a moderate available moisture capacity.

This soil is suited to all crops adapted to the area but is best suited to small grain and meadow. Alfalfa mixed with bromegrass or orchardgrass is one of the best mixtures for meadow. If row crops are grown, grasses or small grain should be interseeded between the crop rows and allowed to grow after harvest so that the fields are protected in winter.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 2 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 4 or 5 years of meadow are suitable. If management is at a high level, but contour tillage is not used, a suitable rotation is 1 year of a small grain and 1 or 2 years of meadow. If contour tillage is used, and the management is at a high level, 1 year of a row crop, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IVe-5

Princeton soils, 6 to 12 percent slopes, severely eroded, are the only soils in this capability unit. These soils occur on uplands that are covered by windblown material. They are light colored to moderately dark colored and have a loam to sandy clay loam surface layer and a sandy clay loam to clay loam subsoil. Erosion is the main hazard, but droughtiness is also a problem. These soils generally supply a medium amount of water to crops during the growing season.

These soils are generally low in phosphate, nitrogen, and potash. The need for lime is moderate.

The soils are suited to most crops adapted to the area. Because they are susceptible to erosion and are slightly droughty late in the growing season, they are best suited to small grain and deep-rooted legumes and grasses. Alfalfa mixed with brome grass makes a good meadow. Soybeans do not grow well on these soils.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 5 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 2 or 3 years of meadow are suitable. If contour tillage is used, and the level of management is high, 2 years of row crops, 1 year of a small grain, and 3 years of meadow are suitable. With terraces and a high level of management, 3 years of row crops, 1 year of a small grain, and 1 year of meadow are suitable.

CAPABILITY UNIT IVe-8

This capability unit consists of shallow to moderately deep, gently sloping and sloping, well-drained soils that occur on slightly eroded to severely eroded uplands and are underlain by sandstone, siltstone, and shale. These soils are generally next to breaks. They are moderately dark colored and have a silt loam to coarse clay loam surface layer and a clay loam to coarse clay loam subsoil. Their use is limited by erosion and droughtiness. These soils generally supply a small amount of water to crops during the growing season. They are—

High Gap silt loam, 6 to 12 percent slopes.

High Gap soils, 2 to 6 percent slopes, severely eroded.

These soils are generally very strongly acid and low in nitrogen, phosphate, and potash. The response to additions of lime and fertilizer is good.

The soils are best suited to meadow, but except for soybeans, most crops adapted to the area can be grown. Meadow has higher and more uniform yields than small grain or row crops. A good mixture for meadow is birdsfoot trefoil and orchardgrass, for it yields as well as any other mixture, and it does not require so much lime or fertilizer. Row crops generally should not be grown more than once every 3 or 4 years.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 5 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 2 or 3 years of meadow are suitable. If management is at a high level, but contour tillage is not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 years of meadow. With contour tillage and a high level of management, 2 years of row crops, 1 year of a small grain, and 2 or 3 years of meadow are suitable.

CAPABILITY UNIT IVe-9

This capability unit consists of moderately deep or deep, sloping to moderately steep, well-drained soils that are moderately eroded or severely eroded and occur on terraces, on scattered knolls, and along the border of outwash plains. These soils are moderately dark colored

and have a loam to gravelly clay loam surface layer and a silty clay loam to gravelly clay loam subsoil. They are underlain by gravel and sand. Erosion is the major hazard, but droughtiness is also a problem. The soils generally supply only a small amount of water to plants during the growing season. They are—

Fox loam, 12 to 18 percent slopes, moderately eroded.

Fox soils, 6 to 12 percent slopes, severely eroded.

Warsaw soils, 6 to 12 percent slopes, severely eroded.

These soils are generally moderately acid, low in nitrogen and phosphate, and medium in potash. Because the soils are leached readily, it is better to add fertilizer on a year-to-year basis than to add it in large amounts with the purpose of carrying some over to future years.

These soils are best suited to meadow, but except for soybeans, most crops adapted to the area can be grown. Meadow has higher and more uniform yields than small grain or row crops. Alfalfa mixed with brome grass or orchardgrass and birdsfoot trefoil mixed with timothy do well because these mixtures are drought resistant. Row crops should not be grown on these soils more than once in every 5 or 6 years.

If management is at an average level, and contour tillage or other practices to control erosion are not used, a suitable rotation is 1 year of a small grain and 3 or 4 years of meadow. If contour tillage is used, 1 year of a small grain and 2 or 3 years of meadow are suitable. If management is at a high level, but contour tillage is not used, a suitable rotation is 1 year of a small grain and 2 years of meadow. With contour tillage and a high level of management, 1 year of a row crop, 1 year of a small grain, and 5 years of meadow are suitable.

CAPABILITY UNIT IVw-3

Tawas muck is the only soil in this capability unit. This soil occurs on bottom land adjacent to terraces and in abandoned river channels. It is shallow to moderately deep, nearly level, and very poorly drained. It is dark colored and consists of 12 to 42 inches of mucky material over sand, loamy sand, and coarse sandy loam. Wetness is the main hazard. Surface runoff is very slow, or water is ponded. Permeability is moderate or moderately rapid. When the muck dries out, wind erosion occurs. This soil generally supplies a small or medium amount of water to crops during the growing season.

This soil is normally neutral, and it requires little additional lime. It is high in nitrogen but low in available potash. To obtain medium or high yields, adequate amounts of potash and phosphate are needed.

This muck is well suited to soybeans, corn, and other row crops. Under either an average or a high level of management, drained areas are suited to continuous row crops. Areas that cannot be drained should be kept in permanent pasture.

To insure good crop yields, artificial drainage is needed. Diversions are first installed to intercept runoff from uplands. Then open ditches 200 feet apart are dug to a depth of 3 feet. The side slopes of these ditches are 1:1. Dams that cost little can be built to control the water table. This soil is not suitable for drainage by tile.

Crop residues and cover crops can be used to control wind erosion that is likely during winter and early in spring.

CAPABILITY UNIT IVs-1

This capability unit consists of gently sloping to sloping, well-drained soils that occur in areas of sandy till and in areas of dunes. These soils are deep and moderately dark colored. They have a loamy fine sand surface layer and a loamy fine sand to sand subsoil. Erosion is not apparent. The major hazard on these soils is droughtiness, for generally they do not supply enough water to crops during the growing season. The soils are—

Chelsea loamy fine sand, 2 to 6 percent slopes.
Chelsea loamy fine sand, 6 to 12 percent slopes.

These soils are porous and readily leached of plant nutrients. Consequently, any fertility program should be on a year-to-year basis instead of one planned to carry over fertilizer from the preceding year.

These soils are best suited to meadow, but occasionally row crops and small grain can be grown. Meadow mixtures that do well are alfalfa-orchardgrass and birdsfoot trefoil-timothy. These soils can also be used for watermelons, cantaloupes, or other special crops.

If the level of management is average, and contour tillage or similar practices are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 4 years of meadow. If contour tillage is used, 1 year of a row crop, 1 year of a small grain, and 3 years of meadow are suitable. If the level of management is high, but contour tillage or similar practices are not used, a suitable rotation is 1 year of a row crop, 1 year of a small grain, and 2 or 3 years of meadow. If contour farming is used, and the level of management is high, 1 year of a row crop, 1 year of a small grain, and 2 years of meadow are suitable.

CAPABILITY UNIT VIe-1

This capability unit consists of shallow to deep, gently sloping to steep, well-drained soils that occur on slightly eroded to severely eroded terraces and till and outwash plains. These soils are moderately dark colored and have a silt loam to gravelly clay loam surface layer. In some places bedrock is directly under the surface layer, and in other places the subsoil ranges from loam to gravel and sand. Erosion is the main hazard, but droughtiness is also a problem. These soils generally supply only a small amount of water to plants during the growing season. They are—

Fox soils, 12 to 18 percent slopes, severely eroded.
Gullied land, gravelly materials.
Gullied land, loamy materials.
High Gap soils, 6 to 12 percent slopes, severely eroded.
Muskingum stony complex, 2 to 12 percent slopes.
Ockley soils, 12 to 18 percent slopes, severely eroded.
Princeton fine sandy loam, 18 to 25 percent slopes.
Russell silt loam, 18 to 25 percent slopes.
Russell silt loam, 18 to 25 percent slopes, moderately eroded.
Russell soils, 12 to 18 percent slopes, severely eroded.

Most of these soils are suited only to permanent pasture or meadow. Deep-rooted legumes and grasses produce the highest yields. Occasionally to reestablish meadow, a small grain can be grown on Russell soils, 12 to 18 percent slopes, severely eroded, if conservation practices are followed. Yields, however, are low.

To maintain and improve these soils, deep-rooted legumes and grasses should be used, and the soils should

be managed carefully so that fertility is maintained or improved.

CAPABILITY UNIT VIw-1

Only Marl beds are in this capability unit. This land type generally occurs in small areas on bottoms along small drainageways. It is nearly level, very poorly drained, and uneroded. It consists of beds of marl that are overlain by less than 12 inches of dark-colored mucky loam. The major hazard is wetness. Surface runoff is very slow or ponded, and permeability is very slow.

This land type is suited only to permanent pasture, but generally it is farmed the same way as are surrounding soils because it is scattered among them in small areas. Wooded areas probably should be left in trees.

CAPABILITY UNIT VIe-1

Chelsea loamy fine sand, 12 to 18 percent slopes, is the only soil in this capability unit. This strongly sloping soil occurs on terraces and is deep and well drained. It is moderately dark colored and has a loamy fine sand surface layer and a loamy sand and sand subsoil. The major hazard is droughtiness. The soil does not supply enough water to meet the needs of crops during the growing season.

This soil is best suited to permanent pasture. During a year when rainfall is normal, the pasture can be grazed in spring and early in summer, but livestock should be kept off the pasture during the dry period late in summer. Careful management and rotation grazing are needed.

CAPABILITY UNIT VIIe-1

This capability unit consists of shallow or very shallow, steep or very steep, well-drained soils and of dumps, strip-mined areas, and pits of gravel. The soils occur on uplands and terraces and have a loamy to gravelly loam surface layer and subsoil (fig. 8). The pits of gravel, coal



Figure 8.—Shallow soil that has a gravelly surface layer and subsoil.



Figure 9.—Steep, shallow soils should be kept in trees and the woodland properly managed.

dumps, and strip-mined areas may contain clayey materials, clean sand, stones, shale fragments, or large chunks of bedrock. The main hazard is erosion, but droughtiness is also a problem on some of the land types and soils. The soils and land types in this capability unit are—

- Gravel pits.
- Hennepin complex, 18 to 25 percent slopes.
- Hennepin complex, 25 to 50 percent slopes.
- Hennepin complex, 18 to 25 percent slopes, severely eroded.
- Mine pits and dumps.
- Muskingum stony complex, 25 to 60 percent slopes.

These mapping units are suitable only for pasture and trees. In areas that are not too steep, pasture can be established and maintained. Pasture plants grow well in spring, but not during the dry period. Fairly high yields of forage can be obtained if a complete fertilizer is added.

The wooded areas (fig. 9) should be kept in trees and managed well. Cleared slopes that are too steep for pasture should be reforested and protected from livestock and fire.

CAPABILITY UNIT VIII-1

This capability unit consists of nearly level to very steep, well-drained soils that occur on bottom lands and terrace breaks. These soils are moderately dark and dark colored and have a gravelly loam or flinty surface layer that is underlain by bedrock or gravel and sand. The major hazard is droughtiness. These soils have low available water capacity. They are—

- Rodman gravelly complex, 18 to 25 percent slopes.
- Rodman gravelly complex, 25 to 50 percent slopes.
- Stony alluvial land.

These soils are suitable only for permanent vegetation. Their best use is for trees, but pasture plants grow well on the Rodman soils early in spring, though not during the rest of the growing season. The growth early in spring can be stimulated and increased by applying a complete fertilizer. On the soils in this unit that are used for trees, careful management is needed if even low or medium yields of timber are to be obtained.

Pasture on Rodman soils of more than 25 percent slopes should be replanted to trees.

Estimated yields

Table 7 lists the average acre yields of the principal crops in Fountain County that can be expected on each soil in the county under two levels of management. In columns A are yields to be expected under average or medium level of management, and in columns B are yields to be expected under the improved or high level of management that some farmers in the county are now practicing.

The yields are estimated averages for a period of 5 to 10 years. They are based on farm records and on interviews with farmers, members of the staff of the Purdue Agricultural Experiment Station, and others familiar with the agriculture of the county, as well as on direct observation of soil scientists and work unit conservationists. Considered in making the estimates were the prevailing climate, characteristics of the soils, and the influence of different kinds of management on the soils.

It should be understood that these yield figures may not apply directly to specific tracts of land for any particular year, because the soils vary somewhat from place to place, management practices differ slightly from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates appear to be as accurate a guide as can be obtained without further detailed and lengthy investigations. They are useful in showing the relative productivity of the soils and how soils respond to improved management.

The management needed to get the yields of columns A consists of (a) using cropping systems that maintain tilth and organic matter; (b) using management practices that lessen erosion sufficiently so that a great reduction in the qualities of the land is prevented; (c) applying fertilizers and lime in moderate amounts as indicated by soil tests; (d) returning crop residues to the soil; (e) plowing and tilling by conventional methods; (f) using crop varieties generally adapted to the climate and soils; (g) controlling weeds moderately well by tillage and spraying; and (h) draining wet land enough to permit cropping; in some places yields are somewhat restricted by wetness.

The management needed to get the yields in columns B consists of (a) using a cropping system that maintains tilth and organic matter; (b) using the cultural practices, mechanical practices, or both, that are needed to control erosion and thereby maintain or improve the qualities of the land rather than reduce them; (c) maintaining a high level of available phosphate, potash, and nitrogen as indicated by frequent soil tests and according to the recommendations of the State Agricultural Experiment Station; (d) liming the soils as indicated by soil tests and according to recommendations; (e) using crop residues to the fullest extent for protecting and improving the soils; (f) practicing minimum tillage; (g) using only the best adapted varieties of crops; (h) tilling and spraying to control weeds; and (i) adequately draining wet soils.

Yields higher than those listed in columns B of table 7 are possible. On some soils heavy additions of nitrogen, phosphate, and potash are profitable. Some farmers can produce more than 115 bushels of corn per acre, or more

TABLE 7.—*Estimated average acre yields of the principal crops under two levels of management*

[Yields in columns A are those obtained under the management commonly practiced; those in columns B are yields to be expected under improved management. Absence of yield indicates crop is not commonly grown]

Soil	Corn		Soybeans		Wheat		Alfalfa-brome mixture	
	A	B	A	B	A	B	A	B
Alford silt loam, gravelly substratum, 0 to 2 percent slopes	Bu. 70	Bu. 100	Bu. 30	Bu. 40	Bu. 29	Bu. 45	Tons 3.0	Tons 4.0
Alford silt loam, 0 to 2 percent slopes	70	100	30	40	29	45	3.0	4.0
Alford silt loam, 2 to 6 percent slopes	70	100	30	40	29	45	3.0	4.0
Alford silt loam, 2 to 6 percent slopes, moderately eroded	65	85	28	35	26	38	3.0	4.0
Alford silt loam, 6 to 12 percent slopes	60	75	25	30	22	30	2.8	3.8
Alford silt loam, 6 to 12 percent slopes, moderately eroded	55	70	23	30	21	28	2.5	3.5
Alford silt loam, 2 to 6 percent slopes, severely eroded	49	68	25	30	23	34	2.0	3.0
Alford silt loam, 6 to 12 percent slopes, severely eroded	32	45	20	27	19	26	2.0	3.0
Ayrshire loam	70	100	30	40	30	43	3.0	4.0
Birkbeck silt loam, 0 to 2 percent slopes	70	100	30	40	28	44	3.0	4.0
Birkbeck silt loam, 2 to 6 percent slopes	70	100	30	40	27	44	3.0	4.0
Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded	65	85	30	40	25	38	3.0	4.0
Brookston silty clay loam	77	105	30	40	35	43	3.3	4.5
Camden loam, 2 to 6 percent slopes, moderately eroded	66	87	28	35	26	38	3.0	4.0
Celina silt loam, 2 to 6 percent slopes, moderately eroded	55	80	28	35	30	37	3.0	4.0
Chelsea loamy fine sand, 2 to 6 percent slopes	38	45	16	24	16	25	1.6	2.7
Chelsea loamy fine sand, 6 to 12 percent slopes	35	40	16	20	16	25	1.2	1.6
Chelsea loamy fine sand, 12 to 18 percent slopes	31	32	13	16	13	17	1.0	1.4
Crane silt loam	70	100	30	40	30	43	3.0	4.0
Crosby silt loam, 0 to 2 percent slopes	70	100	30	40	30	43	3.0	4.0
Dana silt loam, 0 to 2 percent slopes	80	105	30	40	30	43	3.0	4.2
Dana silt loam, 2 to 6 percent slopes, moderately eroded	75	100	28	38	30	40	3.0	4.0
Delmar silt loam	60	80	25	32	25	35	2.5	3.0
Eel loam	73	94	33	40	30	40		
Eel silt loam	75	94	33	40	30	40		
Eel silty clay loam	75	94	33	40	28	38		
Elston loam, 0 to 2 percent slopes	70	85	25	30	30	40	3.0	4.0
Elston loam, 2 to 6 percent slopes, moderately eroded	70	80	23	28	28	35	3.0	4.0
Elston sandy loam, 0 to 2 percent slopes	65	75	23	28	28	35	2.5	3.5
Elston sandy loam, 2 to 6 percent slopes, moderately eroded	60	70	20	25	25	30	2.5	3.5
Finecastle silt loam, 0 to 2 percent slopes	70	100	30	40	30	43	3.0	4.0
Finecastle silt loam, 2 to 6 percent slopes	65	95	28	38	30	40	3.0	4.0
Finecastle silt loam, 2 to 6 percent slopes, moderately eroded	60	80	25	35	28	35	3.0	4.0
Fox fine sandy loam, 0 to 2 percent slopes	50	70	20	28	25	30	2.5	3.0
Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded	45	60	18	25	20	28	2.5	3.0
Fox loam, 0 to 2 percent slopes	60	70	25	30	30	42	3.0	4.0
Fox loam, 2 to 6 percent slopes	55	65	23	28	28	37	3.0	4.0
Fox loam, 2 to 6 percent slopes, moderately eroded	50	60	23	28	28	36	3.0	4.0
Fox loam, 12 to 18 percent slopes, moderately eroded					20	30	2.5	3.0
Fox silt loam, 0 to 2 percent slopes	60	70	25	30	30	42	3.0	4.0
Fox silt loam, 2 to 6 percent slopes	55	65	23	28	28	39	3.0	4.0
Fox silt loam, 2 to 6 percent slopes, moderately eroded	50	60	23	28	28	36	3.0	4.0
Fox silt loam, 6 to 12 percent slopes, moderately eroded	36	49	20	25	25	30	2.5	3.0
Fox soils, 2 to 6 percent slopes, severely eroded	40	55			20	25	2.5	3.0
Fox soils, 6 to 12 percent slopes, severely eroded					18	22	2.0	3.0
Fox soils, 12 to 18 percent slopes, severely eroded							2.0	3.0
Genesee loam	70	100	26	40	28			
Genesee loam, high bottom	70	100	26	40	36	40	3.0	4.0
Genesee silt loam	70	100	26	40				
Genesee silty clay loam	70	100	26	40				
Gravel pits								
Gullied land, gravelly materials								
Gullied land, loamy materials								
Hennepin complex, 18 to 25 percent slopes								
Hennepin complex, 18 to 25 percent slopes, severely eroded								
Hennepin complex, 25 to 50 percent slopes								
High Gap silt loam, 0 to 2 percent slopes	50	70	18	27	26	40	2.5	3.0
High Gap silt loam, 2 to 6 percent slopes	44	65	17	26	26	40	2.5	3.0
High Gap silt loam, 2 to 6 percent slopes, moderately eroded	38	58	17	26	25	36	2.5	3.0
High Gap silt loam, 6 to 12 percent slopes	28	37			20	29	2.5	3.0
High Gap soils, 2 to 6 percent slopes, severely eroded	20	28			13	20	2.3	2.8
High Gap soils, 6 to 12 percent slopes, severely eroded	14	18					2.0	2.5
Huntsville silt loam	75	93	21	28				
Landes fine sandy loam	48	62	22	37				
Marl beds								
Miami silt loam, 2 to 6 percent slopes, moderately eroded	60	90	22	36	27	45	3.0	4.0

TABLE 7.—Estimated average acre yields of the principal crops under two levels of management—Continued

Soil	Corn		Soybeans		Wheat		Alfalfa-brome mixture	
	A	B	A	B	A	B	A	B
Miami silt loam, 6 to 12 percent slopes.....	Bu. 50	Bu. 80	Bu. 20	Bu. 30	Bu. 20	Bu. 30	Tons 3.0	Tons 4.0
Miami silt loam, 6 to 12 percent slopes, moderately eroded.....	45	75	18	28	19	26	3.0	4.0
Miami soils, 2 to 6 percent slopes, severely eroded.....	50	80	18	28	18	28	2.5	3.0
Miami soils, 6 to 12 percent slopes, severely eroded.....	40	60			15	20	2.5	3.0
Mine pits and dumps.....								
Muskingum stony complex, 2 to 12 percent slopes.....								
Muskingum stony complex, 25 to 60 percent slopes.....								
Ockley loam, 0 to 2 percent slopes.....	60	80	25	38	30	40	3.0	4.0
Ockley silt loam, 0 to 2 percent slopes.....	70	100	26	39	30	40	3.0	4.0
Ockley silt loam, 2 to 6 percent slopes.....	60	90	26	38	30	40	3.0	4.0
Ockley silt loam, 2 to 6 percent slopes, moderately eroded.....	55	80	20	32	19	32	3.0	4.0
Ockley silt loam, 6 to 12 percent slopes.....	45	70	22	34	23	39	3.0	4.0
Ockley silt loam, 6 to 12 percent slopes, moderately eroded.....	40	60	20	28	17	23	3.0	4.0
Ockley silt loam, 12 to 18 percent slopes.....					22	24	2.5	3.0
Ockley silt loam, 12 to 18 percent slopes, moderately eroded.....	14	28			21	20	2.5	3.0
Ockley soils, 2 to 6 percent slopes, severely eroded.....	40	50	19	28	14	24	2.5	3.0
Ockley soils, 6 to 12 percent slopes, severely eroded.....			14	18	12	17	2.5	3.0
Ockley soils, 12 to 18 percent slopes, severely eroded.....							2.3	2.8
Ockley soils, 12 to 18 percent slopes, severely eroded.....							3.5	4.5
Parr silt loam, 2 to 6 percent slopes, moderately eroded.....	75	90	27	37	36	45	3.0	4.0
Parr silt loam, 6 to 12 percent slopes, moderately eroded.....	55	70			26	32	3.0	4.0
Parr soils, 2 to 6 percent slopes, severely eroded.....	55	70	21	26	21	28	2.5	3.0
Parr soils, 6 to 12 percent slopes, severely eroded.....	45	60			18	25	2.5	3.0
Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded.....	50	70	20	30	23	34	3.0	4.0
Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded.....	44	60	18	28	20	30	3.0	4.0
Princeton fine sandy loam, 18 to 25 percent slopes.....							1.5	2.0
Princeton loam, 0 to 2 percent slopes.....	72	90	25	35	30	40	3.0	4.0
Princeton loam, 2 to 6 percent slopes, moderately eroded.....	54	73	23	28	28	35	3.0	4.0
Princeton soils, 6 to 12 percent slopes, severely eroded.....	33	45			20	30	3.0	4.0
Ragsdale silty clay loam.....	81	110	28	45	35	43	3.5	4.5
Ragsdale silty clay loam, till substratum.....	83	115	28	45	35	42	3.5	4.5
Raub silt loam.....	80	108	30	40	30	45	3.0	4.0
Reesville silt loam, 0 to 2 percent slopes.....	70	105	30	40	30	45	3.0	4.0
Reesville silt loam, 2 to 6 percent slopes, moderately eroded.....	65	95	15	35	28	35	3.0	4.0
Rodman gravelly complex, 18 to 25 percent slopes.....								
Rodman gravelly complex, 25 to 50 percent slopes.....								
Romney silty clay loam.....	76	109	28	45	35	43	3.5	4.5
Romney silty clay loam, gravelly substratum.....	70	109	28	45	35	43	3.5	4.5
Russell silt loam, 2 to 6 percent slopes.....	65	95	22	36	27	45	3.0	4.0
Russell silt loam, 2 to 6 percent slopes, moderately eroded.....	60	90	22	36	27	45	3.0	4.0
Russell silt loam, 6 to 12 percent slopes.....	55	75	20	30	20	30	3.0	4.0
Russell silt loam, 6 to 12 percent slopes, moderately eroded.....	50	70	18	28	19	26	3.0	4.0
Russell silt loam, 12 to 18 percent slopes.....	45	55			15	24	2.5	3.0
Russell silt loam, 12 to 18 percent slopes, moderately eroded.....	40	50			15	24	2.5	3.0
Russell silt loam, 18 to 25 percent slopes.....								
Russell silt loam, 18 to 25 percent slopes, moderately eroded.....								
Russell soils, 2 to 6 percent slopes, severely eroded.....	55	75			20	28	2.5	3.0
Russell soils, 6 to 12 percent slopes, severely eroded.....	45	55			15	24	2.0	2.5
Russell soils, 12 to 18 percent slopes, severely eroded.....		25					2.0	2.5
Shadeland silt loam.....	50	65	20	30	25	35		
Shoals silt loam.....	55	75	26	40	20	30		
Shoals silty clay loam.....	55	75	26	40	18	28		
Sidell silt loam, 0 to 2 percent slopes.....	80	105	30	40	36	45	3.0	4.5
Sidell silt loam, 2 to 6 percent slopes.....	75	90	27	37	36	45	3.0	4.5
Sidell silt loam, 2 to 6 percent slopes, moderately eroded.....	75	90	27	37	36	45	3.0	4.0
Sidell soils, 2 to 6 percent slopes, severely eroded.....	65	80	21	26	22	31	2.5	3.0
Sleeth silt loam.....	70	90	30	40	30	43	3.0	4.0
Sloan silt loam.....	70	95	26	40				
Sloan silty clay loam.....	70	95	26	40				
Stony alluvial land.....								
Sunbury silt loam.....	80	110	30	40	36	45	3.0	4.5
Tawas muck.....	55	80	22	32				
Tippecanoe silt loam, 0 to 2 percent slopes.....	70	94	30	40	30	43	3.0	4.0
Walkkill silty clay loam.....	75	100	30	40	35	43		
Warsaw loam, 0 to 2 percent slopes.....	65	80	25	30	30	40	3.0	4.0
Warsaw loam, 2 to 6 percent slopes, moderately eroded.....	50	65	22	28	28	38	3.0	4.0
Warsaw silt loam, 0 to 2 percent slopes.....	65	80	23	30	30	39	3.0	4.0
Warsaw soils, 6 to 12 percent slopes, severely eroded.....			25		18	20	2.0	3.0
Washtenaw silt loam.....	75	100	30	40	35	43	3.3	4.4
Wea silt loam, 0 to 2 percent slopes.....	75	100	29	40	36	45	3.2	4.3

TABLE 7.—*Estimated average acre yields of the principal crops under two levels of management—Continued*

Soil	Corn		Soybeans		Wheat		Alfalfa-brome mixture	
	A	B	A	B	A	B	A	B
Wea silt loam, 2 to 6 percent slopes.....	Bu. 70	Bu. 95	Bu. 29	Bu. 40	Bu. 36	Bu. 45	Tons 3.1	Tons 4.2
Wea silt loam, 2 to 6 percent slopes, moderately eroded.....	65	88	27	37	36	45	3.1	4.2
Wea soils, 2 to 6 percent slopes, severely eroded.....	45	56	21	26	21	28	2.4	3.5
Wea soils, 6 to 12 percent slopes, severely eroded.....					18	26	2.0	2.8
Westland silt loam.....	75	103	30	40	35	45	3.3	4.4
Westland silty clay loam.....	75	105	30	40	35	45	3.3	4.3
Westland silty clay loam, loamy substratum.....	75	105	30	40	35	45	3.3	4.3
Westland silty clay loam, moderately deep.....	70	86	30	40	35	45	3.3	4.3
Westland silty clay loam, thin solum variant.....	70	87	26	33	25	30	3.0	3.5
Whitaker loam.....	70	100	30	40	30	42	3.0	4.0
Whitaker silt loam.....	70	100	30	40	30	42	3.0	4.0
Wingate silt loam, 0 to 2 percent slopes.....	70	100	30	40	30	45	3.0	4.0
Wingate silt loam, 2 to 6 percent slopes.....	65	95	30	40	30	45	3.0	4.0
Wingate silt loam, 2 to 6 percent slopes, moderately eroded.....	60	90	28	35	30	40	3.0	4.0
Xenia silt loam, 0 to 2 percent slopes.....	70	100	28	35	30	40	3.0	4.0
Xenia silt loam, 2 to 6 percent slopes, moderately eroded.....	65	95	28	35	30	37	3.0	4.0

than 45 bushels of soybeans. In some places, on light-colored or sandy soils, nitrogen can be added as a side dressing. Consult your soil conservationist, county agent, or specialists at the experiment station for suggestions on the kinds and amounts of fertilizer, lime, and seed mixtures to use.

Woodland ²

Hardwood trees originally covered approximately two-thirds of Fountain County, and prairie vegetation covered the rest. The Conservation Needs Inventory reported that in 1959 the woodland in the county amounted to 33,000 acres. Most of this woodland is in areas that can produce hardwoods of high quality. The Conservation Needs Inventory also reported that trees were needed to control erosion on 1,660 acres in the county. When areas were cleared, little regard was shown for the steepness of slope or for the kind of soil. If the eroded tracts are planted to trees, the soil will be stabilized and erosion controlled, and adjacent areas will be protected from silting.

The first part of this subsection names the kinds of trees that are common in the county and tells where these trees are found. In the second part, the soils of the county are placed in 13 woodland suitability groups and the woodland management of these groups is discussed.

Kinds of trees

The woodland in the county can be divided into four kinds of areas according to the kinds of valuable trees that are plentiful in them. These trees are upland oaks, tulip-poplar, pin oak, and sweetgum.

Upland oaks are found in most well-drained areas of uplands. The oaks in these areas are white, black, red, and chinquapin, but occurring with them are hickory, ash, sugar maple, and tulip-poplar.

Tulip-poplar is generally on the lower parts of the north- and northeast-facing slopes (cool aspects) and in coves. These areas are called tulip-poplar because that is the most valuable tree in them and the one that should be encouraged in management. Other trees in these areas are white oak, red oak, hickory, beech, black walnut, and sugar maple.

Pin oak occurs only on the poorly drained soils of the county. With this tree are soft maple, sweetgum, swamp white oak, elm, and ash.

Although sweetgum grows in areas dominated by other trees, it is plentiful on poorly drained uplands and on bottom lands in areas of the somewhat poorly drained Shoals soil. Also in these areas are soft maple, red birch, river birch, hickory, ash, and sycamore.

Woodland suitability groups

To assist owners of woodland in planning the use of soils, the soils of the county have been placed in 13 woodland suitability groups. These groups are part of a broad system, and they are not numbered consecutively. Each group is made up of soils that are similar in potential productivity, that are suitable for similar trees, and that require similar management. These groups are given in table 8 and are described later in this subsection.

Listed in table 8 for each group are the site indexes of upland oaks, tulip-poplar, pin oak, and sweetgum. Site index is the total height, in feet, that trees of a given species, growing on a given soil in an even-aged, well-managed stand, will attain in 50 years (fig. 10). It is, therefore, a measure of potential productivity. Of the properties that determine the productivity of a soil for trees, the capacity to provide moisture and an adequate root zone probably are most important. These conditions are determined by the thickness of the surface layer, the texture and consistence of each significant layer, aeration, drainage, depth to the water table, and the natural supply of plant nutrients. Also in table 8 are ratings of hazards to management and lists of trees to favor in the natural stand and trees to use in plantings. Some terms used in table 8 require explanation.

² By JOHN HOLWAGER, woodland conservationist, Soil Conservation Service.



Figure 10.—Woodland conservationist determining age of trees for site index rating.

Seedling mortality is the failure of seedlings to grow in a soil after natural seeding or after seedlings have been planted. It is affected by the nature of the soil and by other environmental factors. The ratings for seedling mortality given in this report are for trees in a normal environment. Mortality is *slight* if not more than 25 percent of the planted seedlings die, or if trees ordinarily regenerate naturally in places where there are enough seeds. It is *moderate* if 25 to 50 percent of the seedlings die, or if trees do not regenerate naturally in numbers needed for adequate restocking. In some places, replanting to fill open spaces is necessary. Mortality is *severe* if more than 50 percent of the planted seedlings die, or if trees do not ordinarily reseed naturally in places where there are enough seeds. If mortality is severe, plant seedlings where the seeds do not grow, prepare special seedbeds, and use good methods of planting to insure a full stand of trees.

Erosion hazard is rated according to the risk of erosion on well-managed woodland that is not protected by special practices. It is *slight* where only a slight loss of soil is expected. Generally, erosion is slight if slopes range from 0 to 12 percent and runoff is slow or very slow. The erosion hazard is *moderate* if the loss of soil is moderate in places where runoff is not controlled and the vegetative cover is not adequate for protection. It is *severe* if steep slopes, rapid runoff, slow infiltration and permeability, and past erosion make the soil susceptible to severe erosion.

Windthrow hazard depends on the development of roots and on the ability of the soils to hold trees firmly in the soil. The hazard is *slight* if trees are firmly rooted and do not fall over in a normal wind. It is *moderate* if roots hold the trees firmly, except when the soil is excessively wet and the wind is strong. Windthrow hazard is *severe* if roots do not provide enough stability to prevent the trees from blowing over when they are not protected by other trees.

Equipment limitations are rated according to the degree that soils restrict or prevent the use of forestry equipment. Limitations are *slight* if there are no restrictions on the type of equipment or on the time of year that equipment

can be used. They are *moderate* if slopes are moderately steep, if heavy equipment is restricted by wetness in winter and early in spring, or if the use of equipment damages the tree roots to some extent. Equipment limitations are *severe* if many types of equipment cannot be used, if the time the equipment cannot be used is more than 3 months a year, and if the use of equipment severely damages the roots of trees and the structure and stability of the soil. Equipment limitations are severe on moderately steep and steep slopes that are stony and have rock outcrops. They are also severe on wet bottom lands and low terraces in winter and early in spring.

WOODLAND SUITABILITY GROUP 1

This group consists of medium-textured, moderately well drained or well drained soils that are generally deep. Slopes range from 0 to 18 percent. Permeability is moderate, and available moisture capacity is generally high. Surface runoff is slow on the nearly level soils and is medium on the strongly sloping soils. The soils are—

Alford silt loam, 0 to 2 percent slopes.
 Alford silt loam, gravelly substratum, 0 to 2 percent slopes.
 Alford silt loam, 2 to 6 percent slopes.
 Alford silt loam, 2 to 6 percent slopes, moderately eroded.
 Alford silt loam, 2 to 6 percent slopes, severely eroded.
 Alford silt loam, 6 to 12 percent slopes.
 Alford silt loam, 6 to 12 percent slopes, moderately eroded.
 Alford silt loam, 6 to 12 percent slopes, severely eroded.
 Birkbeck silt loam, 0 to 2 percent slopes.
 Birkbeck silt loam, 2 to 6 percent slopes.
 Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded.
 Camden loam, 2 to 6 percent slopes, moderately eroded.
 Celina silt loam, 2 to 6 percent slopes, moderately eroded.
 Fox loam, 0 to 2 percent slopes.
 Fox loam, 2 to 6 percent slopes.
 Fox loam, 2 to 6 percent slopes, moderately eroded.
 Fox loam, 12 to 18 percent slopes, moderately eroded.
 Fox silt loam, 0 to 2 percent slopes.
 Fox silt loam, 2 to 6 percent slopes.
 Fox silt loam, 2 to 6 percent slopes, moderately eroded.
 Fox silt loam, 6 to 12 percent slopes, moderately eroded.
 Fox soils, 2 to 6 percent slopes, severely eroded.
 Fox soils, 6 to 12 percent slopes, severely eroded.
 Fox soils, 12 to 18 percent slopes, severely eroded.
 Miami silt loam, 2 to 6 percent slopes, moderately eroded.
 Miami silt loam, 6 to 12 percent slopes.
 Miami silt loam, 6 to 12 percent slopes, moderately eroded.
 Miami soils, 2 to 6 percent slopes, severely eroded.
 Miami soils, 6 to 12 percent slopes, severely eroded.
 Ockley loam, 0 to 2 percent slopes.
 Ockley silt loam, 0 to 2 percent slopes.
 Ockley silt loam, 2 to 6 percent slopes.
 Ockley silt loam, 2 to 6 percent slopes, moderately eroded.
 Ockley silt loam, 6 to 12 percent slopes.
 Ockley silt loam, 6 to 12 percent slopes, moderately eroded.
 Ockley silt loam, 12 to 18 percent slopes.
 Ockley silt loam, 12 to 18 percent slopes, moderately eroded.
 Ockley soils, 2 to 6 percent slopes, severely eroded.
 Ockley soils, 6 to 12 percent slopes, severely eroded.
 Ockley soils, 12 to 18 percent slopes, severely eroded.
 Princeton loam, 0 to 2 percent slopes.
 Princeton loam, 2 to 6 percent slopes, moderately eroded.
 Russell silt loam, 2 to 6 percent slopes.
 Russell silt loam, 2 to 6 percent slopes, moderately eroded.
 Russell silt loam, 6 to 12 percent slopes.
 Russell silt loam, 6 to 12 percent slopes, moderately eroded.
 Russell silt loam, 12 to 18 percent slopes.
 Russell silt loam, 12 to 18 percent slopes, moderately eroded.
 Russell soils, 2 to 6 percent slopes, severely eroded.
 Russell soils, 6 to 12 percent slopes, severely eroded.
 Russell soils, 12 to 18 percent slopes, severely eroded.
 Xenia silt loam, 0 to 2 percent slopes.
 Xenia silt loam, 2 to 6 percent slopes, moderately eroded.

TABLE 8.—*Woodland*

[Absence of site index or hazard rating indicates that the

Woodland group	Potential productivity (site index at 50 years) ¹			
	Upland oaks	Tulip-poplar	Pin oak	Sweetgum
Group 1: Deep or moderately deep, medium-textured, moderately well drained or well drained soils that are nearly level to strongly sloping and have slow or medium surface runoff; moderate in permeability and high or moderate in available moisture capacity.	85-95	90-105	-----	70-80
Group 2: Deep or moderately deep, moderately fine textured to moderately coarse textured, well-drained soils that are nearly level to steep and have slow or rapid surface runoff; moderate in permeability and moderate or high in available moisture capacity.	85-95	95-105	-----	-----
Group 3: Very severely eroded, deep, medium-textured soil that is sloping to very steep and has rapid surface runoff; moderate in permeability and high in available moisture capacity.	-----	-----	-----	-----
Group 4: Deep, medium-textured, well-drained soil that is steep or very steep and has rapid surface runoff; moderate in permeability and high in available moisture capacity.	80-90	90-100	-----	-----
Group 5: Deep or moderately deep, medium-textured, somewhat poorly drained soils that are level or gently sloping and have slow surface runoff; slow in permeability and high in available moisture capacity.	80-92	90-100	85-100	75-85
Group 8: Deep, moderately fine textured to moderately coarse textured, well drained or moderately well drained soils that are nearly level and have slow surface runoff; moderate in permeability and high in available moisture capacity; most soils flooded periodically.	-----	95-105	-----	95-105
Group 11: Deep, medium-textured or moderately fine textured, very poorly drained or poorly drained soils that are nearly level and have slow to ponded surface runoff; slow in permeability and high in available moisture capacity; high water table.	95-105	90-105	85-105	-----
Group 12: Shallow or moderately deep, medium-textured, well-drained soils that are nearly level to steep and have rapid or medium surface runoff; moderate or rapid in permeability and moderately low or low in available moisture capacity.	80-90	80-90	-----	-----
Group 13: Deep, medium-textured or moderately fine textured, somewhat poorly drained soils that are level and have slow to ponded surface runoff; slow in permeability and high in available moisture capacity; flooded periodically; seasonally high water table.	-----	-----	90-105	85-95
Group 16: Gravel pits, mine pits and dumps, and stony alluvial land that are not suited to trees, except possibly those used for posts and pulpwood; rapid runoff and moderate erosion hazard.	-----	-----	-----	-----
Group 17: Deep, coarse-textured, excessively drained, sandy soils that are gently sloping to strongly sloping and have slow surface runoff; rapid in permeability and low in available moisture capacity; wind erosion likely.	65-75	-----	-----	-----
Group 19: Shallow, medium-textured, well-drained soils that are strongly sloping to very steep and have rapid surface runoff; rapid in permeability and low in available moisture capacity.	60-70	-----	-----	-----
Group 23: Soils and land types that are of minor or no importance for the production of timber.	-----	-----	-----	-----

¹ Site indexes were calculated by using tree measurements on 200 separate plots and, in calculation, by using the age-height curves in "FORESTRY HANDBOOK" (5) for upland oaks (p. 6.45), for sweetgum

(p. 6.44), and for tulip-poplar (p. 6.46). The curve for sweetgum was used to calculate the site index of pin oak.

The Fox soils are moderately deep and have moderate available moisture capacity.

The soils of this group are some of the best in the State for producing timber. They are suited to upland oaks, tulip-poplar, and sweetgum. Sweetgum, however, should not be encouraged in management because its productivity is low.

On the soils of this group, seedling mortality may be as high as 50 percent in severely eroded areas and on all

south-facing slopes. The erosion hazard is slight, except on slopes of more than 12 percent. On the steeper slopes skid trails and logging roads should be located with care. Because root development is not restricted in these soils, there is no windthrow hazard.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 330 to 470 for upland oaks, 410 to 590 for tulip-poplar, and 220 to 250 for sweetgum.

suitability groups

trees are not commonly grown or are not suited to the soil]

Seedling mortality	Erosion hazard	Windthrow hazard	Equipment limitation	Suitable trees ²	
				Favored in existing stands	Favored for planting
Slight or moderate.	Slight or moderate.	Slight.....	Slight or moderate.	Red oak, white oak, white ash, tulip-poplar, and black walnut.	White pine, red pine, shortleaf pine, and black locust.
Slight or moderate.	Slight or moderate.	Slight.....	Moderate or severe.	Red oak, white oak, white ash, tulip-poplar, and black walnut.	White pine, red pine, shortleaf pine, black locust, and Virginia pine.
Moderate or severe.	Severe.....	Slight.....	Severe.....	(³).....	Black locust, red pine, and white pine.
Slight or moderate.	Severe.....	Slight.....	Severe.....	Red oak, white oak, black oak, tulip-poplar, and black walnut.	White pine, red pine, shortleaf pine, and black locust.
Slight.....	Slight.....	Moderate or severe.	Slight or moderate.	Sweetgum, pin oak, soft maple, bur oak, white ash, and tulip-poplar.	White pine, sweetgum, and soft maple.
Slight.....	Slight.....	Slight.....	Slight.....	Cottonwood, sycamore, tulip-poplar, black walnut, and white ash.	White pine, cottonwood, and black locust.
Moderate.....	Slight.....	Severe.....	Severe.....	Sweetgum, pin oak, soft maple, bur oak, white ash, and tulip-poplar.	(⁴).
Slight.....	Moderate.....	Slight or moderate.	Severe.....	White oak, black oak, red oak, tulip-poplar, and white ash.	Red pine, white pine, shortleaf pine, and Virginia pine.
Slight.....	Slight.....	Moderate.....	Moderate.....	Sweetgum, pin oak, soft maple, and tulip-poplar.	White pine, shortleaf pine, and cottonwood.
Slight.....	Moderate.....	Slight.....	Severe.....	Cottonwood, sycamore, soft maple, and green ash.	Virginia pine, shortleaf pine, and white pine.
Moderate or severe.	Slight or moderate.	Slight.....	Slight or moderate.	Black oak, white oak, and black cherry.	White pine, red pine, and jack pine.
Slight or moderate.	Moderate or severe.	Moderate.....	Moderate or severe.	Chinquapin oak, red oak, basswood, and white ash.	Black locust, white pine, and jack pine.
					White pine, red pine, Norway spruce, and arborvitae.

² Partial list. Woodland conservationist will supply complete list.

³ Trees occur naturally in only a few places. Pines are planted to control erosion.

⁴ Planting is not needed, for trees regenerate naturally.

WOODLAND SUITABILITY GROUP 2

This group consists of moderately deep or deep, well-drained soils that are moderately fine textured to moderately coarse textured. Slopes range from 0 to 25 percent. Permeability is moderate, and available moisture capacity is moderate or high. Surface runoff is slow on the nearly level soils and is rapid on the steep soils. The soils are—

Fox fine sandy loam, 0 to 2 percent slopes.

- Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Hennepin complex, 18 to 25 percent slopes.
- Hennepin complex, 18 to 25 percent slopes, severely eroded.
- Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded.
- Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded.
- Princeton fine sandy loam, 18 to 25 percent slopes.
- Princeton soils, 6 to 12 percent slopes, severely eroded.
- Russell silt loam, 18 to 25 percent slopes.
- Russell silt loam, 18 to 25 percent slopes, moderately eroded.

These soils produce good timber because their root zone is deep and their available moisture capacity is good. Seedling mortality is moderate on the steeper slopes, on the south-facing slopes, and in all areas of fine sandy loam. If skid trails and logging roads are needed on the slopes of 18 to 25 percent, they should be located with care because there is a moderate hazard of erosion. On these steep slopes logging with ordinary farm equipment is impractical.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 330 to 470 for upland oaks and 475 to 590 for tulip-poplar.

WOODLAND SUITABILITY GROUP 3

Only Gullied land, loamy materials, is in this group. It is very severely eroded, has deep gullies, and is sloping to very steep. The soil material is medium textured, moderately permeable, and high in available moisture capacity. The moisture supply is low because surface runoff is rapid.

This land type has deep soil material and can produce good timber if erosion is controlled (fig. 11), but seedlings must be planted in almost all areas if a good stand is to be obtained. Replanting is required in many places because as many as 50 percent of the planted seedlings may die and enough trees do not regenerate naturally to form a full stand. The deep, wide gullies make logging difficult. The site index cannot be determined accurately because the degree of erosion varies greatly.

Black locust, red pine, or white pine is planted to stabilize the soil and to serve as a long-time nurse crop for native hardwoods. In some areas that are logged before hardwoods regenerate, black locust, red pine, and white pine produce posts and poles.

WOODLAND SUITABILITY GROUP 4

Hennepin complex, 25 to 50 percent slopes, is the only soil in this group. It is deep, medium textured, well drained, and steep or very steep. Permeability is moderate, available moisture capacity is high, and surface runoff is rapid.

Because of the sharp breaks and steep slopes, this soil is suited only as woodland, and most of it is still in native timber. Some trees have been damaged by grazing and burning.

Good hardwoods can be produced, and erosion can be controlled on this soil. It has a deep root zone and high available moisture capacity. It is limited, however, by its steep slopes that make the soil susceptible to erosion and limit the use of equipment. Equipment limitations are severe. Where practical, the main logging roads should be located on the ridgetops and narrow bottoms, but large gullies can be prevented where logging roads and skid trails run up and down slope by digging cutoff ditches to check the flow of runoff. Seeding fescue on bare areas at log decks and along trails helps to check further erosion.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 290 to 410 for upland oaks and 410 to 530 for tulip-poplar.



Figure 11.—Pine trees planted to control erosion and produce timber.

WOODLAND SUITABILITY GROUP 5

This group consists of medium-textured, somewhat poorly drained soils that occur on the level plains and on gentle slopes of terraces and uplands. These soils are normally deep. Surface runoff and permeability are slow, and available moisture capacity is high. The soils are—

- Ayrshire loam.
- Crosby silt loam, 0 to 2 percent slopes.
- Fincastle silt loam, 0 to 2 percent slopes.
- Fincastle silt loam, 2 to 6 percent slopes.
- Fincastle silt loam, 2 to 6 percent slopes, moderately eroded.
- Reesville silt loam, 0 to 2 percent slopes.
- Reesville silt loam, 2 to 6 percent slopes, moderately eroded.
- Shadeland silt loam.
- Steeth silt loam.
- Whitaker loam.
- Whitaker silt loam.

Shadeland silt loam is moderately deep, but the rest of the soils in this group are deep.

The soils in this group generally have slight seedling mortality, but in unusually wet years they may be too wet for natural reseedling. To supplement natural reseedling, management should include practices to insure that shoots sprout from the stumps of harvested trees. Equipment limitations are slight or moderate, depending on wetness. Late in winter and early in spring, the Crosby, Fincastle, and Reesville soils generally are so wet that they cannot be logged. Logging on these and other soils in the group when they are wet damages the shallow root system and compacts the soils. The trees have shallow roots because drainage is somewhat poor, and the roots do not have to go deeply for water. Because of the shallow roots, windthrow is likely and seed trees cannot be left in logged areas.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 290 to 440 for upland oaks, 350 to 530 for pin oak, 410 to 530 for tulip-poplar, and 220 to 350 for sweetgum.

WOODLAND SUITABILITY GROUP 8

This group consists of deep, nearly level, moderately coarse textured to fine-textured soils that are generally well drained. These soils occur on bottom lands along rivers and smaller streams. Most of the soils are likely to be flooded periodically. Permeability is moderate, surface runoff is slow, and available moisture capacity is high. The soils are—

Eel loam.
Eel silt loam.
Eel silty clay loam.
Genesee loam.
Genesee loam, high bottom.
Genesee silt loam.
Genesee silty clay loam.
Landes fine sandy loam.

The Eel soils are moderately well drained, and Genesee loam, high bottom, is not subject to frequent flooding.

Timbered areas of these soils are generally in narrow strips along the Wabash River and other major streams. The soils in this group have no limitations to producing timber. The occasional flooding often helps the establishment of seedlings because cottonwood, sycamore, soft maple, and other trees generally depend on high water to disperse their seeds. The growth of trees is encouraged by the high fertility of these soils and ample moisture.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 475 to 590 for tulip-poplar and 475 to 590 for sweetgum.

WOODLAND SUITABILITY GROUP 11

This group consists of deep, medium-textured or moderately fine textured soils that are nearly level or depressional. These soils are very poorly drained or poorly drained. Permeability is slow, available moisture capacity is high, and surface runoff is slow to ponded. The water table is seasonally high. The soils are—

Brookston silty clay loam.
Delmar silt loam.
Ragsdale silty clay loam.
Ragsdale silty clay loam, till substratum.
Romney silty clay loam.
Romney silty clay loam, gravelly substratum.
Sloan silt loam.
Sloan silty clay loam.
Washtenaw silt loam.
Westland silt loam.
Westland silty clay loam.
Westland silty clay loam, loamy substratum.
Westland silty clay loam, moderately deep.
Westland silty clay loam, thin solum variant.

These soils are often so wet that natural reseeding is poor and planting is difficult. For more than 3 months of the year, the soils are so wet that the use of equipment is limited and logging is somewhat difficult. Equipment limitations are severe. Also, because of ponding and a high water table, roots do not penetrate deeply and the windthrow hazard is severe.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 350 to 590 for pin oak, 410 to 590 for tulip-poplar, and 350 to 475 for sweetgum.

WOODLAND SUITABILITY GROUP 12

This group consists of shallow or moderately deep, medium-textured, well-drained soils that are underlain by sandstone and shale. Permeability is moderate or rapid, and available moisture capacity is moderately low or low. Surface runoff is medium on the nearly level to sloping soils and rapid on the steep soils. The soils are—

High Gap silt loam, 0 to 2 percent slopes.
High Gap silt loam, 2 to 6 percent slopes.
High Gap silt loam, 2 to 6 percent slopes, moderately eroded.
High Gap silt loam, 6 to 12 percent slopes.
High Gap soils, 2 to 6 percent slopes, severely eroded.
High Gap soils, 6 to 12 percent slopes, severely eroded.
Muskingum stony complex, 2 to 12 percent slopes.
Muskingum stony complex, 25 to 60 percent slopes.

Logging equipment is difficult to use on the steep soils in this group and on the stony soils, which have loose rocks and rock outcrops on the surface. Although the soils are shallow and moderately deep, trees are anchored by sending their roots through the cracks in the underlying bedrock. Consequently, the windthrow hazard is less than might be expected in soils that are not deep. Because the erosion hazard on steep slopes is moderate, care should be taken in locating logging roads.

According to the Doyle rule, the potential productivity on the hot, south- and southwest-facing slopes, in board feet per acre per year, in a well-managed, fully stocked stand is 290 to 410 for upland oaks and tulip-poplar. On the hot slopes upland oaks produce 60 to 80 board feet less, and tulip-poplar is so unproductive that growing it is not advisable.

WOODLAND SUITABILITY GROUP 13

This group consists of deep, somewhat poorly drained, medium-textured or moderately fine textured soils that occur on bottom lands and are level or depressional. Permeability is slow, available moisture capacity is high, and surface runoff is slow to ponded. These soils are flooded periodically and have a seasonally high water table. They are—

Shoals silt loam.
Shoals silty clay loam.

Seedling mortality and erosion hazard are slight on these soils. Because the water table is seasonally high, roots do not penetrate these soils deeply and the windthrow hazard is moderate. The soils are wet late in winter and early in spring, and equipment limitations are moderate. If logging is carried on during this wet period, the shallow roots are damaged and the soil is compacted.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 410 to 590 for pin oak and 290 to 410 for sweetgum.

WOODLAND SUITABILITY GROUP 16

This group consists of abandoned strip mines and mine spoil in uplands, of gravel pits on terraces, and of very flinty alluvial material on bottom lands. Many of the strip mines and gravel pits are filled with water. The sloping to steep spoil has been deposited in high, long ridges. The soil material of these land types has slow permeability and moderate available moisture capacity.

Surface runoff is rapid, and erosion is difficult to control. The land types are—

- Gravel pits.
- Mine pits and dumps.
- Stony alluvial land.

This woodland group generally is not suitable for producing trees. Erosion is a problem on the steep slopes and breaks. In some areas posts and pulpwood may be produced, but special equipment is needed for harvesting, and all logging operations are difficult. In many places it is necessary to construct logging roads before harvesting.

Making estimates of suitability and productivity for these land types is impractical because the condition of the sites and the soil material varies widely.

WOODLAND SUITABILITY GROUP 17

This group consists of deep, coarse-textured, excessively drained soils that occur on gently sloping to strongly sloping knobs and long ridges. These soils are rapid in permeability and low in available moisture capacity. Their surface runoff is slow. Wind erosion is a major hazard. The soils are—

- Chelsea loamy fine sand, 2 to 6 percent slopes.
- Chelsea loamy fine sand, 6 to 12 percent slopes.
- Chelsea loamy fine sand, 12 to 18 percent slopes.

In the steeper areas and on all southern exposures of these soils, as many as 50 percent of planted seedlings may die and trees do not regenerate naturally in numbers large enough to form a full stand. Wind erosion is moderate in places where the soils are left bare for some time after forestry operations. After blowouts are formed, wind erosion is difficult to control. Because these soils are sandy, the use of logging equipment is limited and a track-type tractor may be needed on the sandy ridges.

Oaks on these soils are of fairly low quality because they have little resistance to insects and disease and are damaged by them. If hardwoods are damaged by insects and disease, the owner should consider converting to pines.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 155 to 200 for upland oaks.

WOODLAND SUITABILITY GROUP 19

This group consists of shallow, medium-textured soils and of land that is gullied and gravelly. The soils and land type are well drained and strongly sloping to very steep. Surface runoff and permeability are rapid, and available moisture capacity is low. In this group are—

- Gullied land, gravelly materials.
- Rodman gravelly complex, 18 to 25 percent slopes.
- Rodman gravelly complex, 25 to 50 percent slopes.

On the southern exposures, as many as 50 percent of the planted seedlings may die and not regenerate naturally to form a full stand of trees. The erosion hazard is moderate or severe on the steep and very steep slopes and in the gullied areas. Gullies form rapidly and cut deeply into the underlying gravelly material. Root development is shallow because these soils are shallow over gravel. Only a few roots go deeper than 12 to 18 inches.

Consequently, there is a windthrow hazard. On the short steep slopes of Gullied land, gravelly materials, logging is costly and hazardous and the use of equipment is limited.

According to the Doyle rule, the potential productivity, in board feet per acre per year, in a well-managed, fully stocked stand is 130 to 180 for upland oaks.

WOODLAND SUITABILITY GROUP 23

In this group are soils in areas of prairie grasses and in areas that are transitional between prairie grasses and timber. These soils are of little or no importance in producing timber. They are—

- Crane silt loam.
- Dana silt loam, 0 to 2 percent slopes.
- Dana silt loam, 2 to 6 percent slopes, moderately eroded.
- Elston loam, 0 to 2 percent slopes.
- Elston loam, 2 to 6 percent slopes, moderately eroded.
- Elston sandy loam, 0 to 2 percent slopes.
- Elston sandy loam, 2 to 6 percent slopes, moderately eroded.
- Huntsville silt loam.
- Marl beds.
- Parr silt loam, 2 to 6 percent slopes, moderately eroded.
- Parr silt loam, 6 to 12 percent slopes, moderately eroded.
- Parr soils, 2 to 6 percent slopes, severely eroded.
- Parr soils, 6 to 12 percent slopes, severely eroded.
- Raub silt loam.
- Sidell silt loam, 0 to 2 percent slopes.
- Sidell silt loam, 2 to 6 percent slopes.
- Sidell silt loam, 2 to 6 percent slopes, moderately eroded.
- Sidell soils, 2 to 6 percent slopes, severely eroded.
- Sunbury silt loam.
- Tawas muck.
- Tippecanoe silt loam, 0 to 2 percent slopes.
- Wallkill silty clay loam.
- Warsaw loam, 0 to 2 percent slopes.
- Warsaw loam, 2 to 6 percent slopes, moderately eroded.
- Warsaw silt loam, 0 to 2 percent slopes.
- Warsaw soils, 6 to 12 percent slopes, severely eroded.
- Wea silt loam, 0 to 2 percent slopes.
- Wea silt loam, 2 to 6 percent slopes.
- Wea silt loam, 2 to 6 percent slopes, moderately eroded.
- Wea soils, 2 to 6 percent slopes, severely eroded.
- Wea soils, 6 to 12 percent slopes, severely eroded.
- Wingate silt loam, 0 to 2 percent slopes.
- Wingate silt loam, 2 to 6 percent slopes.
- Wingate silt loam, 2 to 6 percent slopes, moderately eroded.

Because these soils are of little importance in producing timber, estimates of their productivity are not given. Tree plantings may become important in windbreaks that protect farmsteads and feedlots.

Wildlife

A well-planned, well-managed system of management not only provides high yields of crops from year to year, but it also provides food and cover for desirable kinds of wildlife so that they increase in number. The number of wildlife decreases in cultivated areas unless provisions are made to replace the natural food and cover that was destroyed where areas were cleared. A decrease in wildlife marks an increase in harmful insects, rodents, and other pests. On most farms in the county habitats for wildlife can be improved by using practices that supply food and cover (8).³

The first part of this subsection describes the food and cover in the county and how they can be increased on cropland, pasture, woodland, and other kinds of land.

³ Italic numbers in parentheses refer to Literature Cited, p. 119.

In the second part, the county is divided into four areas and the wildlife in these areas is described.

Food and cover

The balance of food and cover for wildlife is ideal on only a few farms in the county. Some farms consist almost entirely of soils in classes I and II that are used to produce row crops. On these farms, food for wildlife may be abundant but cover is scarce. Other farms in the county consist largely of soils in classes VI and VII that are in pasture and woods. On these soils, ample cover is available for wildlife but food may be scarce.

The soils in the different classes can be managed so that both food and cover are abundant. On the soils in classes I, II, and III, where food is abundant but cover is scarce, cover can be provided by fence rows, by windbreaks, by perennial borders, and by vegetation on the banks of drainage ditches and streams. On soils in classes III, IV, and VI, odd areas and areas around ponds and in marshes can be used for both food and cover. Food and cover can be provided on soils in classes VI and VII by planting wildlife borders at least 16 inches wide and by planting small areas to grasses and conifers.

In the following paragraphs are ways to increase the food and cover on cropland, pasture, woodland, and in other areas.

On cropland use a cropping system that includes grass-legume meadows and cover crops. Delay mowing waterways and headlands until after grain is harvested so that nesting birds are not disturbed. The grain in small areas adjacent to woods should be left standing. Leave cover crops and crop residues on the ground in winter, and plow in spring.

On pasture do not permit overgrazing, for overgrazing destroys cover. Renovate and reseed old, depleted pasture. Delay mowing until early in summer so that nesting birds are not disturbed.

On woodland protect all trees from fire and the young trees from overgrazing. In areas logged leave, per acre, at least two trees that have dens for squirrels. Leave hollow fallen logs, and pile brush near the edge of woods. In thickly wooded places, clear small areas to improve the habitat of deer.

On the banks of ditches and streams establish and maintain grass so that erosion is controlled and silt does not fill the streams and ditches. Delay mowing, grazing, and spraying until nesting birds have flown away. Plant trees and shrubs for windbreaks where needed.

Along fence rows plant native shrubs in a band at least 16 feet wide. Use a cropping system that includes sweet-clover or lespedeza.

Fence odd areas so that livestock are kept out. Keep half the area in grass or a grass-legume mixture and the other half in other plants that provide food and cover.

Fence areas around ponds to keep out livestock. Improve the ground cover around the ponds so that erosion is controlled and the pond is not silted. Keep half of the surrounding area in grass or a grass-legume mixture. Keep woody plants at least 30 feet from the water.

In windbreaks protect the trees and shrubs from fire and overgrazing. Plant suitable trees and shrubs, and control unwanted weeds and woody plants.

In roadside rights-of-way delay mowing until after grain is harvested so that nesting birds can bring off their young. Do not burn these areas.

Wildlife areas in the county⁴

For the purpose of describing the wildlife in the county and how their habitats can be improved, Fountain County can be divided into areas of (1) somewhat poorly drained and poorly drained soils in the east-central part of the county and most of the southern part; (2) soils of terraces and uplands along the major streams; (3) soils on narrow strips of bottom lands along the major streams; and (4) soils of prairie uplands and terraces.

Largest of these areas is the one in the east-central and southern parts of the county. It amounts to about 40 percent of the county. The soils in this area are nearly level or depressional and somewhat poorly drained or poorly drained. Fincastle, Reesville, and Brookston soils are on uplands, and Sleeth and Westland soils are on terraces. Most areas have been cleared, drained, and cultivated. They provide food for rabbits, quail, pheasants, and songbirds, but the amount of cover is small and its distribution is not good. Although food is ample for pheasants, their only travel lanes and cover for nesting are along narrow, grassed fence rows and in small fields of grain. Small, undrained woodlots are scattered throughout this area. They provide food for woodcock, but satisfactory nesting places are few. Woodcock prefer to nest in idle areas of grasses and briers. Hawks and owls feed on small game and the plentiful field mice. If the stripped-mined areas are managed well, they provide good habitats for wildlife and fish.

The areas of terraces and uplands along the major streams amount to about 31 percent of the county. They have the best distribution of food and cover in the county. In these areas are nearly level to sloping Ockley and Fox soils, small areas of Chelsea soils, and gently sloping and sloping Russell, Alford, Princeton, and Miami soils. Quail stay near the cultivated fields and feed on corn, soybeans, and small grain. They use the woods for cover. Rabbits are plentiful, for they prefer agricultural areas where they can obtain food and cover. Many kinds of songbirds nest in the woods, brush, and meadows next to the cultivated fields. The mourning dove nests in these and in other areas in the county. Although it is valued as a game bird in other States, in Indiana farm families prize it more for its esthetic value. The Muskingum, Hennepin, and Rodman soils are wooded and occur on steep slopes of breaks between the uplands and terraces and between the terraces and bottom lands. If the springs at the foot of these slopes were improved, the few deer in the area would benefit. Squirrels are numerous in these areas, for the many kinds of hardwoods provide them with food and cover. Raccoon and opossum are abundant in wooded areas and are increasing. Some skunk are found. Farm ponds in these areas generally provide fishing and other recreation (fig. 12).

The bottom lands along the major streams amount to about 10 percent of the county. Along these streams in narrow strips are the Genesee, Eel, Shoals, and Huntsville soils. Wood ducks and raccoons range these strips and compete with each other for nesting places in hollow

⁴ By JAMES MCCALL, biologist, Soil Conservation Service.



Figure 12.—A farm pond that provides good fishing and other recreation.

den trees. Also in these areas are muskrat and a few mink. The Wabash River and its oxbow sloughs attract about 25 kind of migrating waterfowl, but mallard and black ducks are most numerous. A few deer range the willow thickets, woods, and open areas of the bottom lands. Caught in the Wabash River and other streams are channel catfish, buffalo fish, carp, perch, bass, and bluegill. Along the more than 35 miles of Wabash River in the county, people fish commercially and for sport. For sport warm-water fish are caught in Coal Creek and other small streams.

The soils of the prairie uplands and terraces account for about 19 percent of the county. The Sidell, Parr, Raub, and Ragsdale soils are on uplands in Cain Township and in the northeastern and central parts of the county. The Wea, Warsaw, and Elston soils occur on terraces along the Wabash River north of Covington. Tippecanoe and Westland soils are along other major streams. Generally the prairie uplands and terraces provide abundant food for wildlife, but there is not enough cover or travel lanes. Pheasants, quail, and rabbits live in these areas in moderate numbers that could be increased by providing good cover. Rabbits and quail will also increase if low shrubs, sercia lespedeza, and other suitable plants are grown along field borders and in odd areas. The rabbits and quail can flee to these areas after eating the grain left by cornpickers and combines.

Part of the Shades State Park is in the southeastern corner of the county. The park provides good cover and nesting places for wildlife that increases the population of areas adjacent to the park.

Engineering Properties of Soils⁵

Soils are of special interest to the engineer because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties of soils that are most important to engineering are permeability to

water, strength against shearing, compaction characteristics, soil drainage, shrink-well characteristics, grain size, plasticity, and pH. Depths to water table and to bed-rock or unconsolidated material are also important. The topographic position of the soils may be significant.

The information in this report can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway and airport locations and in planning detailed soil investigations of the selected locations.
3. Assist in designing drainage systems, farm ponds, diversion terraces, and other structures for soil and water conservation.
4. Locate possible sources of sand and gravel.
5. Correlate performance of structures with soil mapping units and, thus, develop information that is useful in designing and maintaining new structures.
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 other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations in this subsection can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works where heavy loads are to be supported and where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Much of the information in this subsection is in tables 9, 10, and 11. The data in table 9 are from actual laboratory tests, and the estimates for the soils listed in tables 10 and 11 were made by comparing those soils with the soils tested. At many construction sites, major variations in the soil may be present within the depth of the proposed excavations, and several soils may occur within a short distance. For these reasons, specific laboratory data on engineering properties of the soil at the construction site should be obtained before any engineering work is planned in detail.

Information useful for engineering can be obtained from the soil map and from other parts of this report, particularly the sections "Descriptions of the Soils" and "Formation and Classification of Soils." By using the information on the soil map, in the soil profile descriptions, and in the tables of this subsection, the engineer can plan a detailed investigation of the soil at the proposed construction site.

Some terms used by the soil scientist may be unfamiliar to the engineer, and some terms have special meanings in soil science. These terms, as well as other

⁵ By RALPH H. STURM, soil scientist, and FAY ANDERSON, area engineer, Soil Conservation Service.

special terms that are used in this report, are defined in the Glossary.

Engineering classification systems

Two systems for classifying soils are in general use among engineers. They are the system approved by the American Association of State Highway Officials (AASHO) (1) and the Unified system adopted by the Corps of Engineers, U.S. Army (10).

AASHO CLASSIFICATION SYSTEM

Many highway engineers classify soil materials according to the AASHO system. In this system soils are classified in seven principal groups on the basis of their texture and plasticity characteristics. The groups range from A-1 (gravelly soils of high bearing capacity, which are the best soils for subgrades) to A-7 (clay soils of low strength when wet, which are the poorest soils for subgrades).

Within each of the principal groups, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best materials to 20 for the poorest. The group index for the horizons tested are shown in parentheses after the soil group symbol in the next to last column of table 9. The estimated AASHO classification for each soil in the county, without the group index number, is given in table 10.

UNIFIED CLASSIFICATION SYSTEM

Some engineers prefer the Unified system of soil classification. In this system soils are classified according to their texture and plasticity and their performance as engineering construction materials. In this system the major groupings are of coarse-textured soils, fine-textured soils, and organic soils. Table 9 shows the Unified classification of the samples tested, and table 10 gives the estimated Unified classification of each soil in Fountain County.

Soil data related to engineering

Three of the most important soil series of Fountain County were sampled at locations selected by the Soil Conservation Service. Soil samples of each of the three series were taken from three different locations. Except in the test for the California bearing ratio (CBR), these samples were tested according to standard AASHO procedures by Purdue University in cooperation with the Indiana State Highway Department and the Bureau of Public Roads. The samples were tested so that the soils of the county could be evaluated for engineering purposes. Because all the layers of each profile were not sampled, these samples do not represent the range of soil characteristics even within the three soil series sampled, and, of course, they do not represent the range of characteristics of all the soils in Fountain County. The test results, however, have been used as a general guide in estimating the engineering properties of each soil in the county.

Mechanical analyses were made by a combination of the sieve and hydrometer methods. The liquid limit and plasticity index were determined. The results of these

tests and the classification of each sample according to the AASHO and Unified systems are given in table 9.

Table 9 also lists data on the relationship between moisture content and the density of the soil when it is compacted, as determined by the methods described in AASHO Designation: T 99-57 (1). If the soil material is compacted at successively higher moisture content, assuming that the same amount of force is used in compacting the soil, the density of the compacted material will increase until the "optimum moisture content" is reached. After that, the density decreases as the moisture content increases. The oven-dry weight in pounds per cubic foot of the soil at the optimum moisture content is the "maximum dry density." Data on the relationship of moisture to density are important in planning earthwork because generally the soil is most stable if it is compacted to about its maximum dry density when it is at approximately the optimum moisture content.

Engineering interpretations of soils

In table 10, the soils of the county and their map symbols are listed, and certain characteristics that are significant to engineering use are described. The color of soils and other characteristics that are not important to engineering, are omitted, except for a few soils in which they are needed to distinguish soils that are otherwise similar. The estimated classification of each important soil layer is given according to the AASHO and the Unified classification systems.

Some features of a soil may be a help in one kind of engineering work but a hindrance in another. For example, a highly permeable substratum makes a soil unsuitable as a site for a farm pond, but it might be favorable for artificial drainage.

Frozen soil materials should not be used in constructing embankments. If the soil material is gravelly or sandy and contains only a very small percentage of silt or clay, it may be used in earthwork during winter, provided the material is compacted according to the required standards for such constructions and provided that none of the material is frozen.

Frost action is a serious problem in this county (3). Soils that consist of a mixture of clay, silt, and coarser materials are not so susceptible to frost heaving and the resulting humps as are soils that contain a high percentage of silt or very fine sand. A coarse-textured soil is susceptible to damaging frost action if about 10 percent or more of the soil material passes a No. 200 mesh sieve (0.074 mm.).

Because differences in expansion between one material and another cause damage from frost heaving, uniformity of soil materials is important in building roads that will not be damaged by frost. Some deposits of glacial till in the county contain lenses or pockets of fine sand and silt that cause differential frost heave.

Poorly drained and very poorly drained soils are common in depressions. In some of these depressions the material is highly organic; peat and muck may extend to a depth of 2 to 6 feet. Peat or muck is not suitable for use as foundations of roads or other engineering structures, because they have low strength and are highly compressible. The peat and other highly

TABLE 9.—

[Tests performed by Purdue University in cooperation with the Indiana Highway Commission and the Bureau of Public Roads. Except Association of State

Soil name and location	Parent material	Indiana report No. (S-59-23)	Depth	Horizon	Moisture-density ¹		CBR test ²				
					Maximum dry density	Optimum moisture	Molded specimen		CBR ⁴	Swell	
							Dry density	Moisture content			
Crosby silt loam: NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 15, T. 18 N., R. 7 W. (Modal)	Glacial till of Wisconsin age.	12-1	<i>Inches</i> 0-6	Ap	<i>Lb. per cu. ft.</i> 104	<i>Percent</i> 19	<i>Lb. per cu. ft.</i> 102.3	<i>Percent</i> 19.0	<i>Percent</i> 17	<i>Percent</i> 0.3	
		12-2	19-26	B22	103	19	103.3	17.9	5	2.3	
		12-3	34-45	C1	119	13	114.1	13.5	7	.6	
	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 18 N., R. 7 W. (Modal)	Glacial till of Wisconsin age.	13-1	0-7	Ap	96	21	97.8	21.3	9	.6
			13-2	11-19	B2	96	23	96.2	24.1	10	1.4
			13-3	37-52	C12	124	12	118.7	12.2	4	0
	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 18 N., R. 7 W. (Shallowly leached)	Glacial till of Wisconsin age.	14-1	0-7	Ap	108	15	106.0	14.5	11	.4
			14-2	14-23	B22	109	17	103.8	15.1	4	2.9
			14-3	30-45	C1	118	14	116.7	13.4	5	.3
Elston loam: SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 20 N., R. 9 W. (Modal)	Stratified sand containing some gravel.	9-1	11-20	A12	117	13	109.1	13.0	15	.3	
		9-2	42-50	B22	117	12	115.0	12.2	28	.04	
		9-3	64-76	C1	112	16	107.6	16.9	13	.11	
SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 15, T. 20 N., R. 9 W. (Modal)	Stratified sand containing some gravel.	10-1	0-7	Ap	120	12	117.6	12.4	6	.09	
		10-2	18-27	B21	114	14	113.2	14.3	3	.04	
		10-3	50+	C	112	14	109.2	12.7	21	.02	
SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 15, T. 20 N., R. 9 W. (Deep, sandy)	Stratified sand containing some gravel.	11-1	0-8	Ap	122	11	118.7	11.3	15	.04	
		11-2	21-27	B1	120	12	120.3	12.0	10	.11	
		11-3	47-81	B32	107	14	107.5	13.6	17	.02	
Sleeth silt loam: SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 20 N., R. 6 W. (Modal)	Glacial outwash.	15-1	0-7	Ap	103	19	103.2	18.8	8	.11	
		15-2	21-29	B22	98	23	95.0	21.8	4	2.3	
		15-3	63-73	IIIC	110	10	(?)	(?)	(?)	(?)	
NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 23, T. 20 N., R. 7 W. (Modal)	Glacial outwash.	16-1	0-7	Ap	103	15	104.9	14.7	12	.4	
		16-2	18-25	B22	103	19	97.8	18.6	9	1.5	
		16-3	73-83	IIIC	118	12	117.9	9.7	20	.04	
NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 36, T. 20 N., R. 7 W. (Deeply leached)	Glacial outwash.	17-1	2-9	A2	106	16	104.3	15.5	18	0	
		17-2	14-27	B2	104	17	105.8	16.1	20	.6	
		17-3	64-80	IIIC	126	9	(?)	(?)	(?)	(?)	

¹ Based on AASHO Designation: T 99-57, Method A (1).

² The soil sample is prepared according to the method described in AASHO Designation: T 87-49 (1). Water is added to bring the moisture content to within 0.5 percent of optimum. Specimens are compacted as described in AASHO Designation: T 99-57, Method B, to within 1 pound per cubic feet of maximum dry density. A surcharge of 35 pounds is added, and the specimen is soaked from

top and bottom for 4 days. The penetration is performed at a rate of 0.05 inch per minute while the 35-pound surcharge is on the specimen.

³ Mechanical analysis according to the AASHO Designation: T 88-57 (1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is

Engineering test data

for the tests to obtain the California bearing ratio (CBR), tests were made in accordance with standard procedures of the American Highway Officials (AASHO) (1)]

Mechanical analysis ³											Liquid limit	Plasticity index	Classification	
Percentage passing sieve—							Percentage smaller than—						AASHO	Unified ⁵
1-in.	¾-in.	⅜-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.	0.007 mm.	0.002 mm.				
			100	99	92	85	77	65	30	12	34	12	A-6(9)-----	ML-CL.
		100	99	98	95	74	68	59	40	30	44	28	A-7-6(16)-----	CL.
			100	99	96	83	74	60	41	25	30	15	A-6(10)-----	CL.
				100	95	89	86	68	40	15	43	16	A-7-6(11)-----	ML-CL.
				100	98	86	85	84	56	40	71	48	A-7-6(20)-----	CH.
		100	97	93	84	58	50	45	33	15	23	10	A-4(5)-----	CL.
			100	99	93	75	69	54	25	11	31	11	A-6(8)-----	CL.
			100	99	92	65	62	55	44	34	44	27	A-7-6(13)-----	CL.
		100	99	96	89	68	63	52	38	24	25	10	A-4(7)-----	CL.
			100	99	69	49	43	38	24	15	35	15	A-6(5)-----	SC.
100	96	92	84	71	23	12	11	10	9	6	NP	NP	A-1-b(0)-----	SP-SM.
100	97	97	95	94	21	6	4	3	2	2	15	NP	A-1-b(0)-----	SW-SM.
				100	92	40	34	30	20	12	21	5	A-4(1)-----	SM-SC.
	100	99	96	92	63	31	30	29	23	19	30	11	A-2-6(0)-----	SC.
		100	99	94	25	8	5	4	3	2	NP	NP	A-1-b(0)-----	SW-SM.
				100	81	36	35	30	20	12	22	7	A-4(0)-----	SM-SC.
				100	98	83	28	26	23	15	22	7	A-2-4(0)-----	SM-SC.
				100	82	10	8	7	6	6	17	NP	A-2-4(0)-----	SP-SM
		100	99	98	92	83	79	59	30	14	31	9	A-4(8)-----	ML-CL.
				100	99	98	90	75	50	38	60	32	A-7-6(20)-----	CH.
	100	97	95	90	71	7	5	5	4	3	22	NP	A-3(0)-----	SP-SM.
				100	93	82	78	60	28	15	30	10	A-4(8)-----	CL.
				100	97	95	90	70	45	35	56	32	A-7-6(19)-----	CH.
100	96	90	84	74	25	8	7	7	5	3	16	NP	A-1-b(0)-----	SW-SM.
				100	95	87	78	60	30	15	24	2	A-4(8)-----	ML.
				100	99	90	85	60	35	26	45	20	A-7-6(13)-----	ML-CL.
100	89	79	71	64	50	23	22	18	11	8	17	4	A-1-b(0)-----	SM-SC.

analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all 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 than 2 millimeters is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes of soils.

⁴ At 0.1 inch penetration.
⁵ SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification.
⁶ NP means nonplastic.
⁷ Insufficient material for CBR test.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
AdA	Alford silt loam, gravelly substratum, 0 to 2 percent slopes.	Well-drained soil developed in windblown silt; 1 to 1½ feet of silt loam over about 2½ feet of silty clay loam to heavy silt loam over 2½ feet of silty clay loam to heavy silt loam over 2½ to 4 feet of silt loam underlain by strata of sand, fine gravel, gravelly sand, and minor amounts of silt, or by glacial loam till.	Feet 15+	Feet More than 25.	Inches 0-15 15-44 44-80 80+
AfA	Alford silt loam, 0 to 2 percent slopes.	Well-drained soils developed in deep windblown silt; about 1 foot of silt loam over 2½ to 3½ feet of heavy silt loam to silty clay loam over silt loam or loam underlain by calcareous loam till.	15+	More than 25.	0-11
AfB	Alford silt loam, 2 to 6 percent slopes.				11-52
AfB2	Alford silt loam, 2 to 6 percent slopes, moderately eroded.				52-64
AfB3	Alford silt loam, 2 to 6 percent slopes, severely eroded.				64+
AfC	Alford silt loam, 6 to 12 percent slopes.				
AfC2	Alford silt loam, 6 to 12 percent slopes, moderately eroded.				
AfC3	Alford silt loam, 6 to 12 percent slopes, severely eroded.				
Ay	Ayrshire loam.	Somewhat poorly drained soil developed in thick deposits of windblown silt and sand; 1 to 1½ feet of loam over 2 feet of clay loam or sandy clay loam underlain by 1 to 5 feet of windblown fine sandy loam, coarse silt, and fine sand.	15+	2 or less.	0-18 18-44 44+
BbA	Birkbeck silt loam, 0 to 2 percent slopes.	Moderately well drained soils developed in 3 to 6 feet of windblown silt; about 1 foot of silt loam over 3 to 4 feet of silty clay loam to silt loam over 1 to 2 feet of silt loam underlain by calcareous loam till.	15+	More than 25.	0-11
BbB	Birkbeck silt loam, 2 to 6 percent slopes.				11-40
BbB2	Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded.				40-60 60+
By	Brookston silty clay loam.	Very poorly drained, black, depressional soil developed in silt-mantled loam till; about 1 foot of silty clay loam to heavy silt loam over 2 to 2½ feet of silty clay loam over 1 to 2 feet of loam to light clay loam underlain by calcareous loam till.	15+	0 (ponded).	0-11 11-36 36-52 52+
CaB2	Camden loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soil developed in silt, sand, some gravel and clay of outwash plains and valley trains; ¾ to 1 foot of loam over 1½ to 2½ feet of sandy clay to clay loam over 1 to 2 feet of sandy loam underlain by bands of sand, loamy sand, and silt.	15+	More than 3½.	0-9 9-30 30-52 52+
CbB2	Celina silt loam, 2 to 6 percent slopes, moderately eroded.	Moderately well drained soil developed in silt and material weathered from loam till; about 1 foot of silt loam over 2½ to 3 feet of silty clay loam underlain by calcareous loam till.	15+	More than 25.	0-12 12-36 36+

estimated physical and chemical properties

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Silt loam.....	ML.....	A-4	100	95-100	95-100	<i>Inches per hour</i> 0.8- 2.5	<i>Inches per inch of soil</i> 0.18	<i>pH</i> 6.6 to 7.3...	Medium or high.	Low.
Silty clay loam to heavy silt loam.	CL or ML..	A-6	100	95-100	95-100	0.8- 2.5	.18	4.5 to 5.5...	Medium or high.	Moderate.
Silt loam.....	ML.....	A-4	100	95-100	90-95	0.8- 2.5	.15	6.6 to 7.3...	Medium or high.	Low.
Stratified layers of silt and sand.	ML or SM..	A-4	100	95-100	45-95	2.5- 5.0	.10	Calcareous..	Medium or high.	Low.
Silt loam.....	ML.....	A-4	100	95-100	95-100	0.8- 2.5	.20	5.6 to 6.0...	Medium or high.	Low.
Heavy silt loam to silty clay loam.	CL.....	A-6	95-100	95-100	95-100	0.8- 2.5	.18	5.1 to 6.0...	Medium or high.	Low or moderate.
Loam.....	ML-CL....	A-4	95-100	95-100	80-85	0.8- 2.5	.15	6.6 to 7.3...	Medium or high.	Low.
Loam (till)....	CL.....	A-4	90-95	80-85	65-70	0.8- 2.5	.11	Calcareous..	Medium....	Low.
Loam.....	ML or CL..	A-4	100	85-90	65-70	0.8- 2.5	.16	6.1 to 6.5...	Medium or high.	Low.
Sandy clay loam to clay loam.	CL.....	A-6	95-100	80-85	50-60	0.2- 0.8	.19	5.6 to 6.0...	Medium....	Moderate.
Fine sandy loam to coarse silt.	ML.....	A-4	95-100	80-85	60-65	0.8- 2.5	.13	6.6 to 7.3...	High.....	Low.
Silt loam.....	ML.....	A-4	100	95-100	95-100	0.8- 2.5	.18	6.1 to 6.5...	Medium or high.	Low.
Silty clay loam to silt loam.	ML or CL..	A-6	100	95-100	95-100	0.2- 0.8	.17	5.1 to 5.5...	Medium or high.	Low or moderate.
Silt loam.....	ML or CL..	A-6	100	95-100	90-95	0.8- 2.5	.18	6.6 to calcareous.	Medium or high.	Low or moderate.
Loam (till)....	CL.....	A-4	95-100	85-90	65-70	0.2- 0.8	.13	Calcareous..	Medium....	Low.
Silty clay loam to heavy silt loam.	CL.....	A-6	100	95-100	95-100	0.2- 0.8	.21	6.6 to 7.3...	Medium or high.	Moderate.
Silty clay loam	CL.....	A-6	95-100	95-100	90-95	0.05- 0.2	.18	6.6 to 7.3...	Medium or high.	Moderate.
Loam.....	ML.....	A-4	95-100	85-95	70-75	0.8- 2.5	.16	6.6 to 7.3...	Medium or high.	Low.
Loam (till)....	CL.....	A-4	95-100	85-90	70-75	0.2- 0.8	.14	Calcareous..	Medium or high.	Low.
Loam.....	ML.....	A-4	95-100	85-90	70-75	0.8- 2.5	.17	5.6 to 6.0...	Medium or high.	Low.
Sandy clay loam to clay loam.	CL.....	A-6	95-100	80-85	50-60	0.2- 0.8	.17	5.1 to 6.0...	Medium....	Moderate.
Fine sandy loam to coarse sandy loam.	SM or ML..	A-4	95-100	65-70	45-55	0.8- 2.5	.09	5.6 to 6.0...	Medium....	Low.
Sand, loamy sand, and silt bands.	SM.....	A-2 or A-4	90-95	40-50	30-40	2.5- 5.0	.05	Calcareous..	Medium or high.	Low.
Silt loam.....	ML.....	A-4	100	95-100	90-95	0.8- 2.5	.18	5.6 to 6.0...	Medium or high.	Low.
Silty clay loam to clay loam.	CL.....	A-6	95-100	90-95	80-85	0.2- 0.8	.18	5.1 to 5.5	Medium....	Moderate.
Loam (till)....	CL.....	A-4	95-100	85-90	65-75	0.2- 0.8	.14	Calcareous..	Medium....	Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
ChB ChC ChD	Chelsea loamy fine sand, 2 to 6 percent slopes. Chelsea loamy fine sand, 6 to 12 percent slopes. Chelsea loamy fine sand, 12 to 18 percent slopes.	Well-drained soils developed on terraces in sand of glacial drift over strata of sand and silt; about ½ to 1 foot of dark-brown loamy fine sand over 3 feet of yellowish-brown loamy fine sand over interbedded thin bands of fine sand and sandy loam to heavy loamy sand underlain by fine sand.	Feet 15+	Feet More than 25.	Inches 0-8 8-48 48-93
Cn	Crane silt loam.	Somewhat poorly drained soil developed in 0 to 3 feet of windblown silt over silty and loamy outwash; 1 to 1½ feet of silt loam over 3 to 4½ feet of silty clay loam to sandy clay loam over loamy fine sand to sandy loam underlain by strata of loose gravel and sand.	15+	2 feet or less.	93+ 0-18 18-48 48-70 70+
CrA	Crosby silt loam, 0 to 2 percent slopes.	Somewhat poorly drained soil developed in 0 to 1½ feet of windblown silt over material weathered from loam till; about 1 foot of silt loam over 2 feet of light silty clay and clay loam underlain by calcareous light clay loam to loam till.	15+	Less than 2 (perched).	0-11 11-31 31+
DaA DaB2	Dana silt loam, 0 to 2 percent slopes. Dana silt loam, 2 to 6 percent slopes, moderately eroded.	Moderately well drained soils developed in silt and material weathered from loam till; 1 to 1½ feet of silt loam over 1 to 2 feet of silty clay loam over 3 to 4 feet of clay loam underlain by calcareous loam till.	15+	More than 25.	0-16 16-32 32-70 70+
Dm	Delmar silt loam.	Poorly drained soil developed in windblown silt over material weathered from loam till; about 1 foot of silt loam over 1½ to 2 feet of silty clay loam over 1½ feet of clay loam underlain by calcareous loam till.	15+	Less than 1 (perched).	0-11 11-28 28-44 44+
Em Es Et	Eel loam. Eel silt loam. Eel silty clay loam.	Moderately well drained alluvial soils on bottom lands; subject to occasional or frequent flooding; 2 to 4 feet of loam and silt loam underlain by strata of sandy loam, silt, and loam material. The silty clay loam is finer textured from the surface to a depth of about 2 feet.	15+	More than 3.	0-15 15-26 26+
EuA EuB2 EwA EwB2	Elston loam, 0 to 2 percent slopes. Elston loam, 2 to 6 percent slopes, moderately eroded. Elston sandy loam, 0 to 2 percent slopes. Elston sandy loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils developed on outwash plains, terraces, and valley trains in stratified fine and medium sand containing some gravel; ½ to 2 feet of sandy loam over 1¼ to 2 feet of gravelly sandy loam underlain by medium and coarse sand.	15+	More than 25.	0-6 6-26 26-50 50-76+
FcA FcB FcB2	Fincastle silt loam, 0 to 2 percent slopes. Fincastle silt loam, 2 to 6 percent slopes. Fincastle silt loam, 2 to 6 percent slopes, moderately eroded.	Somewhat poorly drained soils developed in silt and material weathered from loam till; about 1 foot of silt loam over 2 to 3½ feet of silty clay loam over 1½ feet of clay loam underlain by calcareous loam till.	15+	Less than 2 (perched).	0-13 13-38 38-60 60+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unifed	AASHO	No. 10	No. 40	No. 200					
Loamy fine sand	SM	A-2	95-100	40-50	20-25	5.0-10.0	0.06	6.1 to 6.5	Medium	Low.
Loamy fine sand	SM	A-2	95-100	40-50	20-25	5.0-10.0	.02	5.1 to 5.5	Medium	Low.
Interbedded thin bands of fine sand and sandy loam and heavy loamy sand.	SM	A-4	95-100	50-60	40-50	2.5- 5.0	.04	5.1 to 5.5	Medium	Low.
Fine sand	SM	A-2	95-100	15-25	10-15	5.0-10.0	.02	6.6 to 7.3	Low	Low.
Silt loam	ML or CL	A-4	100	95-100	90-95	0.8- 2.5	.20	6.1 to 6.5	Medium or high.	Low.
Silty clay loam to sandy clay loam.	CL	A-6	95-100	80-85	50-55	0.05- 0.2	.18	5.6 to 6.0	Medium	Moderate.
Loamy fine sand to sandy loam.	SM	A-2 or A-4	95-100	60-70	30-40	2.5- 5.0	.9	5.6 to 6.6	Medium	Low.
Stratified gravel and sand.	SP	A-1	50-60	10-15	0-5	5.0-10.0	.03	Calcareous	Low	Low.
Silt loam	ML or CL	A-4	100	95-100	90-95	0.8- 2.5	.18	6.1 to 6.6	Medium or high.	Low.
Light silty clay.	CH	A-7, A-6	100	95-100	85-90	0.05- 0.2	.17	5.1 to 7.3	Medium	High.
Light clay loam to loam till.	CL	A-4 to A-6	95-100	85-90	65-70	0.2- 0.8	.14	Calcareous	Medium	Low or moderate.
Silt loam	ML	A-4	100	90-95	85-90	0.8- 2.5	.20	6.1 to 6.5	Medium or high.	Low.
Silty clay loam	CL	A-6 or A-7	95-100	95-100	90-95	0.2- 0.8	.17	5.6 to 6.0	Medium	Moderate or high.
Clay loam	CL	A-6	95-100	75-80	65-70	0.2- 0.8	.17	6.1 to 6.5	Medium	Moderate.
Loam (till)	CL	A-4	95-100	85-90	65-70	0.2- 0.8	.14	Calcareous	Medium	Low.
Silt loam	ML or CL	A-4	100	90-95	85-90	0.8- 2.5	.21	5.6 to 6.0	Medium or high.	Low.
Silty clay loam	CL or CH	A-7	100	95-100	90-95	0.2- 0.8	.21	4.5 to 5.0	Medium	Moderate or high.
Clay loam	CL	A-6	95-100	75-80	65-70	0.05- 0.2	.17	5.1 to 5.5	Medium	Moderate.
Loam (till)	CL	A-4	95-100	85-90	65-70	0.2- 0.8	.14	Calcareous	Medium	Low.
Silt loam, loam, or silty clay loam.	ML or CL	A-4 or A-6	95-100	95-100	85-70	0.8- 2.5	.20	6.6 to 7.3	Medium or high.	Low or moderate.
Loam, silt loam, or silty clay loam.	ML or CL	A-4 or A-6	95-100	90-95	85-90	0.8- 2.5	.20	6.6 to 7.3	Medium or high.	Low or moderate.
Sandy loam, silt, or sand.	SM	A-4	95-100	40-50	35-40	0.8- 5.0	.13	6.6 to 7.3	Medium or high.	Low.
Loam or sandy loam.	SM or SC	A-4	100	90-95	40-50	0.8- 2.5	.18	6.6 to 7.3	Medium or high.	Low.
Sandy loam	SM or SC	A-2	90-100	60-65	30-35	0.8- 2.5	.10	5.6 to 6.0	Medium	Low.
Gravelly sandy loam.	SM	A-4	90-95	70-75	40-45	2.5- 5.0	.08	5.1 to 5.5	Medium	Low.
Medium and coarse sand.	SP-SM	A-3	95-100	80-85	5-10	5.0-10.0	.04	Calcareous	Low	Low.
Silt loam	ML or CL	A-4	100	90-95	85-90	0.8- 2.5	.20	5.1 to 5.5	Medium or high.	Low.
Silty clay loam	CL	A-7	100	95-100	90-95	0.2- 0.8	.18	4.5 to 5.0	Medium	Moderate or high.
Clay loam	CL	A-6	95-100	75-80	65-70	0.2- 0.8	.17	5.1 to 5.5	Medium	Moderate.
Loam (till)	CL	A-4	95-100	85-90	60-70	0.2- 0.8	.14	Calcareous	Medium	Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
FfA	Fox fine sandy loam, 0 to 2 percent slopes.	Well-drained soils developed in 1 to 1½ feet of loamy outwash; ½ to 1 foot of fine sandy loam over 1½ to 2½ feet of gravelly clay loam to sandy clay loam underlain by stratified gravel and sand.	Feet 15+	Feet More than 25.	Inches 0-9
FfB2	Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded.				9-37
FmA	Fox loam, 0 to 2 percent slopes.	Well-drained soils developed in 1 to 1½ feet of silty and loamy outwash; ½ to 1 foot of loam or silt loam over 1½ to 2½ feet of clay loam, sandy clay loam, or gravelly clay loam underlain by stratified gravel and sand.	15+	More than 25.	0-9
FmB	Fox loam, 2 to 6 percent slopes.				9-36
FmB2	Fox loam, 2 to 6 percent slopes, moderately eroded.				
FmD2	Fox loam, 12 to 18 percent slopes, moderately eroded.				
FnA	Fox silt loam, 0 to 2 percent slopes.				
FnB	Fox silt loam, 2 to 6 percent slopes.				
FnB2	Fox silt loam, 2 to 6 percent slopes, moderately eroded.				36+
FnC2	Fox silt loam, 6 to 12 percent slopes, moderately eroded.				
FpB3	Fox soils, 2 to 6 percent slopes, severely eroded.				
FpC3	Fox soils, 6 to 12 percent slopes, severely eroded.				
FpD3	Fox soils, 12 to 18 percent slopes, severely eroded.				
Gm	Genesee loam.	Well-drained, alluvial soils on bottom land; 1½ to 2 feet of sandy loam, loam, silt loam, or silty clay loam underlain by strata ranging from fine sand to silty clay loam.	15+	More than 3½.	0-16
Go	Genesee loam, high bottom.				
Gs	Genesee silt loam.				16-45
Gt	Genesee silty clay loam.				45+
Gw	Gullied land, gravelly materials.	Well-drained, severely eroded soil material, some areas of which have sandy clay loam material overlying the calcareous, stratified sand and gravel.	15+	More than 3½.	0-10 10-60
Gy	Gullied land, loamy materials.	Well-drained, severely eroded soil material, some areas of which have clay loam or silty clay loam overlying calcareous loam till.	15+	More than 25.	0-10 10-60
HcE	Hennepin complex, 18 to 25 percent slopes.	Well-drained, shallow soils developed in weathered loam till; 1 to 1½ feet of loam over calcareous loam till.	15+	More than 25.	0-4
HcE3	Hennepin complex, 18 to 25 percent slopes, severely eroded.				4-17
HcF	Hennepin complex, 25 to 50 percent slopes.				17+
HgA	High Gap silt loam, 0 to 2 percent slopes.	Well-drained soils developed in material weathered from loam till over sandstone, siltstone, and shale; ½ to 1 foot of silt loam over 1 to 2 feet of clay loam underlain by bedrock.	1½-3	Depth undetermined.	0-7
HgB	High Gap silt loam, 2 to 6 percent slopes.				7-34
HgB2	High Gap silt loam, 2 to 6 percent slopes, moderately eroded.				34+
HgC	High Gap silt loam, 6 to 12 percent slopes.				
HhB3	High Gap soils, 2 to 6 percent slopes, severely eroded.				
HhC3	High Gap soils, 6 to 12 percent slopes, severely eroded.				

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface			
Hn	Huntsville silt loam.	Well-drained, alluvial soil on bottom land; 3 to 4 feet of silt loam in layers with thin layers of sand between them and underlain by sand or loam glacial till; silt loam is black in top foot and very dark gray below.	<i>Feet</i> 4+	<i>Feet</i> More than 3½.	<i>Inches</i> 0-11 11-43 43+			
Ld	Landes fine sandy loam.	Well-drained, alluvial soil on bottom land; 3 to 4 feet of alternating layers of fine sandy loam, loamy fine sand, and sandy loam.	15+	More than 25.	0-9 9-32 32+			
Ma	Marl beds.	Very poorly drained muck over marl; ½ to 1 foot of mucky loam over marl containing some gravel.	15+	0 _x (ponded).	0-9 9+			
MmB2	Miami silt loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils developed in 0 to 1½ feet of windblown silt over material weathered from loam till; about ¾ to 1 foot of silt loam over 1½ to 2½ feet of heavy silt loam to silty clay loam underlain by calcareous loam till.	15+	More than 25.	0-10			
MmC	Miami silt loam, 6 to 12 percent slopes.				10-31			
MmC2	Miami silt loam, 6 to 12 percent slopes, moderately eroded.				31+			
MsB3	Miami soils, 2 to 6 percent slopes, severely eroded.							
MsC3	Miami soils, 6 to 12 percent slopes, severely eroded.							
MxC	Muskingum stony complex, 2 to 12 percent slopes.	Well-drained soils developed in weathered interbedded sandstone, siltstone, and shale; ½ foot of stony loam over ½ to 1½ feet of heavy loam underlain by bedrock.	<2	Depth undetermined.	0-6			
MxF	Muskingum stony complex, 25 to 60 percent slopes.				6-18 18+			
ObA	Ockley loam, 0 to 2 percent slopes.	Well-drained soils developed in 0 to 3 feet of windblown silt over loamy and silty outwash; about 1 foot of loam or silt loam over 2 to 2½ feet of silty clay loam over ½ to 2 feet of sandy clay loam underlain by calcareous strata of gravel and sand.	15+	More than 3½.	0-13			
OcA	Ockley silt loam, 0 to 2 percent slopes.				13-39			
OcB	Ockley silt loam, 2 to 6 percent slopes.				39-45			
OcB2	Ockley silt loam, 2 to 6 percent slopes, moderately eroded.				45+			
OcC	Ockley silt loam, 6 to 12 percent slopes.							
OcC2	Ockley silt loam, 6 to 12 percent slopes, moderately eroded.							
OcD	Ockley silt loam, 12 to 18 percent slopes.							
OcD2	Ockley silt loam, 12 to 18 percent slopes, moderately eroded.							
OkB3	Ockley soils, 2 to 6 percent slopes, severely eroded.							
OkC3	Ockley soils, 6 to 12 percent slopes, severely eroded.							
OkD3	Ockley soils, 12 to 18 percent slopes, severely eroded.							
PbB2	Parr silt loam, 2 to 6 percent slopes, moderately eroded.				Well-drained soils developed in 0 to 1½ feet of windblown silt over material weathered from loam till; ½ to 1 foot of very dark brown silt loam over 1½ to 2½ feet of silty clay loam to coarse clay loam underlain by calcareous loam till.	15+	More than 25.	0-6
PbC2	Parr silt loam, 6 to 12 percent slopes, moderately eroded.							6-31
PdB3	Parr soils, 2 to 6 percent slopes, severely eroded.							
PdC3	Parr soils, 6 to 12 percent slopes, severely eroded.							31+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Silt loam.....	ML or CL..	A-4	95-100	95-100	85-90	<i>Inches per hour</i> 0.8- 2.5	<i>Inches per inch of soil</i> 0.21	6.6 to 7.3...	Medium or high.	Low.
Silt loam.....	ML or CL..	A-4	95-100	95-100	85-90	0.8- 2.5	.20	6.6 to cal- careous.	Medium or high.	Low.
Sand or loam (glacial till).	CL.....	A-4	95-100	85-90	65-70	0.8- 5.0	.07	Calcareous..	Medium....	Low.
Fine sandy loam.	SM, SC, or CL.	A-4	95-100	80-85	45-55	2.5- 5.0	.18	6.6 to cal- careous.	Medium....	Low.
Loamy sand to loamy fine sand.	SM.....	A-2	95-100	40-50	20-25	2.5- 5.0	.10	6.6 to cal- careous.	Medium....	Low.
Sandy loam....	SC.....	A-2	90-100	60-65	30-35	0.8- 2.5	.13	6.6 to cal- careous.	Medium....	Low.
Mucky loam....	OL.....	A-7	95-100	90-95	70-75	0.8- 2.5	.22	Calcareous..	Medium....	Low.
Marl.....		A-7				0.05	.10	Calcareous..	Medium....	Low.
Silt loam.....	ML.....	A-4	100	95-100	85-90	0.8- 2.5	.18	6.1 to 6.5...	Medium or high.	Low.
Heavy silt loam, clay loam, and silty clay loam.	CL.....	A-6	95-100	80-90	80-90	0.2- 0.8	.17	5.6 to 6.0...	Medium....	Moderate.
Loam (till)....	CL.....	A-4	95-100	85-90	65-70	0.2- 0.8	.14	Calcareous..	Medium....	Low.
Stony loam....	ML.....	A-4	95-100	80-90	60-70	0.8- 2.5	.18	4.0 to 4.4...	Medium....	Low.
Heavy loam....	CL.....	A-4	95-100	85-90	65-70	0.8- 2.5	.18	4.5 to 5.0...	Medium....	Low.
Weathered bed- rock.								5.1 to 5.5...		
Loam or silt loam.	ML.....	A-4	100	90-95	85-90	0.8- 2.5	.18	5.6 to 6.0...	Medium or high.	Low.
Silty clay loam..	CL.....	A-6	100	95-100	90-95	0.8- 2.5	.17	5.1 to 5.5...	Medium....	Moderate.
Sandy clay loam..	SC.....	A-6	95-100	80-85	40-45	0.8- 2.5	.16	5.1 to 6.0...	Medium....	Moderate.
Stratified gravel and sand.	GP or SM..	A-1 or A-3	50-60	10-15	5-10	5.0-10.0	.03	Calcareous..	Low.....	Low.
Silt loam.....	ML or CL..	A-4	100	95-100	85-90	0.8- 2.5	.21	5.6 to 6.0...	Medium or high.	Low.
Light clay loam to silty clay loam.	CL.....	A-6	95-100	95-100	90-95	0.8- 2.5	.18	5.6 to 6.0...	Medium or high.	Moderate.
Loam (till)....	CL.....	A-4	95-100	85-90	60-70	0.2- 0.8	.13	Calcareous..	Medium....	Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
PrB2	Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded.	Well-drained soils developed in thick windblown deposits of coarse silt and fine sand; about 1 foot of loam to sandy loam over 2 to 4 feet of sandy clay to clay loam over about 1 foot of sandy loam underlain by windblown coarse silt and fine sand.	Feet 15+	Feet More than 25.	Inches 0-11
PrC2	Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded.				11-56
PrE	Princeton fine sandy loam, 18 to 25 percent slopes.				56-62
PsA	Princeton loam, 0 to 2 percent slopes.				62+
PsB2	Princeton loam, 2 to 6 percent slopes, moderately eroded.				
PsC3	Princeton soils, 6 to 12 percent slopes, severely eroded.				
Ra	Ragsdale silty clay loam.	Very poorly drained, black, depressional soil developed in deep silt; about 1 foot of black silty clay loam over 1½ feet of fine silty clay loam over 1 to 1½ feet of silty clay loam underlain by silt to silt loam.	15+	0 (ponded).	0-9 9-49 49+
Rc	Ragsdale silty clay loam, till substratum.	Very poorly drained, black, depressional soil developed in silt material over loam till; about 1 foot of silty clay loam to light silty clay loam over 1 to 3½ feet of silty clay loam over about 1½ to 1 foot of clay loam underlain by calcareous loam till.	15+	0 (ponded).	0-13 13-48 48+
Rd	Raub silt loam.	Somewhat poorly drained soil developed in windblown silt on material weathered from loam till; 1 to 1½ feet of silt loam over 1 to 2 feet of silty clay loam over ½ to 1 foot of clay loam underlain by calcareous loam till.	15+	Less than 2 (perched).	0-14 14-38 38-46 46+
ReA	Reesville silt loam, 0 to 2 percent slopes.	Somewhat poorly drained soils developed in 3 to 7 feet of windblown silt over loam till; ½ to 1 foot of silt loam over 2 to 2½ feet of silty clay loam over ½ to 4 feet of silt underlain by calcareous loam till.	15+	Less than 2 (perched).	0-7
ReB2	Reesville silt loam, 2 to 6 percent slopes, moderately eroded.				7-39 39-64 64+
RmE	Rodman gravelly complex, 18 to 25 percent slopes.	Well-drained, shallow soils developed in gravelly or loamy material over stratified gravel and sand; about 1 foot of gravelly loam over calcareous sand and gravel.	15+	Depth undetermined.	0-13
RmF	Rodman gravelly complex, 25 to 50 percent slopes.				13+
Rn	Romney silty clay loam.	Very poorly drained, black, depressional soil developed in 1½ to 3½ feet of silt over loam till; 1½ to 2 feet of silty clay loam over 1 to 2 feet of silty clay loam to silty clay over 1 to 1½ feet of clay loam underlain by calcareous loam till.	15+	0 (ponded).	0-19 19-36 36-53 53+
Rr	Romney silty clay loam, gravelly substratum.	Very poorly drained, black, depressional soil; 1½ to 2 feet of black silty clay loam over about 2 feet of gray to dark-gray silty clay loam to sandy clay loam underlain by calcareous strata of gravel and sand 1 to several or many feet thick.	15+	0 (ponded).	0-22 22-54 54+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Fine sandy loam or loam.	ML-----	A-4	100	80-85	55-65	<i>Inches per hour</i> 2.5- 5.0	<i>Inches per inch of soil</i> 0.13	5.6 to 6.0---	Medium or high.	Low.
	Sandy clay loam or clay loam.	CL-----	A-6	95-100	70-80	55-65	0.2- 2.5	.17	5.1 to 5.5---	Medium-----
Sandy loam.	SM-----	A-2	95-100	60-65	30-35	2.5- 5.0	.10	5.6 to 6.0---	Medium-----	Low.
	Loamy sand, sandy loam, silt, and fine sand.	SM or ML--	A-4	95-100	80-85	45-55	5.0-10.0	.05	6.6 to calcareous.	Medium-----
Silty clay loam.	CL-----	A-6	100	100	95-100	0.2- 0.8	.20	6.6 to 7.3---	Medium-----	Moderate.
Silty clay loam.	CL-----	A-7	100	100	95-100	0.05- 0.2	.19	6.6 to 7.3---	Medium-----	Moderate or high.
Silt to silt loam.	ML-----	A-4	100	95-100	90-95	0.8- 2.5	.18	Calcareous--	High-----	Low.
Silty clay loam to light silty clay loam.	CL-----	A-6	100	95-100	95-100	0.2- 0.8	.21	6.1 to 6.5---	Medium-----	Moderate.
Silty clay loam to clay loam.	CL-----	A-7, A-6	95-100	90-95	85-90	0.05- 0.2	.18	6.6. to 7.3--	Medium-----	Moderate or high.
Loam (till)-----	CL-----	A-4	95-100	85-90	65-75	0.2- 0.8	.14	Calcareous--	Medium-----	Low.
Silt loam-----	ML-----	A-4 or A-6	100	95-100	85-90	0.8- 2.5	.21	5.6 to 6.0---	Medium or high.	Low.
Silty clay loam.	CL-----	A-7	100	95-100	95-100	0.05- 0.2	.18	5.1 to 5.5---	Medium-----	Moderate or high.
Clay loam-----	CL-----	A-6	95-100	75-80	65-70	0.2- 0.8	.17	6.6 to 7.3---	Medium-----	Moderate.
Loam (till)-----	CL-----	A-4	95-100	85-90	60-70	0.8- 2.5	.14	Calcareous--	Medium-----	Low or moderate.
Silt loam-----	ML-----	A-4	100	95-100	95-100	6.8- 2.5	.20	6.1 to 6.5--	Medium or high.	Low.
Heavy silt loam to silty clay loam.	ML or CL--	A-6	100	99-100	95-100	0.2- 0.8	.18	6.1 to 6.5--	Medium-----	Low or moderate.
Silt loam to silt.	ML-----	A-4	100	95-100	90-95	0.2- 0.8	.17	6.6 to calcareous.	High-----	Low.
Loam (till)-----	CL-----	A-4	95-100	85-90	60-70	0.8- 2.5	.14	Calcareous--	Medium-----	Low or moderate.
Gravelly loam--	ML-----	A-4	90-95	80-85	50-60	2.5- 5.0	.15	6.6 to 7.3--	Medium or high.	Low.
Stratified sand and gravel.	SP-----	A-1	50-60	10-15	0-5	5.0-10.0	.03	Calcareous--	Low-----	Low.
Silty clay loam.	CL-----	A-7	100	95-100	95-100	0.2- 0.8	.20	6.1 to 7.3--	Medium-----	Moderate or high.
Silty clay loam to silty clay.	CL or CH--	A-7	100	95-100	95-100	0.05- 0.2	.19	6.6 to 7.3--	Medium-----	High.
Clay loam-----	CL-----	A-6	95-100	75-80	65-70	0.2- 0.8	.17	6.6 to 7.3--	Medium-----	Moderate.
Loam (till)-----	CL-----	A-4	95-100	85-90	60-70	0.2- 0.8	.11	Calcareous--	Medium-----	Low or moderate.
Silty clay loam.	CL-----	A-6	100	95-100	95-100	0.2- 0.8	.16	5.6 to 6.0--	Medium-----	Moderate.
Silty clay loam to sandy clay loam.	CL-----	A-7 or A-6	95-100	65-70	50-55	0.2- 0.8	.15	6.6 to 7.3--	Medium-----	Moderate.
Gravel and sand.	SP-----	A-1	50-60	10-15	0-5	5.0-10.0	.02	Calcareous--	Low-----	Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface			
RsB	Russell silt loam, 2 to 6 percent slopes.	Well-drained soils developed in windblown silt over material weathered from loam till; about 1 foot of silt loam over 2 to 3 feet of silty clay loam over about 1 foot of loam to clay loam underlain by calcareous loam till.	Feet 15+	More than 25.	Feet 0-10			
RsB2	Russell silt loam, 2 to 6 percent slopes, moderately eroded.				10-42			
RsC	Russell silt loam, 6 to 12 percent slopes.				42-47			
RsC2	Russell silt loam, 6 to 12 percent slopes, moderately eroded.				47+			
RsD	Russell silt loam, 12 to 18 percent slopes.							
RsD2	Russell silt loam, 12 to 18 percent slopes, moderately eroded.							
RsE	Russell silt loam, 18 to 25 percent slopes.							
RsE2	Russell silt loam, 18 to 25 percent slopes, moderately eroded.							
RtB3	Russell soils, 2 to 6 percent slopes, severely eroded.							
RtC3	Russell soils, 6 to 12 percent slopes, severely eroded.							
RtD3	Russell soils, 12 to 18 percent slopes, severely eroded.							
Sa	Shadeland silt loam.				Somewhat poorly drained soil developed in material weathered from glacial drift over bedrock; about 1 foot of silt loam over 1 to 2 feet of silty clay loam underlain by bedrock.	1½-3½	Less than 2 (perched).	0-10 10-33 33+
Sb	Shoals silt loam.				Somewhat poorly drained alluvial soils developed in material derived from glacial drift; ½ to 1 foot of silt loam or clay loam over 2 to 3½ feet of silt loam or silty clay loam underlain by interbedded layers of silt loam and fine sand.	15+	Less than 2.	0-6
Sc	Shoals silty clay loam.	6-40 40+						
SdA	Sidell silt loam, 0 to 2 percent slopes.	Well-drained soils developed in 1½ to 3½ feet of windblown silt over material weathered from loam till; about 1 foot of silt loam over 3 to 4 feet of silty clay loam or clay loam underlain by calcareous loam till.	15+	More than 25.	0-11			
SdB	Sidell silt loam, 2 to 6 percent slopes.				11-55			
SdB2	Sidell silt loam, 2 to 6 percent slopes, moderately eroded.				55+			
SeB3	Sidell soils, 2 to 6 percent slopes, severely eroded.							
Sh	Sleeth silt loam.	Somewhat poorly drained soil developed in 0 to 3 feet of windblown silt over silty and loamy outwash underlain by stratified gravel and sand; about 1 foot of silt loam over 3 to 4 feet of silty clay loam to sandy clay loam underlain by calcareous strata of sand and gravel.	15+	Less than 2 (perched).	0-10 10-60 60+			
Sm	Sloan silt loam.	Very poorly drained, black, depressional soils developed from recent alluvial material washed in from glacial drift areas; about ½ foot of silty clay loam or silt loam over 3 to 4 feet of silty clay loam to sandy clay loam.	15+	0 (ponded).	0-6			
Sn	Sloan silty clay loam.				6-30 30-55 55+			
St	Stony alluvial land.				Well-drained soils in alluvium; 2 to 3 feet of silt loam containing many pieces of flint 4 to 10 inches across and underlain by bedrock.	3-6	Varies because of flooding.	0-5 5-12 12+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Silt loam.....	ML.....	A-4	100	90-95	85-90	<i>Inches per hour</i> 0.8- 2.5	<i>Inches per inch of soil</i> 0.18	<i>pH</i> 6.1 to 6.5...	Medium or high.	Low.
Silty clay loam to heavy clay loam.	CL.....	A-6	95-100	95-100	90-95	0.8- 2.5	.17	5.6 to 6.0...	Medium....	Moderate.
Loam.....	ML.....	A-4	95-100	85-90	65-70	0.8- 2.5	.16	6.6 to 7.3...	Medium or high.	Low.
Loam (till).....	CL.....	A-4	95-100	85-90	65-70	0.8- 2.5	.14	Calcareous..	Medium....	Low.
Silt loam.....	ML or CL..	A-4	100	90-95	85-90	0.8- 2.5	.19	5.6 to 6.0...	Medium or high.	Low.
Silty clay loam. Interbedded sandstone, siltstone, and shale.	CL.....	A-6	95-100	95-100	90-95	0.2- 0.8	.16	5.1 to 5.5...	Medium....	Moderate. Low.
Silt loam or silty clay loam.	ML or CL..	A-6	100	95-100	85-90	0.2- 2.5	.20	6.6 to 7.3...	Medium or high.	Low or moderate.
Silt loam.....	ML.....	A-4	95-100	90-95	85-90	0.2- 0.8	.20	6.6 to 7.3...	Medium or high.	Low.
Silt loam, sandy loam, and fine sand.	ML.....	A-4	95-100	85-90	70-80	0.8- 2.5	.19	6.6 to calcareous.	Medium or high.	Low.
Silt loam.....	ML.....	A-4	100	95-100	85-90	0.8- 2.5	.21	6.6 to 7.3...	Medium or high.	Low.
Silty clay loam or clay loam.	CL.....	A-6	100	95-100	90-95	0.8- 2.5	.19	5.6 to 6.0...	Medium....	Moderate.
Loam (till).....	CL.....	A-4	95-100	85-90	65-70	0.8- 2.5	.14	Calcareous..	Medium....	Low.
Silt loam.....	ML.....	A-4	100	95-100	85-90	0.8- 2.5	.20	5.1 to 6.0...	Medium or high.	Low.
Silty clay loam to sandy clay loam.	CL.....	A-6	95-100	95-100	55-65	0.2- 0.8	.17	5.1 to 5.5...	Medium....	Low or moderate.
Stratified sand and gravel.	SM or SP..	A-1	50-60	10-15	5-10	5.0-10.0	.04	Calcareous..	Low.....	Low.
Silty clay loam or silt loam.	ML or CL..	A-6	100	95-100	90-95	0.2- 0.8	.21	6.6 to 7.3...	Medium or high.	Low or moderate.
Silty clay loam..	CL.....	A-7	100	95-100	90-95	0.05- 0.2	.17	6.6 to 7.3...	Medium....	Moderate or high.
Silty clay loam to sandy clay loam.	CL.....	A-6	95-100	95-100	55-65	0.2- 0.8	.15	6.6 to 7.3...	Medium....	Moderate.
Sandy clay loam.	SC.....	A-6	95-100	80-85	40-45	0.2- 0.8	.14	6.6 to 7.3...	Medium....	Moderate.
Flinty silty loam.	GM.....	A-4	50-60	45-50	45-50	0.8- 2.5	.18	6.6 to 7.3..	Medium or high.	Low.
Very flinty silt loam.	GM.....	A-4	45-50	40-45	35-40	0.8- 2.5	.17	6.6 to 7.3..	Medium or high.	Low.
Very flinty silt loam to bed-rock.								6.1 to 6.5..		Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
Su	Sunbury silt loam.	Somewhat poorly drained soil developed in 4 to 7 feet of windblown silt over loam till; about 1 foot of silt loam over 2 to 3 feet of silty clay loam over 1 to 3 feet of silt loam to silt underlain by calcareous loam till.	Feet 15+	Feet Less than 2 (perched).	Inches 0-11 11-43 43-83 83+
Ta	Tawas muck.	Very poorly drained, organic soils consisting of woody and fibrous material mixed with mineral soil; 1 to 3½ feet of muck over sandy loam to loamy sand.	15+	0 (ponded).	0-32 32+
TcA	Tippecanoe silt loam, 0 to 2 percent slopes.	Moderately well drained soil developed in 0 to 3 feet of windblown silt over silty and loamy outwash; 1 to 1½ feet of silt loam over 2½ to 3½ feet of sandy clay loam to silty clay loam over 1 to 2 feet of sandy loam underlain by calcareous strata of sand and gravel.	15+	More than 25.	0-16 16-38 38-49 49-66 66+
Wa	Walkill silty clay loam.	Very poorly drained soil developed in 1 to 2½ feet of alluvium over muck; about 2½ feet of silty clay loam to fine silt loam over woody fibrous muck that ranges from about 1 to more than 4 feet in thickness.	15+	Less than 2 (perched).	0-8 8-14 14+
WbA	Warsaw loam, 0 to 2 percent slopes.	Well-drained soils developed in 0 to 1½ feet of windblown silt over silty and loamy outwash; 1 to 1½ feet of loam over ½ to 1 foot of gravelly loam over about 1 foot of gravelly clay loam underlain by strata of calcareous gravel and sand.	15+	More than 25.	0-14
WbB2	Warsaw loam, 2 to 6 percent slopes, moderately eroded.				14-24
WcA	Warsaw silt loam, 0 to 2 percent slopes.				24-38
WdC3	Warsaw soils, 6 to 12 percent slopes, severely eroded.				38+
Wh	Washtenaw silt loam.	Very poorly drained soil developed in recent alluvium or colluvium over dark-colored, very poorly drained, depressional soils; about 1 to 2½ feet of silt loam over 2 to 4 feet of silty clay loam underlain by calcareous strata of fine sand and silt to loam till.	15+	0 (ponded).	0-22 22-75 75+
WmA	Wea silt loam, 0 to 2 percent slopes.	Well-drained soils developed in 0 to 3 feet of windblown silt over loamy and silty outwash; 1 to 1½ feet of silt loam over 1 to 2 feet of silty clay loam over 1 to 2 feet of clay loam to sandy clay loam underlain by calcareous strata of gravel and sand.	15+	More than 25.	0-16
WmB	Wea silt loam, 2 to 6 percent slopes.				16-33
WmB2	Wea silt loam, 2 to 6 percent slopes, moderately eroded.				33-51
WnB3	Wea soils, 2 to 6 percent slopes, severely eroded.				51+
WnC3	Wea soils, 6 to 12 percent slopes, severely eroded.				
Wo	Westland silt loam.	Very poorly drained, black, depressional soils developed in silty and loamy outwash; about 1 foot of silt loam or silty clay loam over 2½ to 3 feet of silty clay loam or clay loam over about 1 foot of gravelly loam underlain by strata of calcareous gravel and sand.	15+	0 (ponded).	0-11
Wp	Westland silty clay loam.				11-42 42-51 51+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Silt loam	ML	A-6	100	95-100	85-90	Inches per hour 0.8- 2.5	Inches per inch of soil 0.20	pH 6.6 to 7.3	Medium or high	Low.
Light silty clay loam to silty clay loam.	CL	A-6	100	95-100	90-95	0.2- 0.8	.17	6.1 to 6.5	Medium	Moderate.
Silt loam to silt.	ML	A-4	100	95-100	85-90	0.2- 0.8	.15	6.6 to calcareous.	High	Low.
Loam (till)	CL	A-4	95-100	85-90	65-70	0.2- 0.8	.14	Calcareous.	Medium	Low.
Muck	Pt.	A-7				2.5- 5.0	.25+	6.6 to 7.3	Low	Low.
Sandy loam to loamy sand.	SM	A-1 or A-2	95-100	60-65	20-30	2.5-10.0	.06	Calcareous.	Medium	Low.
Silt loam	ML	A-4	100	95-100	85-90	0.8- 2.5	.20	5.1 to 6.0	Medium or high	Low.
Fine silt loam to silty clay loam.	ML or CL	A-6	100	95-100	90-95	0.2- 0.8	.18	5.1 to 5.6	Medium	Moderate.
Sandy clay loam.	SC	A-6	95-100	80-85	40-50	0.8- 2.5	.16	5.6 to 6.0	Medium	Moderate.
Sandy loam	SM	A-2	95-100	60-65	30-35	2.5- 5.0	.10	5.6 to 6.0	Medium	Low.
Stratified gravel and sand.	GP or SM	A-1 or A-3	50-60	10-15	0-5	5.0-10.0	.03	Calcareous.	Low	Low.
Silty clay loam	CL	A-6	100	95-100	90-95	0.05- 0.2	.18	6.1 to 6.5	Medium	Moderate.
Heavy silt loam	ML or CL	A-6	95-100	95-100	85-90	0.2- 0.8	.17	6.6 to 7.3	Medium	Low or moderate.
Muck	OL	A-7				2.5- 5.0	.25	6.6 to 7.3	Low	Low.
Loam or silt loam.	ML	A-4	95-100	90-95	80-90	0.8- 2.5	.17	6.1 to 6.5	Medium or high	Low.
Gravelly loam	ML	A-4	90-95	75-80	60-65	0.8- 2.5	.16	5.6 to 6.0	Medium or high	Low.
Gravelly clay loam.	CL	A-6	90-95	65-70	60-65	0.2- 0.8	.16	6.1 to 7.3	Medium	Moderate.
Stratified coarse gravel and sand.	SP	A-1	50-60	10-15	0-5	5.0-10.0	.03	Calcareous.	Low	Low.
Silt loam	ML or CL	A-6	100	95-100	85-90	0.8- 2.5	.19	6.6 to 7.3	Medium or high	Low or moderate.
Silty clay loam or clay loam.	CL	A-6	100	95-100	80-90	0.05- 0.2	.17	6.6 to 7.3	Medium	Moderate.
Stratified sand and silt or loam (till).	CL	A-4	95-100	80-85	60-70	0.8- 5.0	.11	Calcareous.	Medium or high	Low.
Silt loam	ML	A-4	95-100	95-100	85-90	0.8- 2.5	.20	6.6 to 7.3	Medium or high	Low.
Silty clay loam	CL	A-6	100	95-100	90-95	0.8- 2.5	.18	5.6 to 6.0	Medium	Moderate.
Clay loam or sandy clay loam.	CL	A-6	95-100	70-80	55-65	0.8- 2.5	.17	6.1 to 6.5	Medium	Moderate.
Stratified fine gravel and sand.	SP	A-1	50-60	10-15	0-5	5.0-10.0	.03	Calcareous.	Low	Low.
Silt loam or silty clay loam.	ML or CL	A-6	100	95-100	90-95	0.2- 0.8	.19	6.1 to 6.5	Medium or high	Low or moderate.
Silty clay loam or clay loam.	CL	A-7	95-100	95-100	80-90	0.05- 0.2	.17	6.1 to 6.5	Medium	Moderate.
Gravelly loam	ML	A-4	90-95	75-80	60-65	0.8- 2.5	.14	6.6 to 7.3	Medium	Low.
Poorly assorted gravel and sand.	GP or SM	A-1 or A-3	50-60	10-15	0-5	5.0-10.0	.03	Calcareous.	Low	Low.

TABLE 10.—*Brief description of soils and their*

Map symbol	Soil name	Description of soil and site	Depth to bed-rock	Depth to seasonally high water table	Depth from surface
Wr	Westland silty clay loam, loamy substratum.	Very poorly drained, black, depressional soil developed in silty and loamy outwash; about 1 foot of silty clay loam over 2 to 2½ feet of clay loam or silty clay loam underlain by stratified sand, silt, and small amounts of gravel.	Feet 15+	Feet 0 (ponded).	Inches 0-12 12-39 39-52 52+
Ws	Westland silty clay loam, moderately deep.	Very poorly drained, black, depressional soil developed in thin cap of windblown silt over loamy and silty outwash; about 1 foot of silty clay loam over 1½ to 2 feet of fine clay loam to sandy clay loam underlain by calcareous strata of gravel and sand.	15+	0 (ponded).	0-13 13-37 37+
Wt	Westland silty clay loam, thin solum variant.	Very poorly drained, black, depressional soil developed in shallow glacial drift over bedrock; 1 to 1½ feet of light silty clay loam or silty clay loam over ½ to 1½ feet of clay loam over ½ foot of loamy sand to sandy loam and sandstone fragments underlain by bedrock.	1½-4	0 (ponded).	0-15 15-20 20-25 25+
Wu Ww	Whitaker loam. Whitaker silt loam.	Somewhat poorly drained soils developed in stratified sand and silt containing gravel and clay; ½ to 1 foot of loam or silt loam over 1½ to 2 feet of fine silty clay loam or clay loam over 1 to 2 feet of sandy clay loam underlain by calcareous strata of sand, silt, and some gravel.	15+	Less than 2 (perched).	0-8 8-29 29-44 44+
WyA WyB WyB2	Wingate silt loam, 0 to 2 percent slopes. Wingate silt loam, 2 to 6 percent slopes. Wingate silt loam, 2 to 6 percent slopes, moderately eroded.	Moderately well drained soils developed in 1½ to 3½ feet of windblown silt over material weathered from loam till; 1 to 1½ feet of silt loam over 2 to 2½ feet of clay loam to silty clay loam underlain by calcareous loam till.	15+	More than 25.	0-13 13-46 46+
XnA XnB2	Xenia silt loam, 0 to 2 percent slopes. Xenia silt loam, 2 to 6 percent slopes, moderately eroded.	Moderately well drained soils developed in 18 to 40 inches of windblown silt over material weathered from loam till; about 1 foot of silt loam over 1½ to 2½ feet of silty clay loam to clay loam over 1 to 2 feet of clay loam to loam underlain by calcareous loam till.	15+	More than 25.	0-11 11-33 33-57 57+

estimated physical and chemical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Hazard of frost damage	Shrink-swell potential
USDA texture	Unified	AASHO	No. 10	No. 40	No. 200					
Silty clay loam.	CL-----	A-6	100	95-100	95-100	<i>Inches per hour</i> 0.2- 0.8	<i>Inches per inch of soil</i> 0.20	6.6 to 7.3---	Medium----	Moderate.
Clay loam or silty clay loam.	CL-----	A-7	95-100	95-100	85-90	0.05- 0.2	.18	6.6 to 7.3---	Medium----	Moderate.
Stratified sand and silt.	ML-----	A-4	95-100	80-85	70-75	0.8- 2.5	.10	6.6 to 7.3---	Medium----	Low.
Stratified sand and silt and some gravel.	ML-----	A-4	90-95	75-80	70-75	2.5-10.0	.05	Calcareous--	Medium----	Low.
Silty clay loam.	CL-----	A-7	100	95-100	90-95	0.2- 0.8	.20	6.1 to 6.5---	Medium----	Moderate or high.
Heavy clay loam to sandy clay loam.	CL-----	A-6	95-100	70-80	55-65	0.05- 0.8	.17	6.1 to 6.5---	Medium----	Moderate.
Stratified gravel and sand.	SP-----	A-1	50-60	10-15	0-5	5.0-10.0	.04	Calcareous--	Low-----	Low.
Light silty clay loam or clay loam.	CL-----	A-6	100	90-95	80-85	0.2- 0.8	.20	6.1 to 6.5---	Medium----	Moderate.
Clay loam.	CL-----	A-6	95-100	75-80	70-75	0.2- 0.8	.18	6.6 to 7.3---	Medium----	Moderate.
Loamy sand and sandstone fragments.	SM-----	A-2	95-100	40-50	20-25	0.8- 2.5	.06	6.6 to 7.3---	Medium----	Low.
Bedrock.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Loam or silt loam.	ML-----	A-4	100	95-100	85-90	0.8- 2.5	.20	6.1 to 6.5---	Medium or high.	Low.
Heavy silty clay loam or clay loam.	CL-----	A-7	100	95-100	80-90	0.2- 0.8	.17	4.5 to 5.0---	Medium----	Moderate.
Sandy clay loam.	SC-----	A-6	95-100	80-85	40-50	0.2- 0.8	.16	5.1 to 5.5---	Medium----	Moderate.
Stratified sand and silt.	SM-----	A-2 or A-4	90-95	40-50	30-40	2.5- 5.0	.02	Calcareous--	Low-----	Low.
Silt loam.	ML-----	A-4	100	90-95	85-90	0.8- 2.5	.21	6.1 to 6.5---	Medium or high.	Low.
Clay loam to silty clay loam.	CL-----	A-6	100	95-100	80-90	0.2- 0.8	.19	5.1 to 5.5---	Medium----	Moderate.
Loam (till).	CL-----	A-4	95-100	85-90	60-70	0.8- 2.5	.13	Calcareous--	Medium----	Low.
Silt loam.	ML-----	A-4	100	90-95	85-90	0.8- 2.5	.19	6.0 to 6.5---	Medium or high.	Low.
Silty clay loam.	CL-----	A-7	100	95-100	90-95	0.2- 0.8	.17	5.1 to 5.5---	Medium----	Moderate.
Loam to clay loam.	CL-----	A-4 to A-6	95-100	85-90	65-70	0.8- 2.5	.14	6.5 to 7.3---	Medium----	Low or moderate.
Loam (till).	CL-----	A-4	95-100	85-90	60-70	0.2- 0.8	.14	Calcareous--	Medium----	Low.

TABLE 11.—*Interpretations*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil ¹	Sand and gravel	Road fill	Highway location	Farm ponds
					Reservoir area
Alford (AdA, AfA, AfB, AfB2, AfB3, AfC, AfC2, AfC3).	Good in top 15 inches.	Poor; small amounts below depth of 6 feet.	Poor.....	Material below 3 to 4 feet very erosive; fair to good.	Soil material suitable in upper 4 feet.
Ayrshire (Ay).....	Good in top 18 inches.	Poor; small amounts of sand below depth of 4 feet or more.	Fair.....	Seasonally perched water table.	Rapidly permeable substratum; generally not suitable.
Birkbeck (BbA, BbB, BbB2).	Good in top 11 inches.	Not suitable, none present.	Fair.....	Material below 3 feet very erosive; fair to good.	Soil material suitable.....
Brookston (By).....	Fair.....	Not suitable, none present.	Poor.....	High water table; ponded.	Soil material suitable..
Camden (CaB2).....	Good in top 9 inches.	Poor; small amounts of gravel below depth of 5 feet.	Fair to good....	Deep and permeable; good.	Rapidly permeable layers in substratum; seepage a problem; not suitable.
Celina (CbB2).....	Good in top 12 inches.	Not suitable, none present.	Fair.....	Deep and permeable; good.	Soil material suitable....
Chelsea (ChB, ChC, ChD).	Poor.....	Good; thick beds of sand below depth of 6 feet.	Fair to good....	Excessively drained; good.	Rapidly permeable material; not suitable.
Crane (Cn).....	Good in top 18 inches.	Good; stratified layers of sand and gravel below depth of 4 feet or more.	Fair to good....	Seasonally perched water table.	Rapidly permeable substratum; generally not suitable.
Crosby (CrA).....	Good in top 11 inches.	Not suitable, none present.	Poor to fair; subsoil very plastic.	Seasonally perched water table; highly plastic material in subsurface layer.	Soil material suitable..
Dana (DaA, DaB2).....	Good in top 16 inches.	Not suitable, none present.	Fair.....	Deep organic surface layer.	Soil material suitable..
Delmar (Dm).....	Good in top 11 inches.	Not suitable, none present.	Poor.....	Seasonally perched water table; very slow permeability.	Soil material suitable..
Eel (Em, Es, Et).....	Good in top 25 inches.	Fair; some stratified gravel and sand in places below depth of 4 feet.	Fair.....	Subject to flooding and seasonally high water table.	Flooding.....
Elston (EuA, EuB2, EwA, EwB2).	Fair to good in top 6 inches.	Good; sand and small amounts of gravel below depth of 4 feet or more.	Good.....	Deep and permeable; good.	Rapidly permeable material; not suitable.
Fincastle (FcA, FcB, FcB2).	Good in top 8 inches.	Not suitable, none present.	Poor to fair....	Seasonally perched water table.	Soil material suitable..
Fox (FfA, FfB2, FmA, FmB, FmB2, FmD2, FnA, FnB, FnB2, FnC2, FpB3, FpC3, FpD3).	Good in top 9 inches.	Good; stratified sand and gravel layers below depth of 2 feet or more.	Good.....	Moderately deep and permeable; good.	Rapidly permeable substratum; not suitable.
Genesee (Gm, Go, Gs, Gt).	Good between depths of 36 to 45 inches.	Fair; some stratified gravel and sand in places below depth of 4 feet.	Fair.....	Subject to flooding....	Flooding.....

of engineering properties

Soil features affecting—Continued				
Farm ponds—Continued	Agricultural drainage	Terraces and diversions	Waterways	Septic tank disposal fields ²
Embankment				
Soil material suitable in upper 6 feet.	Not needed.....	Soil features favorable; suitable on slope of 2 to 12 percent.	High erodibility; suitable.	Moderate permeability and percolation; slight limitation.
Soil material suitable if horizons are mixed.	Perched water table; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; moderate to severe limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	High erodibility; suitable.	Moderately slow permeability; moderate limitation.
High shrink-swell potential; soil material suitable.	High water table; tile and surface drains needed.	Not needed, depressional.	Not needed, depressional.	Ponded; seasonally high water table, slow permeability; severe limitation.
Soil material suitable if horizons are mixed.	Not needed.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable on slopes of 2 to 6 percent.	Moderate permeability and percolation; slight limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable.	Moderately slow permeability and moderate percolation; moderate limitation.
Rapidly permeable deep sand; not suitable.	Not needed.....	Not needed, rapidly permeable.	Soil features favorable; suitable.	Rapid percolation and lateral movement of water; slight limitation.
Upper layers suitable; lower layers are stratified gravel and sand.	Perched water table; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; severe limitation.
High shrink-swell potential; high clay content in B horizon; soil material suitable.	Perched water table; tile and surface drains needed.	Not needed, level.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Seasonally high water table, slow percolation; moderate to severe limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable.	Moderately slow permeability; moderate limitation.
Soil material suitable.....	Perched water table; surface drains and tile to supplement them; subsurface drainage difficult.	Not needed, level flats...	Soil features favorable; suitable.	Seasonally high water table; severe limitation.
Soil material suitable to a depth of 3 feet.	Permeable material; subsurface drainage satisfactory.	Not needed, level bottom land.	Not needed, level bottom land.	Flooding and seasonal high water table; severe limitation.
Rapidly permeable material; not suitable.	Not needed.....	Not needed, level to gently sloping; good infiltration.	Soil features favorable; suitable on slopes of 2 to 6 percent.	Moderate permeability and percolation; slight limitation.
Soil material suitable.....	Perched water table; tile and surface drains needed.	Not needed, level.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Seasonally high water table; moderate to severe limitation.
Rapidly permeable material below 2 feet; not suitable.	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable on slopes of more than 2 percent.	Rapid permeability in substratum; permits lateral movement of water; slight limitation. ³
Soil material suitable.....	Not needed.....	Not needed.....	Not needed, level bottom land.	Flooding; severe limitation.

See footnotes at end of table.

TABLE 11.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil ¹	Sand and gravel	Road fill	Highway location	Farm ponds
					Reservoir area
Gullied land, gravelly materials (Gw).	Poor to fair---	Good; stratified gravel and sand layers below depth of 1 to 2 feet.	Good-----	Permeable material; good.	Rapidly permeable substratum; not suitable.
Gullied land, loamy materials (Gy).	Fair-----	Not suitable, none present.	Fair-----	Soil material suitable; good.	Soil material suitable--
Hennepin (HcE, HcE3, HcF).	Good-----	Not suitable, none present.	Fair-----	Suitable material but steep slopes.	Soil material suitable--
High Gap (HgA, HgB, HgB2, HgC, HhB3, HhC3).	Good between depths of 3 and 7 inches.	Not suitable, none present.	Poor-----	Shallow to bedrock---	Shallow to bedrock; not suitable.
Huntsville (Hn)-----	Good in top 43 inches.	Fair; some stratified sand below depth of 3 to 4 feet.	Poor to fair---	Subject to flooding----	Flooding-----
Landes (Ld)-----	Fair-----	Poor; some stratified sand below depth of 4 feet.	Fair-----	Subject to flooding----	Flooding-----
Marl beds (Ma)-----	Poor-----	Not suitable, none present.	Poor; marl below 1 foot.	High water table; mucky loam less than 1 foot over marl.	Soil material not suitable.
Miami (MmB2, MmC, MmC2, MsB3, MsC3).	Good in top 10 inches.	Not suitable, none present.	Fair-----	Deep and permeable; good for cuts and fills in sloping areas.	Soil material suitable---
Muskingum (MxC, MxF).	Good-----	Not suitable, shallow to rock.	Poor-----	Shallow to bedrock and steep topography.	Shallow to bedrock; not suitable.
Ockley (ObA, OcA, OcB, OcB2, OcC, OcC2, OcD, OcD2, OkB3, OkC3, OkD3).	Good in top 13 inches.	Good; thick beds of sand and gravel below depth of about 4 feet.	Fair to good---	Deep and permeable; good.	Rapidly permeable substratum; not suitable.
Parr (PbB2, PbC2, PdB3, PdC3).	Good in top 12 inches.	Not suitable, none present.	Fair-----	Deep and permeable; highly organic surface layer; good.	Soil material suitable---
Princeton (PrB2, PrC2, PrE, PsA, PsB2, PsC3).	Fair in top 11 inches.	Poor; small amounts of stratified sand.	Fair to good----	Deep and permeable; fair to good.	Some layers of substratum rapidly permeable; subject to seepage; not suitable.
Ragsdale (Ra)-----	Fair-----	Not suitable, none present.	Poor-----	High water table; ponded.	Soil material suitable---
Ragsdale, till substratum (Rc).	Poor-----	Not suitable, none present.	Poor-----	High water table; ponded.	Soil material suitable---
Raub (Rd)-----	Good in top 14 inches.	Not suitable, none present.	Poor to fair---	Seasonally perched water table.	Soil material suitable---
Reesville (ReA, ReB2)---	Good in top 13 inches.	Not suitable, none present.	Poor to fair---	Seasonally perched water table.	Soil material suitable---
Rodman (RmE, RmF)---	Fair-----	Good; thick beds of sand and gravel.	Good-----	Steep topography; good soil material.	Rapidly permeable material; not suitable.

engineering properties—Continued

Soil features affecting—Continued				
Farm ponds—Continued	Agricultural drainage	Terraces and diversions	Waterways	Septic tank disposal fields ²
Embankment				
Rapidly permeable material; not suitable.	Not needed.....	Soil features favorable for diversions; terraces not needed.	Soil features favorable; suitable.	Moderate to rapid permeability, rapid percolation and lateral movement of water; slight limitation.
Soil material suitable.....	Not needed.....	Erosion; earth moving and filling needed.	Soil features favorable; land shaping needed.	Moderately slow permeability, sloping soil; moderate limitation.
Soil material suitable.....	Not needed.....	Steep slopes; not suitable.	Steep slopes but waterways not needed.	Steep slopes; moderate limitation.
Shallow to bedrock; not suitable.	Not needed.....	Bedrock near surface; suitable on slopes of 2 to 12 percent if care is taken to avoid bedrock.	Soil features favorable; suitable.	Shallow to bedrock; severe limitation.
Soil material suitable in upper 3 feet.	Not needed.....	Not needed, level bottom land.	Not needed, level bottom land.	Flooding; severe limitation.
Rapidly permeable layers; not suitable.	Not needed.....	Not needed.....	Not needed.....	Flooding; severe limitation.
Marl below 1 foot; not suitable.	High water table; poor outlets; diversions needed to cut off runoff from upland; not suitable for tile.	Not needed, depression.	Not needed, depression.	Seasonally high water table; severe limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable for drainage.	Slopes; limitation slight to moderate, moderate on steep slopes.
Stony and silty and shallow to bedrock; not suitable.	Not needed.....	Not needed, slopes too steep; soil too shallow.	Not needed; slopes too steep; bedrock too near to surface.	Shallow to bedrock; severe limitation.
Soil material suitable in upper 3 feet.	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable on slopes of 2 to 18 percent.	Moderate permeability and percolation; slight limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable on slopes of 2 to 12 percent.	Slopes; limitation slight to moderate, moderate on steeper slopes.
Soil material suitable if horizons are mixed.	Not needed.....	Soil material favorable but slopes too irregular.	Soil material favorable; suitable.	Moderate permeability and percolation; slight limitation.
Soil material suitable.....	High water table; ponded; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Ponded, seasonally high water table; severe limitation.
High shrink-swell potential; high clay content; soil material suitable.	High water table; tile and surface drains needed.	Not needed.....	Not needed.....	Ponded, seasonally high water table; severe limitation.
Soil material suitable.....	Perched water table; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; severe limitation.
Soil material suitable.....	Perched water table; tile and surface drains needed.	Not needed, level.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Seasonally high water table; severe limitation.
Rapidly permeable material; not suitable.	Not needed.....	Steep slopes; not suitable.	Not needed; rapidly permeable material.	Steep slopes; severe limitation.

See footnotes at end of table.

TABLE 11.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil ¹	Sand and gravel	Road fill	Highway location	Farm ponds
					Reservoir area
Romney (Rn)-----	Fair-----	Not suitable, none present.	Poor in upper layers; good below depth of 53 inches.	High water table; ponded.	Soil material suitable.
Romney, gravelly substratum (Rr).	Fair-----	Good; stratified gravel and sand below depth of 4 feet or more.	Poor in upper layers; good below depth of 54 inches.	High water table; ponded.	Rapidly permeable substratum; not suitable.
Russell (RsB, RsB2, RsC, RsC2, RsD, RsD2, RsE, RsE2, RtB3, RtC3, RtD3).	Good in top 10 inches.	Not suitable, none present.	Fair-----	Deep and permeable; good.	Soil material suitable --
Shadeland (Sa)-----	Good in top 10 inches.	Not suitable, shallow to rock.	Poor-----	Shallow to bedrock-----	Shallow to bedrock; not suitable.
Shoals (Sb, Sc)-----	Good in top 20 inches.	Fair; some stratified sand and fine gravel in places below depth of 4 feet.	Poor to fair-----	Flooding; high water table.	Flooding and high water table.
Sidell (SdA, SdB, SdB2, SeB3).	Good in top 11 inches.	Not suitable, none present.	Fair-----	Highly organic surface layer; deep and permeable; good.	Soil material suitable--
Sleeth (Sh)-----	Fair in top 10 inches.	Good; thick beds of gravel and sand below depth of 4 feet or more.	Fair in upper layers; good in substratum.	Seasonally perched water table.	Rapidly permeable substratum; not suitable.
Sloan (Sm, Sn)-----	Poor-----	Poor; small amounts of sand below depth of 6 feet.	Poor-----	Flooding and ponding--	Soil material suitable but subject to flooding.
Stony alluvial land (St)	Poor-----	Not suitable, none present.	Poor-----	Flooding-----	Flooding; shallowness; not suitable.
Sunbury (Su)-----	Good in top 11 inches.	Not suitable, none present.	Poor to fair-----	Seasonally perched water table.	Soil material suitable --
Tawas (Ta)-----	Poor unless mixed with mineral soil.	Not suitable, none present.	Poor in upper layers; mucky sand at depth of 1 to 3 feet.	High water table; ponded; muck and peat at depth of 1 to 3½ feet.	Soil material not suitable.
Tippecanoe (TcA)-----	Good in top 16 inches.	Good; stratified gravel and sand below depth of 4 feet or more.	Fair to good-----	Deep and permeable; good.	Rapidly permeable substratum; not suitable.
Wallkill (Wa)-----	Fair in top 14 inches.	Not suitable, none present.	Poor; muck below depth of 1 to 2½ feet.	High water table; 1 to 2½ feet of alluvium over muck.	Soil material not suitable.
Warsaw (WbA, WbB2, WcA, WdC3).	Good in top 14 inches.	Good; thick layers of gravel and sand below depth of 2 feet or more.	Good-----	Moderately deep and permeable; good.	Rapidly permeable substratum; not suitable.

engineering properties—Continued

Soil features affecting—Continued				
Farm ponds—Continued	Agricultural drainage	Terraces and diversions	Waterways	Septic tank disposal fields ²
Embankment				
High shrink-swell potential; high clay content; soil material suitable.	High water table; ponded; tile and surface drains needed.	Not needed.....	Not needed, depressional.	Ponded, seasonally high water table; severe limitation.
Upper layers suitable; lower layers contain sand and gravel.	High water table; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; severe limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable.	Slight to moderate slope; limitation slight to moderate; moderate on steeper slopes.
Soil material not suitable.	Slow subsoil drainage; shallow depth to bedrock.	Not needed, level.....	Not needed, level.....	Shallow to bedrock; severe limitation.
Soil material suitable above 4 feet.	Seasonally high water table; subsurface drainage needed.	Not needed, level bottom land.	Not needed, level bottom land.	Severe flooding; severe limitation.
Soil material suitable.....	Not needed.....	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable.	Moderate permeability; slight limitation.
Upper layers suitable; lower layers rapidly permeable.	Slow subsoil drainage; tile needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; moderate or severe limitation.
Soil material suitable above 6 feet.	Ponded floodwater; seasonally high water table; tile and surface drains needed.	Not needed, level to depressional.	Not needed, level to depressional.	Flooding, ponded; severe limitation.
Soil material not suitable.	Not needed.....	Not needed, level bottom land.	Not needed, level bottom land.	Flooding; severe limitation.
Soil material suitable; below 4 feet material is silt in some places.	Perched water table; tile and surface drains needed.	Not needed, level.....	Not needed, level.....	Seasonally high water table; severe limitation.
Rapidly permeable sand below 1 foot or more; not suitable.	High water table; poor outlets; open ditches needed; not suitable for tile.	Soil features favorable for diversions; terraces not needed.	Not needed, depressional.	Muck, ponded; severe limitation.
Soil material suitable in upper 2 to 3 feet; lower layers rapidly permeable.	Not needed.....	Not needed.....	Not needed.....	Moderately slow permeability in upper layers and rapid permeability in substratum; slight limitation.
Muck below 1 to 2½ feet; not suitable.	High water table; poor outlets; tile and open ditches needed.	Not needed.....	Not needed, depressional.	Seasonally high water table; severe limitation.
Rapidly permeable substratum; not suitable.	Not needed.....	Soil features favorable; suitable on slopes of 2 to 12 percent.	Soil features favorable; suitable.	Moderate permeability and percolation; slight limitation.

See footnotes at end of table.

TABLE 11.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—	
	Topsoil ¹	Sand and gravel	Road fill	Highway location	Farm ponds
					Reservoir area
Washtenaw (Wh)-----	Good in top 16 inches.	Not suitable, none present.	Poor-----	High water table; ponded.	Soil material suitable---
Wea (WmA, WmB, WmB2, WnB3, WnC3).	Good in top 16 inches.	Good; thick layers of gravel and sand at 4 feet or more.	Fair to good----	Deep and permeable; good.	Soil material suitable in upper 3 feet.
Westland (Wo, Wp)-----	Fair-----	Good; stratified gravel and sand below depth of 4 feet or more.	Poor in upper layers; good below depth of 4 feet.	High water table; ponded.	Rapidly permeable substratum; not suitable.
Westland, loamy substratum (Wr).	Poor-----	Poor; some stratified sand and small amounts of gravel below depth of 4 feet.	Poor-----	High water table; ponded.	Seepage; not suitable--
Westland, moderately deep (Ws).	Fair-----	Good; thick beds of gravel and sand below depth of 3 feet.	Poor-----	High water table; ponded.	Rapidly permeable substratum; not suitable.
Westland, thin solum variant (Wt).	Fair-----	Not suitable, shallow to bedrock.	Poor-----	Shallow to bedrock; ponded.	Shallow to bedrock; not suitable.
Whitaker (Wu, Ww)-----	Good in top 8 inches.	Poor; small amounts of stratified fine sand below depth of 4 feet or more.	Fair in upper layers; good below depth of 3 to 4 feet.	Seasonally high water table.	Rapidly permeable substratum; seepage.
Wingate (WyA, WyB, WyB2).	Good in top 13 inches.	Not suitable, none present.	Fair-----	Deep and permeable; good.	Soil material suitable---
Xenia (XnA, XnB2)-----	Good in top 11 inches.	Not suitable, none present.	Fair-----	Deep and permeable; good.	Soil material suitable---

¹ Ratings of suitability are for soils that are not more than slightly eroded.

² In determining the degree of limitation—*slight*, *moderate*, and *severe*—for septic tank disposal fields, the soil features considered

organic material should be removed and replaced with a more suitable soil material. Thick deposits of organic materials require special investigation and structures of special design.

In areas of peat or muck, the water table is normally high. Structures built across or in these depressional areas should be on embankments. Depressions that have a high normal water table or a perched water table should be investigated thoroughly before proposed structures are designed.

Some soils that have a high water table may be made more suitable as borrow material by digging ditches to drain the soils before the borrow material is excavated. Also, if a soil is unstable because it has a perched or a normally high water table, underdrains may be required.

Because parts of bottom lands are flooded each year, structures on them should be built on an embankment above the level of high water. Suitable materials for use in embankments can be taken from most soils on bottom lands. If manmade fills on bottom lands encroach on adjacent waterways, the reduced size of these waterways may cause damaging floods and severe erosion.

Table 11 rates the suitability of the soils in each series for various engineering uses. It also lists soil features that might affect the selection and design of structures and the application of various engineering practices. These features are evaluated on the basis of test data and field performance.

Descriptions of the Soils

This section describes the soil series (groups of soils) and single soils (mapping units) of Fountain County. The acreage and proportionate extent of each mapping unit are given in table 12.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. Thus to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How Soils Are Mapped and Classified," not all mapping units are members of a soil series. Marl beds and Gullied land, gravelly mate-

engineering properties—Continued

Soil features affecting—Continued				
Farm ponds—Continued	Agricultural drainage	Terraces and diversions	Waterways	Septic tank disposal fields ²
Embankment				
Soil material suitable; best material below 1 to 2 feet. Rapidly permeable substratum; not suitable.	High water table; tile and surface drains needed. Not needed-----	Not needed----- Soil features favorable; suitable on slopes of 2 to 12 percent.	Not needed, depressional. Soil features favorable; suitable. Not needed, depressional	Seasonally high water table; severe limitation. Moderate permeability and percolation; slight limitation. Seasonally high water table; severe limitation.
Upper layers suitable; lower layers rapidly permeable.	High water table; ponding; tile and surface drains needed.	Not needed-----	Not needed-----	Seasonally high water table; severe limitation.
Upper layers suitable; lower layers rapidly permeable.	High water table; tile and surface drains needed.	Not needed-----	Not needed-----	Seasonally high water table; severe limitation.
Upper layers suitable; lower layers sand and gravel.	High water table; use open ditches for control of ground water and tile to supplement open ditches.	Not needed, depressional	Not needed, depressional	Ponded, seasonally high water table; severe limitation.
Shallow to bedrock; not suitable.	Shallow to bedrock; ponded; surface drains suitable but tile generally not suitable.	Not needed, level-----	Not needed, level-----	Shallow to bedrock; severe limitation.
Soil material suitable if horizons are mixed.	Seasonally high water table; subsurface drainage needed.	Not needed, level-----	Not needed, level-----	Seasonally high water table; moderate or severe limitation.
Soil material suitable-----	Not needed-----	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable.	Moderately slow permeability; moderate limitation.
Soil material suitable-----	Not needed-----	Soil features favorable; suitable on slopes of 2 to 6 percent.	Soil features favorable; suitable.	Moderately slow permeability; moderate limitation.

were permeability, percolation, level of ground water, depth to bedrock, flooding, and slope.

³ Coarse-textured soil material permits unfiltered sewage to travel long distances and probably to contaminate water supplies.

rials, are miscellaneous land types and do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and the woodland group in which the mapping unit has been placed. The pages on which each capability unit and each woodland group are described can be found by referring to the "Guide to Mapping Units" at the back of this report.

Soil scientist, engineers, students, and others who want detailed descriptions of the soil series should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Alford Series

The Alford series consists of moderately dark colored, deep, well-drained soils in nearly level to sloping areas. These soils are on glacial till plains and in areas of out-

wash materials that have been covered by a layer of windblown silt. This silt mantle ranges from 40 to 60 inches in thickness. Alford soils developed under hardwood forest.

The surface layer is dark-brown, friable silt loam about 8 inches thick. The subsurface layer is brown to dark-brown silt loam 3 to 5 inches thick. It is underlain by a subsoil that is about 30 to 40 inches thick and consists of yellowish-brown to dark-brown silt loam in the upper few inches and silty clay loam in the lower part. Medium acid to neutral, light-brown silt underlies the subsoil and is underlain, in turn, by calcareous loam till or by light-brown, yellowish-brown, and gray, calcareous, stratified very fine sand and silt.

Alford soils have good available moisture capacity. Lime is needed if these soils are cropped. Erosion is a major hazard.

Alford soils occur with the Ockley and Princeton soils but developed in finer silt and fine sand than the Princeton soils. In Alford soils the lower part of the subsoil developed from windblown silt rather than from outwash material like that in the Ockley soils.

May 26, 1966

TABLE 12.—Approximate acreage and proportionate extent of soils mapped

Soil	Area		Soil	Area	
	Acres	Percent		Acres	Percent
Alford silt loam, gravelly substratum, 0 to 2 percent slopes	500	0.2	Hennepin complex, 18 to 25 percent slopes, severely eroded	143	0.1
Alford silt loam, 0 to 2 percent slopes	256	.1	High Gap silt loam, 0 to 2 percent slopes	268	6.1
Alford silt loam, 2 to 6 percent slopes	340	.1	High Gap silt loam, 2 to 6 percent slopes	588	.2
Alford silt loam, 2 to 6 percent slopes, moderately eroded	2,449	1.0	High Gap silt loam, 2 to 6 percent slopes, moderately eroded	510	.2
Alford silt loam, 2 to 6 percent slopes, severely eroded	245	.1	High Gap silt loam, 6 to 12 percent slopes	123	(¹)
Alford silt loam, 6 to 12 percent slopes	162	.1	High Gap soils, 2 to 6 percent slopes, severely eroded	87	(¹)
Alford silt loam, 6 to 12 percent slopes, moderately eroded	286	.1	High Gap soils, 6 to 12 percent slopes, severely eroded	88	(¹)
Alford silt loam, 6 to 12 percent slopes, severely eroded	192	.1	Huntsville silt loam	846	.3
Ayrshire loam	223	.1	Landes fine sandy loam	1,113	.4
Birkbeck silt loam, 0 to 2 percent slopes	588	.2	Marl beds	30	(¹)
Birkbeck silt loam, 2 to 6 percent slopes	517	.2	Miami silt loam, 2 to 6 percent slopes, moderately eroded	757	.3
Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded	2,198	.9	Miami silt loam, 6 to 12 percent slopes	139	.1
Brookston silty clay loam	10,909	4.3	Miami silt loam, 6 to 12 percent slopes, moderately eroded	164	.1
Camden loam, 2 to 6 percent slopes, moderately eroded	99	(¹)	Miami soils, 2 to 6 percent slopes, severely eroded	486	.2
Celina silt loam, 2 to 6 percent slopes, moderately eroded	262	.1	Miami soils, 6 to 12 percent slopes, severely eroded	1,450	.6
Chelsea loamy fine sand, 2 to 6 percent slopes	96	(¹)	Mine pits and dumps	535	.2
Chelsea loamy fine sand, 6 to 12 percent slopes	186	.1	Muskingum stony complex, 2 to 12 percent slopes	120	(¹)
Chelsea loamy fine sand, 12 to 18 percent slopes	103	(¹)	Muskingum stony complex, 25 to 60 percent slopes	1,942	.8
Crane silt loam	6,984	2.7	Oekley loam, 0 to 2 percent slopes	200	.1
Crosby silt loam, 0 to 2 percent slopes	6,512	2.5	Oekley silt loam, 0 to 2 percent slopes (based on field review)	8,419	3.3
Dana silt loam, 0 to 2 percent slopes	236	.1	Oekley silt loam, 2 to 6 percent slopes	1,014	.4
Dana silt loam, 2 to 6 percent slopes, moderately eroded	178	.1	Oekley silt loam, 2 to 6 percent slopes, moderately eroded	2,656	1.0
Delmar silt loam	148	.1	Oekley silt loam, 6 to 12 percent slopes	96	(¹)
Eel loam	571	.2	Oekley silt loam, 6 to 12 percent slopes, moderately eroded	314	.1
Eel silt loam	3,752	1.5	Oekley silt loam, 12 to 18 percent slopes	110	(¹)
Eel silty clay loam	376	.1	Oekley silt loam, 12 to 18 percent slopes, moderately eroded	282	.1
Elston loam, 0 to 2 percent slopes	260	.1	Oekley soils, 2 to 6 percent slopes, severely eroded	574	.2
Elston loam, 2 to 6 percent slopes, moderately eroded	78	(¹)	Oekley soils, 6 to 12 percent slopes, severely eroded	558	.2
Elston sandy loam, 0 to 2 percent slopes	400	.2	Oekley soils, 12 to 18 percent slopes, severely eroded	350	.1
Elston sandy loam, 2 to 6 percent slopes, moderately eroded	84	(¹)	Parr silt loam, 2 to 6 percent slopes, moderately eroded	683	.3
Fincastle silt loam, 0 to 2 percent slopes	27,455	10.8	Parr silt loam, 6 to 12 percent slopes, moderately eroded	474	.2
Fincastle silt loam, 2 to 6 percent slopes	980	.4	Parr soils, 2 to 6 percent slopes, severely eroded	90	(¹)
Fincastle silt loam, 2 to 6 percent slopes, moderately eroded	562	.2	Parr soils, 6 to 12 percent slopes, severely eroded	419	.2
Fox fine sandy loam, 0 to 2 percent slopes	704	.3	Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded	445	.2
Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded	272	.1	Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded	165	.1
Fox loam, 0 to 2 percent slopes	2,296	.9	Princeton fine sandy loam, 18 to 25 percent slopes	146	.1
Fox loam, 2 to 6 percent slopes	218	.1	Princeton loam, 0 to 2 percent slopes	343	.1
Fox loam, 2 to 6 percent slopes, moderately eroded	825	.3	Princeton loam, 2 to 6 percent slopes, moderately eroded	160	.1
Fox loam, 12 to 18 percent slopes, moderately eroded	153	.1	Princeton soils, 6 to 12 percent slopes, severely eroded	78	(¹)
Fox silt loam, 0 to 2 percent slopes	4,170	1.6	Ragsdale silty clay loam	16,511	6.5
Fox silt loam, 2 to 6 percent slopes	741	.3	Ragsdale silty clay loam, till substratum	5,345	2.1
Fox silt loam, 2 to 6 percent slopes, moderately eroded	1,511	.6	Raub silt loam	4,124	1.6
Fox silt loam, 6 to 12 percent slopes, moderately eroded	322	.1	Reesville silt loam, 0 to 2 percent slopes	20,846	8.2
Fox soils, 2 to 6 percent slopes, severely eroded	740	.3	Reesville silt loam, 2 to 6 percent slopes, moderately eroded	360	.1
Fox soils, 6 to 12 percent slopes, severely eroded	1,761	.7	Rodman gravelly complex, 18 to 25 percent slopes	475	.2
Fox soils, 12 to 18 percent slopes, severely eroded	209	.1			
Genesee loam	2,670	1.0			
Genesee loam, high bottom	734	.3			
Genesee silt loam	8,888	3.5			
Genesee silty clay loam	272	.1			
Gravel pits	585	.2			
Gullied land, gravelly materials	74	(¹)			
Gullied land, loamy materials	402	.2			
Hennepin complex, 18 to 25 percent slopes	1,297	.5			
Hennepin complex, 25 to 50 percent slopes	7,005	2.8			

See footnote at end of table.

TABLE 12.—Approximate acreage and proportionate extent of soils mapped—Continued

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Rodman gravelly complex, 25 to 50 percent slopes	3, 248	1. 3	Tawas muck	168	0. 1
Romney silty clay loam	1, 132	. 4	Tippecanoe silt loam, 0 to 2 percent slopes	1, 913	. 8
Romney silty clay loam, gravelly substratum	839	. 3	Wallkill silty clay loam	83	(¹)
Russell silt loam, 2 to 6 percent slopes	1, 694	. 7	Warsaw loam, 0 to 2 percent slopes	303	. 1
Russell silt loam, 2 to 6 percent slopes, moderately eroded	7, 906	3. 1	Warsaw loam, 2 to 6 percent slopes, moderately eroded	244	. 1
Russell silt loam, 6 to 12 percent slopes	802	. 3	Warsaw silt loam, 0 to 2 percent slopes	192	. 1
Russell silt loam, 6 to 12 percent slopes, moderately eroded	1, 995	. 8	Warsaw soils, 6 to 12 percent slopes, severely eroded	102	(¹)
Russell silt loam, 12 to 18 percent slopes	765	. 3	Washtenaw silt loam	200	. 1
Russell silt loam, 12 to 18 percent slopes, moderately eroded	472	. 2	Wea silt loam, 0 to 2 percent slopes	6, 350	2. 5
Russell silt loam, 18 to 25 percent slopes	691	. 3	Wea silt loam, 2 to 6 percent slopes	200	. 1
Russell silt loam, 18 to 25 percent slopes, moderately eroded	236	. 1	Wea silt loam, 2 to 6 percent slopes, moderately eroded	815	. 3
Russell soils, 2 to 6 percent slopes, severely eroded	1, 022	. 4	Wea soils, 2 to 6 percent slopes, severely eroded	139	. 1
Russell soils, 6 to 12 percent slopes, severely eroded	1, 377	. 5	Wea soils, 6 to 12 percent slopes, severely eroded	119	(¹)
Russell soils, 12 to 18 percent slopes, severely eroded	501	. 2	Westland silt loam	832	. 3
Shadeland silt loam	1, 898	. 7	Westland silty clay loam	16, 634	6. 5
Shoals silt loam	869	. 3	Westland silty clay loam, loamy substratum	392	. 2
Shoals silty clay loam	100	(¹)	Westland silty clay loam, moderately deep	880	. 3
Sidell silt loam, 0 to 2 percent slopes	341	. 1	Westland silty clay loam, thin solum variant	250	. 1
Sidell silt loam, 2 to 6 percent slopes	111	(¹)	Whitaker loam	1, 177	. 5
Sidell silt loam, 2 to 6 percent slopes, moderately eroded	2, 193	. 9	Whitaker silt loam	614	. 2
Sidell soils, 2 to 6 percent slopes, severely eroded	139	. 1	Wingate silt loam, 0 to 2 percent slopes	392	. 2
Sleeth silt loam	9, 524	3. 7	Wingate silt loam, 2 to 6 percent slopes	94	(¹)
Sloan silt loam	188	. 1	Wingate silt loam, 2 to 6 percent slopes, moderately eroded	200	. 1
Sloan silty clay loam	727	. 3	Xenia silt loam, 0 to 2 percent slopes	145	. 1
Stony alluvial land	57	(¹)	Xenia silt loam, 2 to 6 percent slopes, moderately eroded	1, 220	. 5
Sunbury silt loam	2, 467	. 9	Permanent streams	466	. 2
			Total	254, 080	100. 0

¹ Less than 0.05 percent.

Alford silt loam, 0 to 2 percent slopes (AfA).—This nearly level soil is in large, uniform areas in the southern third of the county on ridgetops above sloping soils. The surface layer is slightly thicker than that in the more sloping Alford soils. Surface runoff is very slow, and permeability is moderate. Included in areas mapped as this soil are small scattered areas of moderately well drained soils, of moderately eroded soils, and of soils that have a darker surface layer.

This soil has few limitations; it can be farmed intensively. (Capability unit I-1; woodland group 1)

Alford silt loam, 2 to 6 percent slopes (AfB).—This soil generally is at the crest of hilltops and at the foot of the longer, steeper, and more severely eroded slopes. The surface layer is thicker and darker at the foot of the longer slopes than it is at the crests. In a few areas this soil is in narrow bands around the head of drainageways. Included in areas mapped as this soil are small scattered areas of moderately well drained soils and of soils that have a darker surface layer.

Because this soil is susceptible to erosion, contour tillage and other practices are needed to control erosion in areas that are intensively cultivated. (Capability unit IIe-3; woodland group 1)

Alford silt loam, 2 to 6 percent slopes, moderately eroded (AfB2).—This is the most extensive Alford soil in the county. It occurs in fairly large areas on moderately

long, irregular slopes, in narrow bands at the head of small drainageways, and around areas of Alford silt loam, 0 to 2 percent slopes. The top layer is 7 or 8 inches of brown silt loam that consists of the original surface layer mixed with a moderate amount of yellowish-brown subsoil. Surface runoff is slow, and permeability is moderate. Some small spots are severely eroded.

This productive soil has only moderate limitations. If it is cultivated intensively, contour tillage and other practices are needed to control erosion. (Capability unit IIe-3; woodland group 1)

Alford silt loam, 2 to 6 percent slopes, severely eroded (AfB3).—This soil generally occurs in long narrow bands below areas of Alford silt loam, 2 to 6 percent slopes, moderately eroded, and above areas of Alford silt loam, 6 to 12 percent slopes, severely eroded. The plow layer consists mainly of subsoil material, except in a few, small, moderately well drained spots that retain some of their original surface layer. Surface runoff is slow or medium, and permeability is moderate.

On this severely eroded soil, contour tillage, terracing, or a cover of meadow crops is needed to prevent excessive loss of soil. (Capability unit IIIe-3; woodland group 1)

Alford silt loam, 6 to 12 percent slopes (AfC).—This soil occurs in wooded areas and in areas where cropping has not been intensive. The subsoil is not so thick as that in Alford silt loam, 0 to 2 percent slopes. In the wooded

areas a layer of partly decomposed leaf litter, about 1 inch thick, overlies the surface soil. Surface runoff is medium.

This soil would erode readily if it were cropped heavily and not managed well. (Capability unit IIIe-3; woodland group 1)

Alford silt loam, 6 to 12 percent slopes, moderately eroded (AfC2).—This soil occurs as narrow bands above the adjoining Alford silt loam, 6 to 12 percent slopes, and below Alford silt loam, 2 to 6 percent slopes, moderately eroded. The plow layer is similar to that of Alford silt loam, 2 to 6 percent slopes. Surface runoff is medium to rapid, and permeability is moderate. Included in areas mapped as this soil are small areas of moderately well drained soils.

The management of this soil should include practices to control erosion and to increase organic-matter content. (Capability unit IIIe-3; woodland group 1)

Alford silt loam, 6 to 12 percent slopes, severely eroded (AfC3).—The subsoil is exposed in most areas of this soil, and in a few places gullies extend to the underlying material. The original surface layer remains in a few spots. Surface runoff is rapid, and permeability is moderate to rapid. Included in areas mapped as this soil are small areas of moderately well drained soils.

This soil is best suited to meadow, but it can be cultivated occasionally. If the soil is cropped, all cultivation should be on the contour and other practices should be used to control erosion. (Capability unit IVe-3; woodland group 1)

Alford silt loam, gravelly substratum, 0 to 2 percent slopes (AdA).—This soil occurs in large level outwash plains in the southern third of the county. It is similar to the Alford soil described for the series except that it is underlain by stratified fine gravel and coarse sand at a depth of 5 feet or more. Surface runoff is very slow, but internal drainage is medium. Included in areas mapped as this soil are small scattered areas of moderately well drained soils.

This soil has few limitations, and it can be farmed intensively. (Capability unit I-1; woodland group 1)

Ayrshire Series

The Ayrshire series consists of moderately dark colored, deep, somewhat poorly drained soils. These soils are nearly level or occur in small slightly depressional areas at the head of draws. Some areas are surrounded by dune-shaped areas of better drained soils. Ayrshire soils developed under hardwood forest.

The surface layer consists of 8 inches of grayish-brown, friable loam. It is underlain by light grayish-brown loam about 10 inches thick. The subsoil is about 30 to 40 inches thick and is grayish-brown coarse sandy loam in the upper part and gray clay loam in the lower part. The underlying material is at a depth ranging from 40 to 70 inches and consists of gray calcareous coarse silt to fine sand. Many, distinct, yellowish-brown mottles occur at a depth of about 8 inches and extend through the subsoil and the underlying material.

Ayrshire soils have a coarser textured surface layer and subsoil than the Reesville soils. They developed in coarse silt and fine sand rather than in silt-capped till as did the Fincastle soils.

Wetness is the main limitation to the use of Ayrshire soils. In areas used for crops, additions of lime are needed occasionally.

The Ayrshire soils occur with the moderately dark colored, well-drained Princeton soils and the dark colored, very poorly drained Ragsdale soils.

Ayrshire loam (Ay).—In many areas this soil is covered by 4 to 6 inches of soil material that washed from surrounding higher lying soils.

This soil has few limitations that restrict its use for crops. The main limitation is the somewhat poor drainage, but this can be easily corrected by tile and surface drains. (Capability unit IIw-2; woodland group 5)

Birkbeck Series

Soils of the Birkbeck series are moderately dark colored, deep, and moderately well drained. These soils occur on the upland till plains in nearly level and gently sloping areas that are covered by windblown silt. They developed under hardwood forest.

The surface layer is 6 to 8 inches of dark-brown to dark grayish-brown silt loam. The subsurface layer consists of yellowish-brown to grayish-brown silt loam 3 to 7 inches thick. Silty clay loam to silt loam makes up the subsoil and is about 45 inches thick. The subsoil is light yellowish brown in the upper part and light yellowish brown mottled with grayish brown in the lower part. The underlying material is grayish-brown and yellow calcareous silt or loam till.

In some of the more sloping areas of these soils, carbonates are at a depth of more than 60 inches, but in the nearly level areas carbonates are at a depth of as little as 40 inches. Mottling occurs at a depth of 18 to about 30 inches.

The Birkbeck soils have good available moisture capacity. Internal drainage is moderate in the upper subsoil and moderately slow in the lower subsoil. Occasional additions of lime are needed in areas where crops are grown in rotation. The organic-matter content is low.

Birkbeck soils developed entirely in silt, but the lower part of Xenia soils developed in loam till.

Birkbeck soils occur in the southern part of the county with the very poorly drained, dark colored Ragsdale soils in depressions; with the somewhat poorly drained, moderately dark colored Reesville soils in nearly level areas; and with the well-drained, moderately dark colored Alford soils in gently sloping to steep areas.

Birkbeck silt loam, 0 to 2 percent slopes (BbA).—This soil occurs in loess-covered areas of the till plains, mainly in the southern half of the county. The surface layer is 6 to 8 inches thick. Surface runoff is slow or very slow.

Included in areas mapped as this soil are small areas of the somewhat poorly drained Reesville soils and areas that have a darker than normal surface layer. A few of the higher areas are moderately eroded.

This nearly level soil is productive, is easily cultivated, and has no serious limitations. If it is farmed intensively, fertilizers should be added in amounts indicated by soil tests. (Capability unit I-1; woodland group 1)

Birkbeck silt loam, 2 to 6 percent slopes (BbB).—This soil occurs in small areas throughout the southwestern

part of the county. Most slopes are short, and erosion is slight. Surface runoff is slow. Included in areas mapped as this soil, especially on slopes of less than 4 percent, are small areas of somewhat poorly drained soils and areas that have a darker than normal surface layer.

This gently sloping soil is productive, is easily cultivated, and has no serious limitation. Areas are small and generally are not farmed as separate units. (Capability unit IIe-3; woodland group 1)

Birkbeck silt loam, 2 to 6 percent slopes, moderately eroded (BbB2).—This is the most extensive Birkbeck soil in the county. It is in large areas that border areas of well-drained and somewhat poorly drained soils. The plow layer consists of a mixture of the original surface soil and some of the yellowish-brown subsoil. In the more sloping areas, carbonates may be leached from the surface to the underlying material. Included in areas mapped as this soil are small areas of well-drained soils.

This soil is productive, is easily cultivated, and has only moderate limitations. If cultivation is intensive, contour tillage, stripcropping, or other practices are needed to control erosion. (Capability unit IIe-3; woodland group 1)

Brookston Series

The Brookston series consists of dark-colored, deep, very poorly drained soils. These soils occur throughout the county in nearly level and depressional areas of the uplands.

The surface layer is black silty clay loam 6 to 8 inches thick and is underlain by a subsurface layer of very dark gray silty clay loam 3 to 5 inches thick. The subsoil is about 40 inches thick and consists of yellowish-brown to gray silty clay loam or clay loam that is mottled with strong brown or brown. The underlying material is gray and brown calcareous till of loam or silt loam texture. It is at a depth ranging from 42 to 70 inches. In some places a few inches of stratified sandy material is directly above the till.

These soils have very high available moisture capacity and slow internal drainage. Their content of organic matter is high, but lime is occasionally needed in cultivated areas.

Brookston soils are underlain by till, but Westland soils are underlain by stratified materials.

Brookston soils occur adjacent to the somewhat poorly drained Fincastle and Crosby soils in nearly level areas, with the moderately well drained Xenia and Celina soils in nearly level to gently rolling areas, and with the well drained Russell and Miami soils in gently rolling to steep areas. The Brookston soils that occur with the Russell soils are more silty than those that occur with the Miami soils.

Brookston silty clay loam (By).—This soil is extensive and occurs throughout the county in nearly level and depressional areas of the till plains. Runoff is very slow or ponded. Included in areas mapped as this soil are small areas that have a silt loam surface layer and small areas of somewhat poorly drained and very poorly drained soils.

This soil is fertile, though the very poor drainage is a major limitation. If it is adequately drained, the soil is productive. (Capability unit IIw-1; woodland group 11)

Camden Series

The Camden series consists of moderately dark colored, deep, well-drained soils that occur on gently sloping terraces and along small streams. These soils developed under hardwood forest.

The surface layer is brown to dark-brown, friable loam 7 to 9 inches thick. The subsoil, about 35 to 40 inches thick, is dark-brown clay loam in the upper part and dark-brown sandy loam in the lower part. It is underlain by brown and gray stratified sand and silt at a depth of 35 to 55 inches. The underlying material is slightly acid in the upper part but is calcareous at a depth ranging from 42 to 70 inches or more.

In areas that are cropped intensively, erosion is the major hazard and frequent additions of lime are needed.

In areas of these soils that grade toward Ockley soils, gravel occurs and the strata of silt decrease.

Camden soils occur with the moderately dark colored, somewhat poorly drained Whitaker soils.

Camden loam, 2 to 6 percent slopes, moderately eroded (CaB2).—The surface layer of this soil is a mixture of the original surface soil and a moderate amount of subsoil, though some small areas are not eroded. On terraces along small streams, areas of this soil are only 2 to 5 acres in size. In some small areas only 2 or 3 inches of stratified material is between the subsoil and the underlying glacial till. Surface runoff is medium, and permeability is moderate. Included in areas mapped as this soil are small areas that have a silt loam to fine sandy loam surface soil.

This soil has only moderate limitations. Practices to control erosion and to prevent excess loss of soil are needed, and droughtiness may be a problem in years when the rainfall distribution is uneven. (Capability unit IIe-1; woodland group 1)

Celina Series

The Celina series consists of moderately dark colored, deep, moderately well drained soils on gentle slopes next to the major drainageways of the glacial till plains. These soils developed under hardwood forest.

The surface layer in moderately eroded areas is dark-brown, friable silt loam about 5 to 8 inches thick. The subsoil, about 25 to 30 inches thick, is brown silty clay loam in the upper part and olive to yellowish-brown clay loam in the lower part. Many, distinct, brown mottles occur in the lower half of the subsoil and extend into the underlying calcareous loam till.

In some areas the Celina soils have a silt cap as much as 18 inches thick. The depth to the underlying calcareous loam till ranges from 24 to 42 inches.

Celina soils have good available moisture capacity. Occasional additions of lime are needed in cropped areas.

The silt cap of the Celina soils is not so thick as that of the Xenia soils. The Celina soils developed from windblown silt and loam till, but the Birkbeck soils developed entirely from windblown silt.

Celina soils occur with the moderately dark colored, well-drained Miami soils; the moderately dark colored, somewhat poorly drained Crosby soils; and the dark colored, very poorly drained Brookston soils.

Celina silt loam, 2 to 6 percent slopes, moderately eroded (CbB2).—The top layer of this soil is brown silt loam about 8 inches thick and generally consists of the original surface soil mixed with a moderate amount of subsoil. In some small areas the original surface soil remains, and in other small areas the subsoil is exposed. Surface runoff is slow to medium, and permeability is moderate. Because this soil is susceptible to further erosion, contour tillage and other practices are needed in areas that are cultivated intensively. (Capability unit IIe-1; woodland group 1)

Chelsea Series

Soils of the Chelsea series are moderately dark colored, deep, and well drained. These soils occur on gently sloping to strongly sloping dunes and troughs of terraces, mainly northwest of Covington in the valley of the Wabash River. They developed under hardwood forest.

The surface layer of these soils is dark-brown loamy fine sand 6 to 8 inches thick. In the subsoil is yellowish-red to reddish-brown heavy loamy sand to sandy loam that is in noncontinuous bands about $\frac{1}{4}$ to $\frac{3}{4}$ inch thick. These bands are separated by light loamy sand or sand. The underlying material is neutral fine sand.

The depth to the first band ranges from 36 to about 60 inches. The number of bands above a depth of 60 inches varies from one to six or more. Strata of fine sand and silt occur at a depth below 6 feet in some areas.

These soils have very low available moisture capacity and very rapid internal drainage. The content of organic matter is low. Lime is needed in cultivated areas.

The subsoil of Chelsea soils is coarser textured and less developed than that of the Princeton soils. Also, less silt is in the parent material of Chelsea soils.

Chelsea soils occur with the well-drained Genesee soils and with the poorly drained Sloan soils on bottom lands. With the Chelsea soils on some terraces are the well-drained Fox and Ockley soils.

Chelsea loamy fine sand, 2 to 6 percent slopes (ChB).—This soil occurs on bottom lands and next to terrace breaks in gently rolling areas of dunelike ridges and hummocks. Surface runoff is slow. In small areas the plow layer consists of the original surface soil mixed with brownish sand from the underlying layers. Included in areas mapped as this soil are a few small areas of moderately rolling, severely eroded soils.

This soil has severe limitations and is low in productivity. It is very droughty and susceptible to wind erosion. Because the soil is sandy, farm machinery is difficult to operate. The soil is in small areas that are farmed the same way as larger areas of surrounding soils. (Capability unit IVs-1; woodland group 17)

Chelsea loamy fine sand, 6 to 12 percent slopes (ChC).—This soil occurs mostly in dunelike ridges on bottom lands that border terraces. A few small areas are along the upland breaks, and a few border the breaks along small streams. Surface runoff is slow. The surface layer is 4 to 8 inches thick. Included in areas mapped as this soil are areas of gently sloping, moderately eroded soils.

This soil is droughty and low in productivity. Because the soil is sandy, the use of machinery is limited. Some areas that are used for small grain or similar crops are

better suited to melons or other special crops. Pine trees would grow well on this soil. (Capability unit IVs-1; woodland group 17)

Chelsea loamy fine sand, 12 to 18 percent slopes (ChD).—This soil occurs as dunes and ridges on bottom lands and along upland and terrace breaks. It is in small areas next to areas of moderately sloping soils. Surface runoff is slow. The surface layer is 4 to 7 inches thick. Included in areas mapped as this soil are areas of moderately eroded soils and a few areas of moderately sloping to steep, shallow gravelly soils.

This soil has serious limitations and is low in productivity. Because the soil is strongly sloping and excessively drained, both wind and water erosion are likely. Most areas are in permanent pasture or trees. Pine trees or other permanent vegetation is the best use. (Capability unit VIIs-1; woodland group 17)

Crane Series

In the Crane series are dark-colored, somewhat poorly drained soils that occur in nearly level areas of the outwash plains in Richland, Logan, and Shawnee Townships. These soils developed under prairie grasses.

The surface layer is very dark brown silt loam 6 to 9 inches thick. The subsurface layer, about 4 to 10 inches thick, generally is very dark gray to very dark brown silt loam. The subsoil ranges from about 36 to 50 inches or more in thickness. It is dark brown to gray mottled with yellowish brown, dark brown, and brown. The subsoil ranges from a silty clay loam in the upper part to sandy clay loam in the lower part. Brown and gray, stratified, calcareous sand and gravel underlie the subsoil.

In some areas Crane soils have a silt cap as much as 36 inches thick. The depth to the calcareous sand and gravel ranges from 42 to 70 inches or more. In some places the surface layer is slightly lighter than very dark brown and is thinner than 6 inches. The subsurface layer or a layer in the upper subsoil is absent in some places. Also, the subsurface layer is a distinct gray in some places.

These soils have high available moisture capacity and slow internal drainage. They are high in organic-matter content. If cultivation is intensive, occasional additions of lime are needed.

Crane soils have a much darker and deeper surface layer than Sleeth soils and generally a darker subsoil.

Crane soils occur with the very poorly drained, dark-colored Westland soils in depressions; with the moderately well drained, dark-colored Tippecanoe soils in nearly level areas; and with the well drained, dark-colored Wea soils in nearly level to sloping areas.

Crane silt loam (Cn).—This soil occurs in nearly level areas of the outwash plains in Richland, Logan, and Shawnee Townships. Surface runoff is slow or very slow. In some places the 6- to 9-inch surface layer is underlain by a gray layer of silt loam about 2 to 4 inches thick. Included in areas mapped as this soil are a few small areas of sloping, moderately eroded soils. In these areas the surface layer is a mixture of the original surface layer and the subsoil.

Drainage is the major problem on this soil. If the soil is adequately drained, it responds well to lime and

fertilizer and can be cropped intensively. (Capability unit IIw-2; woodland group 23)

Crosby Series

The Crosby series consists of moderately dark colored, deep, somewhat poorly drained soils that occur in nearly level areas of the glacial till plains. These soils developed under hardwood forest.

The surface layer, about 8 inches thick, consists of dark grayish-brown, friable silt loam. It is underlain by brown silt loam about 4 inches thick. The subsoil is about 20 inches thick. It is brown to yellowish-brown silty clay loam and, in the lower part, grades to silty clay or silty clay loam with many light-gray to gray mottles. The underlying material is calcareous clay loam to loam till.

Crosby soils have a silt cap that is as much as 18 inches thick in some places. The depth to the underlying material ranges from 24 to 42 inches.

Wetness is the major hazard on Crosby soils, and occasional additions of lime are needed in cultivated areas.

The silt cap of Crosby soils is not so thick as that of Fincastle soils. Crosby soils developed in silt-capped glacial till rather than entirely in windblown silt as did the Reesville soils.

Crosby soils occur with the moderately dark colored, well drained Miami soils; the light-colored, moderately well drained Celina soils; and the dark colored, very poorly drained Brookston soils.

Crosby silt loam, 0 to 2 percent slopes (CrA).—This soil occurs in broad, nearly level parts of the till plains. The surface layer is browner in cultivated areas than in wooded ones. Included in areas mapped as this soil are small areas of gently sloping, moderately eroded soils. In some of these areas the surface layer is a mixture of the original surface soil and the subsoil.

This soil has no serious limitation other than its somewhat poor drainage. Artificial drainage is needed if high yields are to be obtained. (Capability unit IIw-2; woodland group 5)

Dana Series

The Dana series consists of dark-colored, deep, moderately well drained soils that occur on upland in nearly level to gently sloping areas covered with windblown silt. These soils developed under prairie grasses.

The surface layer is very dark grayish-brown to dark-brown silt loam 8 inches thick. A subsurface layer does not occur on the gentle slopes, but it occurs in nearly level areas and consists of dark-brown heavy silt loam about 5 to 8 inches thick. The subsoil, about 35 to 60 inches thick, is silty clay loam to clay loam. It is dark brown to dark yellowish brown in the upper part and yellowish brown mottled with brown and gray in the lower part. Brown to yellowish-brown calcareous loam till underlies the subsoil.

Dana soils range from 42 to about 70 inches in depth to calcareous till. A gray subsurface layer occurs in some places where the Dana soils grade toward the Wingate soils. The depth to mottling ranges from 16 to about 30 inches. Within short distances the thickness of the windblown silt ranges from 18 to about 36 inches.

These soils have good available moisture capacity and moderate to slow internal drainage. They are high in organic-matter content but need occasional additions of lime if cropping is intensive.

Dana soils have a slightly darker colored subsoil than Wingate soils and do not have the subsurface layer of those soils. Also, the surface layer in Dana soils is darker and thicker than that of Xenia soils.

Dana soils occur with the very poorly drained, very dark colored Romney soils in depressions; the very poorly drained, dark colored Ragsdale soils in depressions and nearly level areas; the somewhat poorly drained, dark colored Raub soils in nearly level areas; and the well-drained, dark colored Sidell soils in nearly level to steep areas.

Dana silt loam, 0 to 2 percent slopes (DaA).—This soil is of minor extent and occurs in nearly level areas of the upland, mainly in Shawnee and Logan Townships. Surface runoff is slow. Included in areas mapped as this soil are a few small areas of somewhat poorly drained Raub soils and well-drained Sidell soils.

This nearly level soil has no serious limitations and is productive. It is easily cultivated and can be cropped intensively. (Capability unit I-1; woodland group 23)

Dana silt loam, 2 to 6 percent slopes, moderately eroded (DaB2).—This soil occurs in a few areas on the gently rolling upland till plains, mostly in Davis and Logan Townships. Surface runoff is medium. The plow layer generally consists of a mixture of the original surface soil and the subsoil. Some small areas are not eroded, and others are severely eroded. Included in areas mapped as this soil are small areas of well-drained soils.

This gently sloping soil has only minor limitations and is productive. It is easily cultivated, and there is no drainage problem. If the soil is cultivated intensively, however, contour tillage, stripcropping, or other erosion control practices are needed. (Capability unit IIe-2; woodland group 23)

Delmar Series

Soils of the Delmar series are light colored, deep, and poorly drained. They occur in nearly level and slightly depressional areas of the glacial till plains that are covered with windblown silt. These soils developed under hardwood forest.

The surface layer consists of 8 to 11 inches of gray, friable silt loam. It is underlain by about 3 inches of light-gray, friable silt loam that is faintly mottled with pale brown. The subsoil is gray, firm silty clay loam in the upper part and light olive-brown clay loam in the lower part. Many, distinct, yellowish-brown mottles occur throughout the subsoil. The underlying material consists of light olive-brown calcareous loam till.

Delmar soils have a silt cap that ranges from 18 to 40 inches or more in thickness. The depth to the underlying calcareous material generally ranges from 42 to 66 inches.

Delmar soils occur with the moderately dark colored, well drained Russell soils; the moderately dark colored, moderately well drained Xenia soils; the moderately dark colored, somewhat poorly drained Fincastle soils; and the dark colored, very poorly drained Brookston soils.

Delmar silt loam (Dm).—Most of this soil remains wooded. In some places the calcareous till occurs at

a depth of less than 42 inches. If this soil is cropped, management should include drainage so that high yields are obtained. (Capability unit IIIw-5; woodland group 11)

Eel Series

Soils of the Eel series are moderately dark colored, deep, neutral or calcareous, and moderately well drained. They occur on the flood plains of the Wabash River and of small streams throughout the county.

The surface layer of these soils is dark-brown loam to silty clay loam 6 to 15 inches thick. It is underlain by soil materials that are dark brown, grayish brown, or dark grayish brown and are mottled below a depth of 15 to 26 inches. Strata of calcareous fine sand, silt loam, loam, and fine sandy loam make up the parent material. In some places the texture of the different layers varies within a horizontal distance of a few feet.

The color of the surface layer is lighter than dark brown in some areas, especially in the sandier places. Silt loam, loam, and silty clay loam have been mapped in this county.

These soils have good available moisture capacity. They absorb water at a moderate rate in the upper part of the subsurface layer and at a slow rate lower in the profile. Occasionally Eel soils are flooded by water from the river and from adjacent uplands. During periods of high rainfall, these soils have a temporarily high water table and small areas may be ponded. Additions of lime are not needed.

Eel soils are lighter colored throughout than the Huntsville soils.

Eel soils occur with the well-drained Genesee and Landes soils; the somewhat poorly drained Shoals soils; and the dark-colored, poorly drained Sloan soils.

Eel silt loam (Es).—This is the most extensive Eel soil in the county. It occurs in large areas of bottom land along the Wabash River and in small dissected areas along smaller streams. It occupies the natural drainageways of the larger bottom lands and is somewhat lower than adjacent well-drained soils. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas of loam and silty clay loam and of the somewhat poorly drained Shoals soils.

This nearly level soil is fertile, but occasional flooding is likely. It is easily cultivated, and most areas are used for corn and beans. (Capability unit IIw-7; woodland group 8)

Eel loam (Em).—This soil contains more sand than Eel silt loam. It occurs where overflow is more frequent or where loamy material is washed in from higher soils on terraces. In many places it is in the small dissected areas of small bottoms. In some places the loam extends to a depth of only 12 to 15 inches. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas of sandy loam that are a result of overflow that often deposits much sand.

This nearly level soil is fertile and easy to cultivate. It is limited only by the occasional overflow of the Wabash River and of creeks. Most of this soil is used for corn and beans. (Capability unit IIw-7; woodland group 8)

Eel silty clay loam (Et).—This soil occurs on bottom land behind the natural levees adjacent to the Wabash

River. The surface layer generally is silty clay loam 8 to 10 inches thick, but in a few small areas the entire profile is silty clay loam. Surface runoff generally is slow. This soil occurs with the well-drained Genesee silty clay loam. Many slightly depressional areas are ponded during periods of high rainfall. Included in areas mapped as this soil are small areas of silt loam and of riverwash (sand and gravel).

This nearly level soil is productive, but it is more difficult to cultivate than the coarser Eel soils because its surface layer has a high content of clay. During the growing season it is likely to be flooded occasionally, and sometimes there are sloughs and ponded areas. This soil is used mainly for corn and beans. (Capability unit IIw-7; woodland group 8)

Elston Series

The Elston series consists of dark-colored, deep, well-drained soils that occur on nearly level to gentle slopes of outwash plains and valley trains. These soils developed under prairie grasses.

The surface layer, about 8 inches thick, is black to very dark brown, friable sandy loam to loam. It is underlain by black to dark-brown sandy loam about 10 to 15 inches thick. The subsoil is 30 to 40 inches thick and is reddish-brown gravelly sandy loam in the upper part and sandy loam in the lower part. It is underlain by medium and coarse sand that is yellowish brown and slightly acid or neutral.

The first and second layers combined range from 14 to 30 inches in thickness. The depth to the calcareous underlying sand is as much as 80 inches. In some places small pieces of gravel are scattered throughout the profile in varying amounts.

The main hazards that limit cultivation are droughtiness and soil erosion in the sloping areas. Elston soils have a coarser textured subsoil than the Wea soils and are underlain by medium and coarse sand rather than by calcareous coarse sand and gravel. They are coarser textured and deeper than the Warsaw soils.

The Elston soils occur with the dark-colored, well-drained Warsaw soils and the dark-colored, very poorly drained Westland soils.

Elston loam, 0 to 2 percent slopes (EuA).—This is one of the most extensive Elston soils in the county. Because it is nearly level and has more clay in the subsoil than other Elston soils, it has less rapid internal drainage and higher available moisture capacity. Also, it has thicker and darker colored surface and subsurface layers than the Elston sandy loams. Surface runoff is slow.

Droughtiness may be a problem in years when rainfall is not distributed as well as normal. (Capability unit IIs-1; woodland group 23)

Elston loam, 2 to 6 percent slopes, moderately eroded (EuB2).—This soil occurs on long gentle slopes or at the head of small drainageways. Some of the original surface soil is gone, and the present surface layer is lighter colored than that of Elston loam, 0 to 2 percent slopes. Surface runoff is slow, and permeability is moderately rapid.

Management should include practices to control erosion, to reduce runoff, and to increase infiltration. Because this soil is in small areas, it is generally farmed in the same

way as surrounding soils. (Capability unit IIe-9; woodland group 23)

Elston sandy loam, 0 to 2 percent slopes (EwA).—This is the most extensive Elston soil in the county. It occurs in broad, nearly level areas of the terraces along the Wabash River. Its surface layer is not so thick as that of Elston loam, 0 to 2 percent slopes. Surface runoff is slow, and permeability is moderate to rapid.

This soil is slightly droughtier than Elston loam, 0 to 2 percent slopes. It is better suited to hay or small grain than to row crops. (Capability unit IIIs-1; woodland group 23)

Elston sandy loam, 2 to 6 percent slopes, moderately eroded (EwB2).—This soil occurs on long gentle slopes and in a few places around the fringe of Elston sandy loam, 0 to 2 percent slopes, and downslope from that soil. The surface layer is dark brown. Surface runoff is slow or medium, and permeability is moderate to rapid.

Management should include practices to control erosion, to reduce runoff, and to increase infiltration. This soil is best suited to hay or pasture, but it is generally farmed the same way as large areas of adjoining soils because it is in small scattered areas. (Capability unit IIIe-12; woodland group 23)

Fincastle Series

Soils of the Fincastle series are moderately dark colored, deep, and somewhat poorly drained. They are nearly level to gently sloping and occur mainly in the southern half of the county. These soils are on uplands of the glacial till plains that are covered with windblown silt. They developed under hardwood forest.

The surface layer consists of about 8 inches of dark grayish-brown, friable silt loam. It is underlain by 3 to 5 inches of dark grayish-brown silt loam. The subsoil is 35 to 45 inches thick and is dark grayish-brown to brown silty clay loam in the upper part and brown clay loam in the lower part. Many, distinct, gray and yellowish-brown mottles occur throughout the subsoil. The underlying material is neutral or calcareous loam till.

The silt cap ranges from 18 to 40 inches in thickness. The depth to the underlying calcareous till ranges from 40 to 72 inches. The top 2 or 3 inches of soil is slightly darker in wooded areas than in cultivated areas.

Fincastle soils have a thicker silt cap than Crosby soils and are deeper to underlying calcareous till. They developed in silt and material weathered from loam till, whereas Reesville soils developed entirely in silt.

Wetness is the major hazard on the Fincastle soils.

Fincastle soils occur with the moderately dark colored, well drained Russell soils; the moderately dark colored, moderately well drained Xenia soils; the light-colored, poorly drained Delmar soils; and the dark colored, very poorly drained Brookston soils.

Fincastle silt loam, 0 to 2 percent slopes (FcA).—This soil is in large uniform areas and is the most extensive Fincastle soil in the county. Surface runoff is very slow. Minor areas of dark-colored, depressional Brookston soils are included.

Artificial drainage is needed if maximum yields are to be obtained. (Capability unit IIw-2; woodland group 5)

Fincastle silt loam, 2 to 6 percent slopes (FcB).—This soil occurs in narrow bands around the head of shallow

drainageways and on the gentle slopes. It is next to better drained soils or more poorly drained soils in depressions. Surface runoff is medium.

If this soil is cultivated, artificial drainage is needed. Generally, the soil is farmed the same way as the surrounding soils. Because slopes are gentle, the erosion hazard is slight to moderate. (Capability unit IIw-2; woodland group 5)

Fincastle silt loam, 2 to 6 percent slopes, moderately eroded (FcB2).—This soil occurs on gentle slopes in areas of nearly level soils, on long gentle slopes, and at the head of drainageways. Its surface layer is a mixture of the original surface soil and a moderate amount of subsoil.

This soil has moderate limitations. Practices to control erosion and to improve drainage of the subsoil are needed. Because areas of this soil are small and scattered, they are generally farmed the same way as the surrounding soils. (Capability unit IIw-2; woodland group 5)

Fox Series

Soils of the Fox series are moderately dark colored, moderately deep or deep, and well drained. They are nearly level to strongly sloping and occur on terraces, on scattered knolls, and along the border of outwash plains next to the Wabash River and to small streams throughout the county. These soils developed under hardwood forest.

The surface layer is brown to dark-brown, friable fine sandy loam to silt loam that is about 6 to 8 inches thick and is underlain by 2 or 3 inches of brown loam or silt loam. The subsoil, about 25 inches thick, is dark-brown to dark yellowish-brown silty clay loam to gravelly clay loam. It is sticky in the lower part, and material from it extends as tongues for 5 to 15 inches into the loose underlying material. The underlying material consists of stratified calcareous sand and gravel.

The surface layer ranges from fine sandy loam to silt loam. In the lower part of the subsoil the amount of pebbles and fine gravel varies. The depth to the calcareous underlying material ranges from 24 to 42 inches.

These soils have a low content of organic matter. The available moisture capacity is low. Occasional additions of lime are needed in intensively farmed areas.

In the Fox soils the underlying material is gravel and sand, but in the Camden soils it is sand and silt. The depth of leaching is less in the Fox soils than in the Ockley.

Fox soils occur with the dark-colored, very poorly drained Westland soils in nearly level areas. In sloping areas Fox soils occur with the deep, moderately dark colored Ockley soils.

Fox fine sandy loam, 0 to 2 percent slopes (FfA).—This soil is coarser textured than Fox silt loam, 0 to 2 percent slopes; larger amounts of fine sand occur throughout the profile. It has a brown to dark grayish-brown surface layer and a subsoil of brown to reddish-brown coarse sandy clay loam or sandy clay loam that is about 10 to 20 inches thick. Surface runoff is slow, and permeability is moderate. Included in areas mapped as this soil are small areas of gravelly loam and of extremely shallow soils.

Droughtiness is a problem on this soil. If crops are grown, a rotation should be used that includes at least 2

years of meadow. (Capability unit IIIs-1; woodland group 2)

Fox fine sandy loam, 2 to 6 percent slopes, moderately eroded (FfB2).—The surface layer of this soil is a mixture of the original surface soil and a moderate amount of subsoil. Surface runoff is slow, and permeability is moderate. Included in areas mapped as this soil are small areas of coarser textured soils. Some small areas are only slightly eroded.

Practices should be used that control erosion and increase the available water capacity. (Capability unit IIIe-12; woodland group 2)

Fox loam, 0 to 2 percent slopes (FmA).—This soil has a higher percentage of sand than Fox silt loam, 0 to 2 percent slopes, and generally is in higher positions. It has a friable, brown to grayish-brown surface layer about 8 inches thick. Small pieces of gravel are scattered throughout the profile in varying amounts. Surface runoff is very slow, and permeability is moderate. Included in areas mapped as this soil are small areas of coarser textured soils and of more poorly drained soils.

This soil is well suited to legumes and small grain. Practices that improve the available moisture capacity should be used. (Capability unit IIs-1; woodland group 1)

Fox loam, 2 to 6 percent slopes (FmB).—This gently sloping soil occurs as small rises in nearly level areas of Fox loam, 0 to 2 percent slopes. Surface runoff is slow or medium, and permeability is moderate. Included in areas mapped as this soil are spots of more severely eroded soils and small areas of coarser textured soils.

If this soil is cultivated intensively, contour tillage, stripcropping, or other practices are needed to control erosion. This soil may be farmed the same way as are the larger areas of surrounding soils. (Capability unit IIe-9; woodland group 1)

Fox loam, 2 to 6 percent slopes, moderately eroded (FmB2).—The plow layer of this soil consists of a mixture of the original surface soil and a moderate amount of subsoil. Surface runoff is medium, and permeability is moderate. Included in areas mapped as this soil are spots of severely eroded soils that have the subsoil exposed.

Practices that control erosion and increase the moisture supply are needed. (Capability unit IIe-9; woodland group 1)

Fox loam, 12 to 18 percent slopes, moderately eroded (FmD2).—This soil occurs on breaks of terraces or on knolls. Its surface soil and subsoil are only moderately thick, and calcareous gravel and sand occur at a depth of about 24 to 28 inches. Because surface runoff is rapid and permeability is moderate, the soil is droughty. In small areas all the surface soil has been removed, and the clayey subsoil is exposed. Included in areas mapped as this soil are areas on steep slopes where loose gravel and sand occur at a depth less than 24 inches.

This soil is primarily suited to permanent pasture and timber. It has severe limitations and is low in productivity. (Capability unit IVe-9; woodland group 1)

Fox silt loam, 0 to 2 percent slopes (FnA).—This is the most extensive Fox soil in the county. It occurs mostly on terraces along the Wabash River, but it also borders outwash plains. Its surface soil is friable silt loam about 9 inches thick, and its subsoil is silty clay loam to gravelly clay loam about 25 inches thick. Surface runoff is very

slow, and permeability is moderate. Included in areas mapped as this soil are small scattered areas that have a surface soil less than 9 inches thick. Also included are small areas that are less well drained than this soil.

This nearly level soil is the most productive Fox soil in the county. All crops suited to the area can be grown. (Capability unit IIs-1; woodland group 1)

Fox silt loam, 2 to 6 percent slopes (FnB).—This soil occurs on small rises, at the head of drainageways, and in slight depressions. It also occurs on the top and sides of knolls. Surface runoff is slow, and permeability is moderate.

This gently sloping soil has only moderate limitations. If it is cultivated intensively, contour tillage or other practices are needed to control erosion. (Capability unit IIe-9; woodland group 1)

Fox silt loam, 2 to 6 percent slopes, moderately eroded (FnB2).—The plow layer of this soil is a mixture of the original surface soil and a moderate amount of subsoil. Surface runoff is slow or medium, and internal drainage is moderate. Included in areas mapped as this soil are small areas that are less well drained than this soil and areas of severely eroded soils that have their clayey subsoil exposed.

This soil is moderately productive. Contour tillage and other practices are needed to control erosion. Also needed are practices that increase infiltration and the available moisture capacity. (Capability unit IIe-9; woodland group 1)

Fox silt loam, 6 to 12 percent slopes, moderately eroded (FnC2).—This soil occurs in long narrow strips around the head of drainageways and above terrace breaks. Its plow layer consists of a mixture of original surface soil and the yellowish-brown subsoil. Its subsoil is shallower than that of Fox silt loam, 0 to 2 percent slopes. Surface runoff is medium or rapid, and permeability is moderate.

This soil is best suited to pasture or hay. Because intensively cropped areas erode readily, a rotation consisting predominantly of small grain and hay should be used and all cultivation should be on the contour. (Capability unit IIIe-9; woodland group 1)

Fox soils, 2 to 6 percent slopes, severely eroded (FpB3).—Because erosion has removed most of the surface soil, and in places part of the subsoil, these soils have a surface layer that ranges from silty clay loam to gravelly clay loam. Generally, outwash material occurs at a depth of about 30 to 35 inches. The available moisture capacity is very low. Surface runoff is rapid, and permeability is moderately rapid.

These soils are well suited to hay and small grain. (Capability unit IIIe-9; woodland group 1)

Fox soils, 6 to 12 percent slopes, severely eroded (FpC3).—These soils occur on ridgetops and on long slopes that extend from them down to more gently sloping soils. The surface soil ranges from gravelly clay loam to clay loam. Sand and gravel occur at a depth of about 24 to 31 inches. Because of the steep slopes and the eroded surface layer, these soils can supply only a small amount of moisture to plants. Surface runoff is medium or rapid, and permeability is moderately rapid.

These soils are best suited to hay or meadow and small grain. (Capability unit IVe-9; woodland group 1)

Fox soils, 12 to 18 percent slopes, severely eroded (FpD3).—Because of the eroded surface layer, steep slopes,

shallowness to underlying material, and very low available moisture capacity, these soils are best suited to permanent pasture and timber. Surface runoff is very rapid, and erosion is very active. These soils are gullied and rilled, and stones lie on the surface. (Capability unit VIe-1; woodland group 1)

Genesee Series

Soils of the Genesee series are moderately dark colored, neutral or mildly alkaline, deep, and well drained. They developed in alluvium washed from soils in areas of windblown silt and of calcareous glacial till. These soils occur on the nearly level flood plains along the Wabash River and smaller streams throughout the county. Some long, narrow areas with moderate slopes occur along the old abandoned channels.

The surface soil, 6 to 9 inches thick, is dark-brown loam to silty clay loam. It is underlain by dark-brown to dark grayish-brown, neutral to calcareous, stratified layers of silt loam, loam, and, in a few places, fine sandy loam. The texture of the various layers is more uniform in areas of the broad flood plains than in those of the narrow bottoms.

These soils have good available moisture capacity, and they absorb water at a moderate rate. They are likely to be flooded frequently by water from both the river and higher lying areas. These soils are very fertile and need no liming.

The Genesee soils are lighter colored throughout than the Huntsville soils and are finer textured than the Landes soils.

Genesee soils occur with the well drained Landes soils; the moderately well drained Eel soils; the somewhat poorly drained Shoals soils in slight depressions; and the very poorly drained Sloan soils in sloughs and wet swampy areas.

Genesee silt loam (Gs).—This is the most extensive Genesee soil in the county. It occurs widely on the flood plains of the Wabash River and of most of the smaller streams. On the smaller bottoms some areas are so badly dissected by meandering streams that cultivation is not practical. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas of silty clay loam and loam and a few small areas of moderately well drained soils.

This soil is fertile, is easy to cultivate, and has an excellent moisture reserve. Under good management, the soil can be cropped intensively without damage. Because flooding is likely, following a good rotation is difficult. Overflow is the principal hazard. (Capability unit I-2; woodland group 8)

Genesee loam (Gm).—This soil occurs chiefly on the narrow bottoms along the smaller streams of the county, but there are some areas along the Wabash River. Surface runoff is slow. The soil layers are similar to those of Genesee silt loam, but they contain a little more sand. Included in areas mapped as this soil are small areas of silt loam and of fine sandy loam.

This soil is fertile, is easily cultivated, and has good moisture reserve. Under good management, the soil can be cropped intensively without damage. Overflow is the principal hazard. (Capability unit I-2; woodland group 8)

Genesee loam, high bottom (Go).—This soil occurs on the flood plains of the Wabash River, mainly adjacent to upland or terrace breaks in places that are slightly higher than the rest of the bottom land. Small areas occur on the bottoms along small streams. In some places the subsoil is finer textured than that of Genesee loam. Surface runoff is slow or medium. In some small areas slopes are as much as 3 percent. Included in areas mapped as this soil are areas of silt loam, fine sandy loam, and sandy loam.

This soil is fertile and less susceptible to flooding than other Genesee soils. Only a few areas are not easily cultivated. Nevertheless, a major hazard is flooding by water from the river or from higher areas when rainfall is high. In some places diversions or levees are needed to prevent erosion or the deposition of sand. (Capability unit I-2; woodland group 8)

Genesee silty clay loam (Gt).—Almost all of this soil is south of Covington along the Wabash River in fairly broad areas behind old natural levees. The surface layer is 8 to 18 inches thick. Silty clay loam extends to a depth of 20 to 30 inches or more. Surface runoff is very slow. In some places this soil is in shallow sloughs that are ponded after a heavy rain or a flood. Included in areas mapped as this soil are a few small areas of silt loam and of moderately well drained soils.

This soil is fertile, but it is subject to flooding from December to June. Corn and soybeans are popular crops because they can be planted in summer and harvested early in fall when floods are less likely. (Capability unit I-2; woodland group 8)

Gravel Pits (Gv)

The larger Gravel pits in the county occur primarily in areas of Fox and Ockley soils on terraces along the Wabash River. These soils are underlain by loose gravel and sand that make good materials for the base courses of roads and for concrete. Scattered throughout the county are small Gravel pits that are sources of gravel suitable for use locally in construction for the home and the farm. Abandoned pits filled with water are satisfactory for fishing and swimming. (Capability unit VIIe-1; woodland group 16)

Gullied Land, Gravelly Materials (Gw)

Gullied land, gravelly materials, occurs in small to medium areas on terraces, moraines, and kames. It ranges from gently sloping to steep but is moderately sloping in most places. The original surface soil between the gullies remains in only a few places. Runoff is rapid or very rapid. Areas have been abandoned or are idle because of the erosion caused by farming up-and-down hill and leaving the surface bare most of the time. Erosion is active; the areas are sheet eroded, and there are many gullies 3 to 10 feet deep. Many of the gullies cannot be crossed with farm machinery. The soils of this mapping unit have 0 to 24 inches of silty material over the gravelly and sandy underlying materials. Depth to carbonates ranges from 0 to 30 inches. On the surface are medium to large stones, as well as gravel and sand. Small areas occur that have a loam or gravelly clay surface layer.

The soils of this mapping unit are low in productivity and have severe limitations to use. Although most areas are large enough to farm separately, they are suited to only permanent pasture or pine trees, and to these only after the areas have been greatly improved. (Capability unit VIe-1; woodland group 19)

Gullied Land, Loamy Materials (Gy)

Gullied land, loamy materials, occurs on moderate slopes of the till plains, generally in areas $\frac{1}{2}$ acre to 3 acres in size. These areas have been farmed consistently up-and-down hill, but they are now abandoned as cropland. Except in the gullies, most areas have some scattered cover of volunteer grasses or lespedeza. Erosion is very active, and little, if any, of the original surface soil remains. Runoff is very rapid. Numerous gullies, 3 to 5 feet deep, extend into the parent material and cannot be crossed with ordinary farm machinery. The depth to carbonate ranges from 0 to 30 inches.

This land has serious limitations. It is not suited to crops, and only after extensive improvements will it be suited to pasture. Its best use is for permanent pasture and trees. (Capability unit VIe-1; woodland group 3)

Hennepin Series

Soils of the Hennepin series are moderately dark colored, very shallow, and well drained. They occur on steep breaks between soils on alluvial terraces and soils on glacial till uplands. They are also along young streams that have cut narrow, deep valleys into the uplands. These soils developed under hardwood forest.

The surface layer is very dark gray to very dark brown, friable loam 3 to 5 inches thick. The subsoil ranges from 5 to 20 inches in thickness and generally consists of dark grayish-brown to brown loam and varied amounts of fine gravel. It is underlain by light olive-brown, calcareous loam till that contains some stones.

These soils vary considerably in thickness within short distances. Their subsoil ranges from sandy loam to silt loam.

The Hennepin soils are underlain by glacial till and thus differ from the Rodman soils, which are on calcareous gravel and sand, and also from the Muskingum soils, which are on weathered sandstone.

Hennepin soils occur with the soils of the Miami-Crosby and the Russell-Fincastle catenas.

Hennepin complex, 18 to 25 percent slopes (HcE).—This complex of soils generally occurs along young streams that have cut narrow, deep valleys into the uplands. The soils are generally thicker than those of Hennepin complex, 25 to 50 percent slopes. Included in mapped areas of these soils, generally at the summit of the slopes, are scattered areas of moderately eroded, deeper soils.

The soils of this complex are best suited to timber. If they are cleared and used for pasture, grazing should be controlled. (Capability unit VIIe-1; woodland group 2)

Hennepin complex, 25 to 50 percent slopes (HcF).—This complex of soils occurs downslope from Hennepin complex, 18 to 25 percent slopes. The surface layer consists of partly decomposed litter. The soils are

generally about 5 to 9 inches thick. Mapped areas include some deeper, severely eroded soils.

The soils in this complex should be left in permanent forest; small eroded areas should be replanted to trees. (Capability unit VIIe-1; woodland group 4)

Hennepin complex, 18 to 25 percent slopes, severely eroded (HcE3).—The top layer of the soils in this complex ranges from loam to silt loam and, in some places, is calcareous and has many pebbles and stones exposed. The soils occur in the same kind of positions as those in Hennepin complex, 18 to 25 percent slopes. They have been grazed too much, or they are at the edge of deeper, more gently sloping soils that are cultivated. Included in some areas mapped as this complex are areas of deeper soils.

The soils in this complex should be replanted to trees and fenced to keep out livestock. (Capability unit VIIe-1; woodland group 2)

High Gap Series

In the High Gap series are moderately dark colored, moderately deep, well-drained soils that occur on nearly level to sloping uplands and are underlain by sandstone, siltstone, and shale.

The surface layer is dark-brown silt loam, 5 to 7 inches thick. It is underlain by 4 to 6 inches of dark-brown to grayish-brown loam or silt loam. The subsoil, about 25 inches thick, is brown to dark-brown loam, sandy loam, or silty clay loam. In some places the subsoil formed from glacial drift and sandstone residuum. Underlying the subsoil is sandstone, siltstone, or shale in varying degrees of weathering.

The depth to underlying bedrock ranges from 15 to 40 inches. In thickness and texture the subsoil is fairly variable. The lower subsoil is mottled in areas where High Gap soils grade toward the Shadeland soils.

High Gap soils have low available moisture capacity and slow or medium internal drainage. They are low in organic-matter content. Frequently additions of lime are needed.

High Gap soils are deeper to bedrock than Muskingum soils and generally do not occur on slopes of more than 12 percent. The slopes of Muskingum soils are as much as 60 percent in some places.

High Gap soils occur with the very poorly drained, very dark colored Westland soils in depressions and the somewhat poorly drained, moderately dark colored Shadeland soils in nearly level areas.

High Gap silt loam, 0 to 2 percent slopes (HgA).—This soil occurs on uplands and terraces that border the Wabash River and small streams. Surface runoff is slow. Included in areas mapped as this soil are areas of loam and small areas of somewhat poorly drained soils.

This nearly level soil is moderately productive. It is most productive in areas where the bedrock is at a maximum depth. The underlying bedrock limits the depth to which roots penetrate. The soil is easily cultivated and can be farmed with moderate intensity if it is fertilized properly. (Capability unit IIs-4; woodland group 12)

High Gap silt loam, 2 to 6 percent slopes (HgB).—This is the most extensive High Gap soil in the county.

Surface runoff is slow or medium, and very little erosion has occurred in most places. Included in areas mapped as this soil are areas of loam and small areas of somewhat poorly drained soils.

This gently sloping soil produces moderate yields of crops and good yields of pasture. Most of it is in pasture or trees; only a small acreage is cropped. The underlying bedrock is the main limitation. Contour tillage or other practices to control erosion should be used in cultivated areas. (Capability unit IIIe-8; woodland group 12)

High Gap silt loam, 2 to 6 percent slopes, moderately eroded (HgB2).—A considerable acreage of this soil occurs on gently sloping breaks that are surrounded by steeper areas of Muskingum soils. The plow layer consists of a mixture of the original surface soil and yellowish-brown subsoil. In most places the depth to bedrock is less than that of High Gap silt loam, 0 to 2 percent slopes. Surface runoff is medium. Included in areas mapped as this soil are areas that have a loam surface layer and areas that are severely eroded.

This soil produces moderate yields of crops, but it is better suited to use as pasture. The underlying bedrock limits the penetration of roots. Contour tillage is needed in cultivated areas. (Capability unit IIIe-8; woodland group 12)

High Gap silt loam, 6 to 12 percent slopes (HgC).—This soil occurs mostly in areas north of Covington along the upland breaks next to the Wabash River. The surface layer is grayish-brown silt loam or loam 6 to 8 inches thick. The depth to bedrock ranges from 18 to 24 inches. Included with this soil are a few small moderately eroded and severely eroded areas and areas on slopes of more than 12 percent.

The productivity of this soil is low because slopes are strong and the bedrock is near the surface. If the soil is cultivated, contour tillage or stripcropping should be used. (Capability unit IVe-8; woodland group 12)

High Gap soils, 2 to 6 percent slopes, severely eroded (HhB3).—These soils occur in small scattered tracts that, in many places, are next to steep breaks and have many rills and small gullies. The plow layer is clay loam or sandy clay loam and consists dominantly of material from the subsoil. Surface runoff is medium. Stones are common on the surface, and bedrock occurs at a depth of 22 to 26 inches.

These soils have severe limitations as cropland and are low in productivity. They are more difficult to cultivate than less severely eroded High Gap soils because of erosion, the high content of clay, and the presence of stones. Pasture and hay are the most productive crops. (Capability unit IVe-8; woodland group 12)

High Gap soils, 6 to 12 percent slopes, severely eroded (HhC3).—These soils occur mostly along the Wabash River north of Attica. Bedrock occurs at a depth of 15 to 24 inches. Surface runoff is rapid. Large amounts of water run in from higher areas, and erosion is very active. Many stones are on the surface. Included in areas mapped as this soil are a few areas of steep soils, of seepage, and of very shallow soils.

These soils have many limitations and are low in productivity. The stones on the surface make cultivation difficult. The soils are suited only to pasture and trees. (Capability unit VIe-1; woodland group 12)

Huntsville Series

Soils of the Huntsville series are dark colored, deep, and well drained. They occur on nearly level flood plains that border the larger, more shallow meandering streams. These soils developed in alluvium that washed from surrounding uplands.

The surface layer is black to very dark grayish-brown, friable silt loam 8 to 10 inches thick, and the subsoil is mainly very dark gray silt loam. Reddish-yellow sand that is loose and calcareous occurs at a depth of 40 inches or more.

These soils vary chiefly in the thickness of the subsoil. In the subsoil, layers of silt loam range from 4 to 20 inches in thickness and have thin lenses of sand between them in some places.

The Huntsville soils have good available moisture capacity and are high in organic-matter content, but flooding is likely in winter and early in spring.

Huntsville soils are darker than Genesee soils and have a higher content of organic matter.

Huntsville silt loam (Hn).—This soil occurs along meandering streams in dissected areas that are likely to be flooded. A few small areas have a thin smear of clean sand on the surface. Included in areas mapped as this soil are areas of somewhat poorly drained soils and of moderately well drained soils.

Because flooding is likely at any time during the growing season, pasture is the best use for this soil. If the stream channels were straightened out and flooding controlled, this soil would be highly productive. (Capability unit I-2; woodland group 23)

Landes Series

Soils of Landes series are moderately dark colored, neutral or calcareous, deep, and well drained. They occur on level flood plains of the Wabash River and its tributaries. These soils developed from coarse-textured sediments that washed from soils derived from calcareous glacial till.

The surface soil, 6 to 10 inches thick, is dark-brown fine sandy loam. It is underlain by yellowish-brown to dark grayish-brown stratified layers of loamy fine sand, sandy loam, and fine sandy loam.

These soils have moderate to good available moisture capacity, and they absorb water at a moderate rate. They are subject to occasional flooding during the early part of the growing season.

Landes soils are coarser textured than are Genesee soils and do not contain so much organic matter as the Huntsville soils.

Landes soils occur with the well drained Genesee soils, the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils.

Landes fine sandy loam (Ld).—This soil of the bottom land along the Wabash River and its tributaries is on natural levees and on materials deposited when areas of the bottom land were washed out. Some of this soil is on bottom land that is frequently flooded and that receive material deposited by runoff from higher lying soils. Included in areas mapped as this soil are small areas of

sand, loamy sand, and riverwash. Also included are small areas of moderately well drained sandy soils.

This soil is fertile and easy to cultivate. Because the content of sand is high, the available moisture capacity is only moderate and the soil may be droughty during dry periods. Unless irrigation is used to supplement the available moisture, this soil does not yield so well as most other well-drained alluvial soils in the county. Overflow and droughtiness are the main hazards. (Capability unit I-2; woodland group 8)

Marl Beds

Marl beds are very dark colored, mucky, very shallow, and very poorly drained. They are slightly depressional or lie at the base of long gentle slopes. They developed under marsh grasses and water-tolerant trees.

The surface layer consists of black loam that contains a large amount of organic matter and is about 8 to 10 inches thick. It is underlain by gray to light grayish-brown gravelly marl that is mottled with brownish yellow. The underlying marl contains less gravel than the surface layer.

Within short distances the surface layer ranges from 2 to 12 inches in thickness. Also within short distances, the purity of the underlying marl varies.

Marl beds have a thinner surface layer than Tawes soils and underlying material of marl instead of sand.

Marl beds (Ma).—These beds are in small widely separated areas. Surface runoff and internal drainage are very slow. Included in areas mapped as Marl beds are areas of mucky loam underlain by marl at a depth of 12 to 18 inches.

Marl beds are of little agricultural importance and are best suited to pasture. Because areas are small and scattered, however, they are generally farmed the same way as surrounding soils. (Capability unit VIw-1; woodland group 23)

Miami Series

The Miami series consists of moderately dark colored, deep, well-drained soils that occur on upland till plains and moraines in areas that are gently sloping to sloping and covered with silt. These soils developed under hardwood forest.

The surface layer is grayish-brown silt loam 6 to 8 inches thick. It is underlain by 4 to 6 inches of brown to yellowish-brown silt loam. The subsoil, about 14 to 22 inches thick, is dark-brown to yellowish-brown silty clay loam or clay loam. It is underlain by olive-brown to dark-brown calcareous loam till.

Miami soils range from 24 to 42 inches in depth to carbonates. In the more sloping and eroded areas, the depth to carbonates is about 30 inches. The silt cap on these soils ranges from 0 to 18 inches in thickness. The amount of pebbles in the lower subsoil varies, and in morainic areas a few inches of sandy or gravelly material lies above the calcareous till.

These soils have moderate to high available moisture capacity. The content of organic matter is low, and occasional additions of lime are needed in cultivated areas. Erosion is a major hazard.

The silt cap of the Miami soils is thinner than that of the Russell soils, which is 18 to 40 inches thick. Also, Miami soils have more grit and pebbles in the subsoil than Russell soils, and many eroded areas are gritty on the surface. Miami soils are not leached so deeply as Russell soils, in which leaching extends to a depth of 42 to 70 inches. The surface layer of Miami soils is much darker colored than that of Parr soils, and generally the subsoil is darker colored.

Miami soils occur with the very poorly drained, dark colored Brookston soils in depressions; the somewhat poorly drained, moderately dark colored Crosby soils in flats and nearly level areas; and the moderately well drained, moderately dark colored Celina soils in nearly level and gently sloping areas.

Miami silt loam, 2 to 6 percent slopes, moderately eroded (MmB2).—This soil occurs on gentle slopes of till plains and moraines. Its slopes are medium in length or short. The plow layer is a mixture of surface soil and yellowish-brown silty clay loam subsoil. Depth to calcareous till is about 30 to 42 inches. Runoff is medium. A few rills or shallow gullies are common in cornfields that have been cultivated up-and-down slope. Included in areas mapped as this soil are small areas of slightly eroded or of severely eroded soils.

This soil is productive. It is susceptible to erosion, however, and if cultivation is intensive contour tillage and other practices are needed. Most of this soil is cleared of timber and is cropped. The soil areas are generally large enough to farm as separate units. (Capability unit IIe-1; woodland group 1)

Miami silt loam, 6 to 12 percent slopes (MmC).—This soil occurs mostly in woods or pasture with the Russell soils. It is also next to the steeper breaks of Hennepin soils. The surface layer ranges from 8 to 12 inches in thickness. Depth to carbonates range from 28 to 35 inches. Surface runoff is medium. Included in areas mapped as this soil are small areas of strongly sloping and of moderately eroded soils.

This soil is moderate to high in productivity, but limitations caused by the slope are severe. If corn or other row crops are grown, contour tillage, stripcropping, and other practices are needed to control erosion. (Capability unit IIIe-1; woodland group 1)

Miami silt loam, 6 to 12 percent slopes, moderately eroded (MmC2).—This soil occurs mostly in pastured areas and in areas that are cultivated only occasionally. It is steeper than Miami silt loam, 2 to 6 percent slopes, moderately eroded, and has a thinner surface layer. Much of the original surface soil has been lost through erosion, and the plow layer is a mixture of original surface soil and yellowish-brown subsoil. A few pebbles occur on the surface. Runoff is medium or rapid, and erosion is likely. Included in areas mapped as this soil are strongly sloping areas and a few small, severely eroded areas.

This soil has severe limitations, but it is moderately productive. If corn and other row crops are grown, contour stripcropping or other practices should be used to control erosion. The soil is well suited to small grain, pasture, and hay. (Capability unit IIIe-1; woodland group 1)

Miami soils, 2 to 6 percent slopes, severely eroded (MsB3).—These soils occur in small to medium-sized

areas throughout the till plains. In many places they are on ridgetops, on knobs, or in eroded areas of steeper soils. Erosion has removed most of the original surface soil, and the plow layer is mostly yellowish-brown silty clay loam to gritty clay loam. Many pebbles are on the surface. The depth to carbonates is 25 to 35 inches. In small areas the lower subsoil is mottled. Gullies 1 to 2 feet deep and rills occur in small areas.

These soils have severe limitations as cropland and are not productive. Surface runoff is medium or rapid, and small gullies may appear between crop rows in cultivated areas. Because these soils have a finer textured plow layer than less eroded Miami soils, they are more difficult to cultivate. Stripcropping, contour tillage, or other erosion control practices are needed in cropped areas. (Capability unit IIIe-1; woodland group 1)

Miami soils, 6 to 12 percent slopes, severely eroded (MsC3).—These soils make up the largest acreage of Miami soils in the county. They are similar to Miami silt loam, 6 to 12 percent slopes, moderately eroded, but they have lost nearly all of their original surface soil and, in some areas, part of their subsoil. The soils occur on bare slopes that extend from ridges down to more gently sloping soils. They also occur around steeper areas of shallow soils in till plains and on the outer border of moraines. Because they are eroded to an uneven depth, they have a spotted appearance. The plow layer is a silt loam in areas where some of the surface soil remains. Most of the plow layer, however, is a dark yellowish-brown gritty silty clay loam to clay loam. Many pebbles occur on the surface. The depth to carbonates ranges from 25 to 30 inches. Runoff is rapid. Included in areas mapped as this soil are small areas of moderately eroded soils, of gullied soils, and of strongly sloping soils.

These soils have serious limitations and are moderate to low in productivity. Erosion is active, and many rills or gullies may appear where row crops are grown. If row crops are grown, terracing, contour stripcropping, or other practices are needed to control erosion. These soils are best suited to pasture and hay. (Capability unit IVe-1; woodland group 1)

Mine Pits and Dumps (Mt)

Almost all of the strip mines in this mapping unit have been abandoned, and their spoil banks have been planted to trees. The spoil banks consist of shale, sandstone, glacial till, and other soil material in long ridges 10 to 70 feet high. Slopes of 40 to 60 percent are common. The spoil is medium acid to calcareous.

Legume pasture and hardwood trees can be grown on the spoil banks. Between the banks are a few narrow ponds that can be used for fishing and swimming. (Capability unit VIIe-1; woodland group 16)

Muskingum Series

Soils of the Muskingum series are moderately dark colored, very shallow, and well drained. They occur on gentle to steep slopes between terrace breaks and uplands along the Wabash River and its main tributaries. These soils developed under hardwood forest.

The surface layer is black to very dark grayish-brown or yellowish-brown stony loam or stony silt loam 3 to

7 inches thick. On the surface is a loose layer of forest litter $\frac{1}{2}$ to 1 inch thick. The subsoil, about 10 inches thick, is light yellowish-brown loam containing fragments of sandstone. It is underlain by acid weathered sandstone.

Muskingum soils range from 5 to 22 inches in depth to bedrock. The subsoil has developed slightly in a few places, generally in areas where bedrock is deepest.

Muskingum soils are underlain by weathered sandstone rather than by calcareous loose sand and gravel as are the Rodman soils, or by calcareous glacial till as are the Hennepin soils.

In this county Muskingum soils are mapped with the moderately dark colored, somewhat poorly drained Shadeland soils and the moderately dark colored, well-drained High Gap soils.

Muskingum stony complex, 2 to 12 percent slopes (MxC).—This complex consists of small areas of soils that have stones and rock outcrops on the surface. It adjoins areas of steeper soils. The soil between the stones and outcrops ranges from 2 to 22 inches in depth. Surface runoff is medium or rapid. Included in areas mapped as this complex are soils on short, steep, severely eroded slopes that have many stones and rock outcrops on the surface.

This soil complex can be used only for forest or permanent pasture. Grazing should be controlled on the pasture. (Capability unit VIe-1; woodland group 12)

Muskingum stony complex, 25 to 60 percent slopes (MxF).—This soil complex has many outcrops of sandstone bedrock and many large boulders on the surface. Surface runoff is rapid. The complex is in trees and should be managed to encourage their growth. (Capability unit VIIe-1; woodland group 12)

Ockley Series

In the Ockley series are moderately dark colored, deep, well-drained soils that occur throughout the county on nearly level to strongly sloping terraces, outwash plains, kames, and moraines. These soils formed in silty material that is as much as 36 inches thick and is underlain by outwash of gravelly clay loam. They developed under forest vegetation.

The surface layer is dark-brown to dark yellowish-brown silt loam or loam 7 to 10 inches thick. The sub-surface layer, about 2 to 4 inches thick, is dark-brown to grayish-brown silt loam or loam. It is underlain by a subsoil that is about 30 to 40 inches thick and consists of yellowish-brown and grayish-brown, calcareous, stratified gravel and sand. Tongues of reddish-brown, sticky clay loam to gravelly clay loam extend from the lower subsoil into the gravel and sand.

Ockley soils generally range from 42 to 72 inches in depth to the calcareous, gravelly material. They are shallowest in the more sloping eroded areas and deepest in the nearly level areas. In areas of moraines and eskers, calcareous till commonly underlies the Ockley soils at a depth of $4\frac{1}{2}$ to 6 feet or more. In areas that have a silt loam surface layer, the depth of leaching increases as the thickness of the silt loam increases. In areas that have a loam surface layer, the subsoil in a few places is sandy clay loam.

These soils contain a small amount of organic matter. The available moisture capacity is high. In cultivated areas occasional additions of lime are needed.

Ockley soils have a thicker solum than the Fox soils and are leached to a greater depth. Fox soils are generally calcareous at a depth of only 24 to 42 inches. The Ockley soils have less gravel, especially in the lower subsoil, than the Fox soils and generally have sandier underlying materials. They are lighter colored in the surface layer and subsoil than the Wea soils.

Ockley soils occur with the very poorly drained, dark colored Westland soils in depressions and with the somewhat poorly drained, moderately dark colored Sleeth soils in nearly level areas. On some slopes of moraines and kames, the Ockley soils occur with the well-drained, light-colored Fox soils.

Ockley loam, 0 to 2 percent slopes (ObA).—This soil occupies terraces, almost all of which are along the east side of Coal Creek in the central part of Fulton Township. It is next to breaks between bottom lands and terraces and extends along the terraces as broad flats back to the upland breaks. All of this soil is sandier and lighter colored than Ockley silt loam, 0 to 2 percent slopes. The subsoil is sandy clay loam or clay loam, and depth to underlying material is generally more than 60 inches. Surface runoff is very slow. Included in areas mapped as this soil are a few areas of silt loam or sandy loam.

This nearly level soil has no severe limitations and is moderate to high in productivity. Because the soil is slightly sandy, it is slightly droughty in dry periods. It is low in organic-matter content and requires good fertilization. This soil is especially well suited to legumes and small grain. (Capability unit I-1; woodland group 1)

Ockley silt loam, 0 to 2 percent slopes (OcA).—This is the most extensive Ockley soil in the county. It is generally on broad outwash plains but, in a few places, it occurs on high terraces. The surface layer is 7 to 10 inches thick and is generally uniform in color and texture. Included in areas mapped as this soil are small moderately eroded areas and areas with a loam surface layer.

This nearly level soil has no severe limitations and is productive. Although runoff is slow or very slow, the soil is somewhat droughty in extremely dry periods. Most of it is used for crops and can be farmed intensively. (Capability unit I-1; woodland group 1)

Ockley silt loam, 2 to 6 percent slopes (OcB).—This soil occurs mostly in gently sloping areas of outwash plains and moraines. Small areas are on terraces. The surface layer is 5 to 7 inches thick. Most slopes are short, and very little erosion has occurred. Surface runoff is medium. Included in areas mapped as this soil are a few areas of loam and a few moderately eroded areas.

This soil has no serious limitations and is productive. Contour tillage and other practices to control erosion are needed in areas large enough to be cultivated intensively. Most areas, however, are small and are farmed with the larger nearly level areas. (Capability unit IIe-1; woodland group 1)

Ockley silt loam, 2 to 6 percent slopes, moderately eroded (OcB2).—This soil occurs mostly on gently sloping areas of moraines and outwash plains; a few areas are on terraces. The plow layer consists of a mixture of original surface soil and yellowish-brown clay loam or silty clay loam subsoil. Depth to the underlying gravel and sand

ranges from 50 to 60 inches. Surface runoff is medium. Included in areas mapped as this soil are a few severely eroded areas that have shallow gullies and a few areas that have a loam surface layer.

This soil has few limitations and is productive. In areas that are cultivated intensively, contour tillage or other practices are needed to control erosion. (Capability unit IIe-1; woodland group 1)

Ockley silt loam, 6 to 12 percent slopes (OcC).—This soil occurs mostly in woods or pasture on moraines and kames, but a few areas are on terraces. It occurs with soils on the steeper breaks. The surface soil is 4 to 6 inches thick, and the depth to loose gravel and sand ranges from 45 to 55 inches. Surface runoff is medium. Included in areas mapped as this soil are areas of moderately eroded soils and of severely eroded soils.

This soil has serious limitations and is only moderately productive. If farming is intensive, contour tillage, stripcropping, or other practices are needed to control erosion. The soil is best suited to pasture but can be cropped occasionally. (Capability unit IIIe-1; woodland group 1)

Ockley silt loam, 6 to 12 percent slopes, moderately eroded (OcC2).—This soil occurs on moraines and kames in the north-central and northeastern parts of the county. The depth to loose gravel and sand exceeds 48 inches in only a few places. The plow layer consists of a mixture of original surface soil and yellowish-brown subsoil. A few pebbles are exposed at the surface. Surface runoff is medium or rapid, and erosion is likely. Included in areas mapped as this soil are a few small areas of loam and areas that are severely eroded.

This soil has severe limitations and is moderate to low in productivity. If this soil is cropped, stripcropping, contour tillage, or other practices should be used to control erosion. (Capability unit IIIe-1; woodland group 1)

Ockley silt loam, 12 to 18 percent slopes (OcD).—This soil occurs mostly on the moraines and kames in Logan and Davis Townships in areas where loess caps the outwash material. It is in small patches in pasture or trees and retains most of its original surface soil. The surface soil is grayish brown. Surface runoff is rapid. Some areas are moderately eroded. Included in areas mapped as this soil are small areas of loam.

This soil is low in productivity and is subject to severe erosion if it is cultivated. It is best suited to pasture or trees. (Capability unit IVe-1; woodland group 1)

Ockley silt loam, 12 to 18 percent slopes, moderately eroded (OcD2).—This soil occurs mostly on the moraines and kames in Logan and Davis townships. It is on ridgetops and on long slopes that extend down to more gently sloping soils. The plow layer is a mixture of original surface soil and yellowish-brown subsoil; subsoil material makes up more than half of the plow layer. The plow layer is silty clay loam to gravelly clay loam. Loose gravel and sand are at a depth of 40 to 50 inches. Surface runoff is rapid. Included in areas mapped as this soil are small areas of loam and a few areas of strongly sloping soils that grade toward the Fox soils.

This soil has severe limitations and is low in productivity. Erosion is very active, and many rills and small gullies occur in some fields where row crops are grown. If this soil is cropped, terracing and other practices should be

used to control erosion. Pasture or small grain are best suited. (Capability unit IVe-1; woodland group 1)

Ockley soils, 2 to 6 percent slopes, severely eroded (OkB3).—These soils occur in small to medium-sized areas that are scattered throughout the broad outwash plains of the county. In many places the soils are around steeper breaks and knobs. Erosion has removed most of the original surface soil, and the plow layer is mostly yellowish-brown to brown silty clay loam or clay loam. In a few areas sand or small pebbles are on the surface. Surface runoff is medium.

These soils have severe limitations and are only moderately productive. Cultivation is difficult because the plow layer has a high content of clay. In cultivated areas, stripcropping, contour tillage, or other practices are needed to control erosion. (Capability unit IIIe-1; woodland group 1)

Ockley soils, 6 to 12 percent slopes, severely eroded (OkC3).—These soils are of considerable extent in areas of moraines and kames in Logan and Davis Townships. They occur on ridgetops and, in a few places, on long slopes that extend down to more gently sloping soils. The plow layer is a mixture of the original surface soil and yellowish-brown subsoil; most of it is subsoil material. The plow layer is silty clay loam to gravelly clay loam. In most places the depth to loose gravel and sand is 40 inches or more. Surface runoff is rapid. Included in areas mapped as this soil are small areas of loam and a few areas of strongly sloping soils that grade toward the Fox soils.

These soils have severe limitations and are low in productivity. Erosion is active, and many rills and small gullies have formed in areas of row crops. If this soil is cropped, terracing and other practices should be used to control erosion. Pasture or small grain are best suited. (Capability unit IVe-1; woodland group 1)

Ockley soils, 12 to 18 percent slopes, severely eroded (OkD3).—These soils occur almost entirely in areas of moraines and kames in Davis, Logan, and Shawnee Townships. They are on knobs, on the higher parts of slopes, and next to the steeper breaks. The plow layer is mostly yellowish-brown clay loam or silty clay loam. Many pebbles or small stones are on the surface in some places. The depth to parent material ranges from 42 to 54 inches. In many places are gullies, rills, and sheet eroded areas. Included in areas mapped as this soil are areas of gullied land, of shallow gravelly soils, and areas that have slopes of more than 18 percent.

The soils have very severe limitations and are low in productivity. Surface runoff is very rapid, and erosion is active. Consequently, intensive cropping is not practical. The soils are best suited to pasture or trees. (Capability unit VIe-1; woodland group 1)

Parr Series

The Parr series consists of dark-colored, deep, and well-drained soils that occur on gently sloping to sloping areas of till plains. These soils developed under prairie grasses.

The surface layer is very dark grayish-brown, friable silt loam about 6 inches thick. The subsoil, 20 to 30 inches thick, is dark-brown to yellowish-brown silty clay loam in the upper part and gritty clay loam in the lower part. Underlying the subsoil is calcareous loam till.

The Parr soils have a silt cap as thick as 18 inches in some places, but generally this cap is considerably thinner. The depth to calcareous till ranges from 24 to 42 inches.

These soils have good available moisture capacity. Erosion is the major hazard. Occasional additions of lime are needed in cropped areas.

Parr soils have a darker colored surface layer than the Miami soils and a silt cap that is not so thick as that of the Sidell soils. Parr soils are underlain by fill, but the Warsaw soils are underlain by calcareous, stratified sand and gravel.

Parr soils occur with the dark colored, very poorly drained Ragsdale soils and the very dark colored, very poorly drained Romney soils.

Parr silt loam, 2 to 6 percent slopes, moderately eroded (PbB2).—This soil occurs on the top of knolls and morainic ridges of the till plains. The surface layer is dark grayish brown to grayish brown and is about 6 inches thick. It is a mixture of the original surface soil and a moderate amount of subsoil. Surface runoff is slow or medium, and internal drainage is medium. Included in areas mapped as this soil are small areas that have a surface layer thicker than 6 inches and small areas that are severely eroded.

Erosion control practices are needed in cultivated areas if maximum yields are to be obtained. (Capability unit IIe-2; woodland group 23)

Parr silt loam, 6 to 12 percent slopes, moderately eroded (PbC2).—This soil occurs in small areas on short slopes of knolls and ridges. It is downslope from Parr silt loam, 2 to 6 percent slopes, moderately eroded, and has a surface layer similar to the surface layer of that soil. Surface runoff and internal drainage are medium.

In cultivated areas, meadow should be included in the rotation and practices used to control erosion. (Capability unit IIIe-2; woodland group 23)

Parr soils, 2 to 6 percent slopes, severely eroded (PdB3).—These soils are in the same kind of position as Parr silt loam, 2 to 6 percent slopes, moderately eroded, and are similar to that soil but have lost most of their original surface soil. In many places the subsoil is exposed. Surface runoff is slow or medium.

In cultivated areas, erosion control practices are needed and meadow should be included in the rotation. (Capability unit IIIe-2; woodland group 23)

Parr soils, 6 to 12 percent slopes, severely eroded (PdC3).—These soils occupy positions similar to those of Parr silt loam, 6 to 12 percent slopes, moderately eroded, but generally their slopes are in the steeper part of the slope range. The surface layer has little of the original surface soil remaining, and in most areas the subsoil is exposed. Surface runoff is medium, and permeability is moderate.

Generally, these soils are best suited to areas of meadow in which a cultivated crop is grown only occasionally. In cultivated areas practices are needed to increase the available water capacity and to control erosion. (Capability unit IVe-2; woodland group 23)

Princeton Series

Soils of the Princeton series are moderately dark colored, deep, and well drained. They occupy nearly

level to steep slopes of uplands that are covered with coarse silt and fine sand. Most of the acreage in this county is near the Wabash River. These soils developed under hardwood forest.

The surface layer is dark yellowish-brown, friable fine sandy loam to loam about 7 inches thick. It is underlain by 3 or 4 inches of dark grayish-brown sandy loam. The subsoil, about 50 inches thick, is dark-brown clay loam in the upper part and brown or yellowish-brown sandy loam in the lower part. It is underlain by calcareous coarse silt and sand that have been deposited by the wind.

The surface layer and the subsoil vary in texture. Generally, areas that have a coarser surface layer have a coarser subsoil. The subsoil is thinner on the steeper slopes than it is in nearly level areas. Depth to calcareous material ranges from about 36 to 75 inches or more and, in most places, is greater in areas of fine sandy loam than in areas of loam.

Princeton soils developed in coarser materials than the Alford soils and in finer materials than the Chelsea soils.

The major hazard on Princeton soils is erosion. Occasional additions of lime are needed in cultivated areas.

Princeton soils occur with the moderately dark colored, somewhat poorly drained Ayrshire soils and the dark colored, very poorly drained Ragsdale soils.

Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded (PrB2).—This soil occurs in moderately long areas. Its surface layer consists of a mixture of the original surface soil and a moderate amount of subsoil. Surface runoff is slow or medium, and permeability is moderate. Less of the original surface soil remains in some areas than in others. Included in areas mapped as this soil are some nearly level areas.

This soil has only moderate limitations. If it is cultivated to row crops, practices are needed to prevent excessive loss of soil and water. (Capability unit IIe-5; woodland group 2)

Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded (PrC2).—This soil is steeper than Princeton fine sandy loam, 2 to 6 percent slopes, moderately eroded. It occurs on the sides of drainageways. Surface runoff is medium or rapid, and droughtiness is a hazard.

This soil has moderate limitations. It is best suited to small grain or meadow. Practices are needed to prevent excessive loss of soil and water. (Capability unit IIIe-5; woodland group 2)

Princeton fine sandy loam, 18 to 25 percent slopes (PrE).—This soil occurs on breaks directly below more gently sloping Princeton soils. It is not so deep as the other Princeton soils, and its subsoil is light sandy clay loam instead of clay loam or sandy loam. Surface runoff is rapid, and permeability is moderate.

This soil is in permanent vegetation. Its best use is for trees. (Capability unit VIe-1; woodland group 2)

Princeton loam, 0 to 2 percent slopes (PsA).—This soil is in broad areas. Its surface layer consists of about 8 inches of dark-brown loam and is darker colored, thicker, and higher in organic-matter content than the surface layer of the other Princeton soils in the county. Surface runoff is very slow, and permeability is moderate. Included in areas mapped as this soil are areas of Ayrshire loam and areas consisting of several inches of colluvium.

This soil has few limitations and produces high yields if management is good. (Capability unit I-1; woodland group 1).

Princeton loam, 2 to 6 percent slopes, moderately eroded (PsB2).—This soil is generally on moderately long slopes, but there are also small bands around the head of drainageways in areas of Princeton loam, 0 to 2 percent slopes. A moderate amount of subsoil is mixed with the original surface soil, and in some areas the light yellowish-brown subsoil is exposed. The surface layer is yellowish brown. Surface runoff is slow, and permeability is moderate. Included in areas mapped as this soil are areas that have a surface layer that is finer textured than loam and is thicker than 8 inches.

This soil has only moderate limitations. In areas that are cultivated to row crops, practices that prevent the excessive loss of soil and water are needed. (Capability unit IIe-3; woodland group 1)

Princeton soils, 6 to 12 percent slopes, severely eroded (PsC3).—These soils are similar to Princeton fine sandy loam, 6 to 12 percent slopes, moderately eroded, but in most places all of their original surface soil has been removed and the subsoil is exposed. Surface runoff is medium or rapid, and permeability is moderate.

These soils have severe limitations to cropping and are best suited to meadow. Practices to prevent the loss of soil and water are needed. (Capability unit IVe-5; woodland group 2)

Ragsdale Series

The Ragsdale series consists of dark-colored, deep, very poorly drained soils that occupy nearly level or depressional areas in uplands covered by windblown silt. These soils occur in depressions throughout the areas of thick loess. They developed under swamp forest and marsh grasses.

The surface layer of these soils is about 7 or 8 inches thick and consists of black, friable silty clay loam that is generally high in organic-matter content. It is underlain by 2 to 4 inches of black to very dark gray silty clay loam. The subsoil, about 40 inches thick, is silty clay loam that is very dark gray and yellowish brown in the upper part and grayish brown in the lower part. It is underlain by calcareous windblown silt or calcareous loam till.

The amount of organic matter in the surface layer varies and depends on the practices used in cultivation and drainage. The silt underlying the subsoil ranges from a few inches to several feet in thickness.

Ragsdale soils have high available moisture capacity. Wetness is the main hazard.

Ragsdale soils have a siltier subsoil than Brookston soils. Windblown silt underlies Ragsdale soils in most places, whereas calcareous till underlies Brookston soils everywhere. Instead of windblown silt or loam till, Westland soils developed in stratified silt, fine sand, coarse sand, and gravel.

Ragsdale silty clay loam (Ra).—This soil occurs mainly in the southern part of the county in large areas. Generally, the color and thickness of the surface layer are more uniform in the largest areas. The color of the surface layer is lighter in the smallest areas than in the

largest ones. Deposited recently on some small areas is a thin layer of alluvium from the surrounding uplands.

This soil has few limitations other than drainage. It can be intensively cropped if it is drained artificially. (Capability unit IIw-1; woodland group 11)

Ragsdale silty clay loam, till substratum (Rc).—This soil occurs on till plains and moraines in Richland, Davis, and Logan Townships. It is nearly level or depressional. Surface runoff is very slow or ponded. Included in areas mapped as this soil are a few gently rolling areas, small areas of Ragsdale soils that have a silt loam surface layer and a till substratum, and small areas of somewhat poorly drained and very poorly drained soils.

These nearly level or depressional soils are fertile. If they are adequately drained, yields of crops are high. (Capability unit IIw-1; woodland group 11)

Raub Series

Soils of the Raub series are dark colored, deep, and somewhat poorly drained. They occur in Richland, Davis, and Shawnee Townships on the nearly level part of upland till plains and moraines that are covered by windblown silt. These soils developed under prairie grasses.

The surface layer is black to very dark gray silt loam 9 to 14 inches thick, and the subsoil is very dark gray to yellowish-brown silt loam 5 to 7 inches thick. The subsoil, about 32 inches thick, is dark grayish-brown, brown, or gray silty clay loam or clay loam that is mottled with yellowish brown. Underlying the subsoil is gray to brownish-yellow calcareous loam or silt loam till.

Raub soils range from 42 to 70 inches or more in depth to calcareous till. Generally, they are capped with a thick layer of silt, and the upper subsoil has uniform texture. Where Raub soils are next to Crane soils on outwash plains, a few inches of water-sorted sandy material occurs above the till in some places. In some small areas the subsurface layer is gray. The lower subsoil is clay loam.

These soils have high available moisture capacity and slow internal drainage. They are fertile and high in organic-matter content, but occasional additions of lime are needed in intensively cropped areas.

Raub soils have a darker, thicker surface layer than Fincastle soils and generally a darker subsoil.

Raub soils occur with the very poorly drained, very dark colored Ragsdale and Romney soils; the moderately well drained, dark colored Dana soils in nearly level to gently rolling areas; and the well drained, dark colored Sidell soils in nearly level to moderately rolling areas. In some places the Ragsdale soils occur with the somewhat poorly drained, dark colored Crane soils.

Raub silt loam (Rd).—This soil occurs in a fairly large acreage in upland morainic areas of the Richland, Shawnee, and Davis Townships. Its surface layer generally is uniform in color and texture. Surface runoff is generally slow, and areas may be ponded after a heavy rain. Included in areas mapped as this soil are small areas of well-drained soils and of very poorly drained soils.

This soil is productive, for it has no severe limitations other than drainage. Intensively cropped areas should

be artificially drained. The soil is easily cultivated. (Capability unit IIw-2; woodland group 23)

Reesville Series

The Reesville series consists of moderately dark colored, deep, somewhat poorly drained soils that occur in nearly level and gently sloping areas of the glacial till plains that are covered with windblown silt. These soils developed under hardwood forest.

The surface layer is dark grayish-brown, friable silt loam 7 to 10 inches thick. The subsoil consists of grayish-brown silty clay loam 25 to 35 inches thick. Underlying the subsoil is yellowish-brown to light brownish-gray calcareous silt that is underlain, in turn, by loam till. Many, prominent, brown mottles occur throughout the subsoil and underlying material.

The silt mantle that overlies the loam till ranges from 36 to 84 inches in thickness. In some areas the underlying silt is neutral rather than calcareous.

Wetness is the main hazard on Reesville soils. Occasional additions of lime are needed in cropped areas.

Reesville soils have a thicker silt cap than the Fincastle soils. The Reesville soils developed in fine silt rather than in coarse silt and fine sand, as did the Ayrshire soils.

The Reesville soils occur with the moderately dark colored, well drained Alford soils; the moderately dark colored, moderately well drained Birkbeck soils; and the dark colored, very poorly drained Ragsdale soils.

Reesville silt loam, 0 to 2 percent slopes (ReA).—This is one of the most extensive soils in the county. It occurs on large, broad, nearly level till plains. Some areas are slightly depressional and have a dark-gray surface layer. Surface runoff is very slow, and permeability is slow. Included in areas mapped as this soil are a few scattered areas of moderately eroded soils.

This soil has only a few limitations, and the major one, drainage, can be easily corrected artificially. (Capability unit IIw-2; woodland group 5)

Reesville silt loam, 2 to 6 percent slopes, moderately eroded (ReB2).—Areas of this soil are small. The surface layer is light grayish brown and consists of a mixture of the original surface soil and a moderate amount of subsoil. Scattered throughout areas of this soil are many small rills.

Most of this soil occurs in narrow bands around the head of shallow drainageways and at the border of areas of Reesville silt loam, 0 to 2 percent slopes. Slopes are short. Surface runoff is slow or medium, and permeability is slow. Included in areas mapped as this soil are small areas that have short, abrupt steep slopes.

Erosion control practices are needed if this soil is cultivated, but the soil is generally farmed in the same way as are the surrounding soils. (Capability unit IIw-2; woodland group 5)

Rodman Series

Soils of the Rodman series are moderately dark colored, very shallow, and well drained. They occur on steep or very steep slopes of narrow terrace escarpments, breaks, and kames. The shallowest soils are on the

steepest slopes. These soils developed under hardwood forest.

The surface layer is very dark gray to grayish-brown gravelly loam about 6 inches thick. The subsurface layer, about 2 to 5 inches thick, is dark yellowish-brown to brown gravelly loam to sandy loam. The subsoil generally shows no development, but in a few places the yellowish-brown subsoil is slightly developed. The underlying material is dark yellowish-brown to gray, calcareous, loose gravel and sand.

In small areas where development is beginning in the subsoil, Rodman soils range from 0 to 18 inches or more in depth to carbonates. These soils overlie calcareous loam till in many places on moraines, kames, and eskers.

Rodman soils have very low available moisture capacity and very rapid internal drainage. The organic-matter content of the surface layer is high in wooded areas and low on exposed slopes.

Rodman soils developed in calcareous sand and gravel rather than in calcareous loam till, as did the Hennepin soils. Rodman soils are neutral to calcareous to a depth ranging from 0 to 18 inches, but the Fox soils are leached to a depth of 24 to 42 inches. Also, development is definite in the subsoil of the Fox soils. Rodman soils are underlain by calcareous gravel and sand, but the Muskingum soils are underlain by sandstone, siltstone, or shale.

Rodman soils occur with the well-drained, moderately dark colored Fox soils in nearly level to strongly sloping areas and with the well-drained, moderately dark colored Oakley soils in nearly level to strongly sloping areas.

Rodman gravelly complex, 18 to 25 percent slopes (RmE).—This soil complex occurs on terrace breaks and in narrow draws that extend back into the terraces. The surface layer is not more than 6 inches thick. Gravel and large stones cover most of the surface in some places. Surface runoff is rapid. Included in areas mapped as this soil are a few moderately eroded and severely eroded areas of sandy and stony, light- to dark-colored, well-drained soils that have had some development in the subsoil.

The soils in this complex have very severe limitations caused by the steep slopes and excessive drainage. Production is very low. Most areas are in trees or permanent pasture and should be left in them. (Capability unit VIIIs-1; woodland group 19)

Rodman gravelly complex, 25 to 50 percent slopes (RmF).—This soil complex is the most extensive mapping unit of Rodman soils in the county. It occurs on the steep breaks of terraces and has very rapid surface runoff. Included in areas mapped as this complex are moderately eroded and severely eroded areas.

The soils in this complex are low in productivity and are suited only to trees, mainly pines. Because the complex is steep and is shallow to loose gravel and sand, it is not suited to pasture. (Capability unit VIIIs-1; woodland group 19)

Romney Series

Soils of the Romney series are very dark colored and very poorly drained. They are mostly in nearly level or depressional areas of the uplands in the northeastern part of the county, and they also occur along old glacial

drainage channels. These soils developed under swamp forest and marsh grasses.

The surface layer, 6 to 9 inches thick, is black to very dark brown silty clay loam. The subsurface layer is black to very dark gray silty clay loam about 10 to 13 inches thick. It is underlain by a subsoil of heavy silty clay loam about 30 to 50 inches thick. The subsoil is black in the upper part and is gray mottled with yellowish brown in the lower part. Underlying the subsoil in most places is gray and yellowish-brown calcareous loam to silt loam till. In areas along the old glacial channels, the underlying material consists of gray, calcareous, loose sand and gravel.

Romney soils range from 42 to 70 inches in depth to carbonates. They have high available moisture capacity and very slow internal drainage. Additions of lime are needed if these soils are cropped intensively.

Romney soils have darker and thicker surface and subsurface layers than Ragsdale soils and a subsoil that is dominantly gray rather than dominantly brown. Also, Romney soils are less mottled with brown than Ragsdale soils.

The Romney soils occur with the dark-colored, very poorly drained Ragsdale soils in depressions; the dark-colored, somewhat poorly drained Raub soils in nearly level areas; and the well-drained, dark-colored Sidell and Parr soils in nearly level to moderately sloping areas.

Romney silty clay loam (Rn).—This soil occurs mainly in Richland, Davis, and Logan Townships on flats and in depressions of till plains and moraines. A few areas are ponded. Surface runoff ranges from slow to ponded. Included in areas mapped as this soil are areas of silt loam and areas of poorly drained and very poorly drained, very dark colored soils.

This soil is fertile and, if artificially drained and well managed, is highly productive. (Capability unit IIw-1; woodland group 11)

Romney silty clay loam, gravelly substratum (Rr).—This soil is similar to Romney silty clay loam, but it is underlain by calcareous sand and gravel rather than by loam or silt loam till. Depth to the calcareous substratum is 42 to 70 inches. Surface runoff is slow or ponded, and internal drainage is very slow. The available moisture capacity is high.

Most of this soil has been artificially drained by open ditches or by tile. In a few small areas additional drainage is needed if the soil is to be cultivated. The soil is highly productive and can be farmed to corn, soybeans, and other row crops. (Capability unit IIw-1; woodland group 11)

Russell Series

The Russell series consists of moderately dark colored, deep, well-drained soils that occur on nearly level to steep uplands of the till plains that are covered by wind-blown silt. These soils developed under hardwood forest.

The surface layer is brown silt loam 6 to 8 inches thick and is underlain by 2 to 4 inches of pale-brown to brown silt loam. The subsoil, about 35 to 40 inches thick, is dark yellowish-brown to yellowish-brown silty clay loam to clay loam. It is underlain by yellowish-brown to pale-brown till of loam or silt loam texture.

Russell soils range from 42 to 70 inches in depth to carbonates. In eroded areas carbonates are at a depth of about 42 inches. The silt ranges from 18 to 40 inches or more in thickness. In some areas the lower subsoil is clay loam that contains a considerable number of pebbles.

These soils have high available moisture capacity and moderate internal drainage. The content of organic matter is low, and erosion is a major hazard. Occasional additions of lime are needed in intensively cropped areas.

Russell soils have a thicker silt cap than the Miami soils and are less gritty. Also, they are more deeply leached. Russell soils have a much lighter colored and thinner surface layer than Sidell soils and generally a lighter colored subsoil. The lower part of the Russell soils developed in loam till, whereas Alford soils developed entirely in silt.

The Russell soils occur with the very poorly drained, dark colored Brookston soils in depressional and ponded areas; the somewhat poorly drained, moderately dark colored Fincastle soils in nearly level areas; and the well-drained, moderately dark colored Xenia soils in nearly level and gently sloping areas.

Russell silt loam, 2 to 6 percent slopes (RsB).—This soil generally occurs in small areas that are scattered throughout areas of other Russell soils. Most slopes are short, and very little erosion has occurred. Surface runoff is slow or medium. Included in areas mapped as this soil are small areas of nearly level and moderately well drained soils.

This soil has only slight limitations and is productive. If cultivation is intensive, contour tillage and other practices are needed to control erosion. Because this soil occurs in small areas, it is generally farmed the same way as are the surrounding soils. Some areas are woodland. (Capability unit IIe-1; woodland group 1)

Russell silt loam, 2 to 6 percent slopes, moderately eroded (RsB2).—This soil is the most extensive Russell soil in the county. It occurs on long to short gentle slopes in areas of moraines and till plains. It also occurs at the base of steeper slopes. The plow layer consists of a mixture of original surface soil and yellowish-brown subsoil. Surface runoff is medium. Included in areas mapped as this soil are small areas of severely eroded soils and small areas of moderately well drained soils.

This soil is productive, for it has only moderate limitations. If the soil is cultivated intensively, contour tillage and other practices are needed to control erosion. (Capability unit IIe-1; woodland group 1)

Russell silt loam, 6 to 12 percent slopes (RsC).—This soil occurs primarily in woods or pasture on till plains and moraines. The surface layer is 6 to 8 inches thick. Most of the original surface soil remains. Surface runoff is medium or rapid. In the steeper areas this soil is not so deep to carbonates as it is in the more gently sloping areas. Included in areas mapped as this soil are small areas of moderately eroded and of severely eroded soils.

This soil is moderately productive, but it has severe limitations caused by slope and the erosion hazard. If the soil is cultivated, terracing, stripcropping, and other practices are needed to control erosion. The soil is well suited to small grain, pasture, or hay. (Capability unit IIIe-1; woodland group 1)

Russell silt loam, 6 to 12 percent slopes, moderately eroded (RsC2).—This soil has lost from a third to a fourth

of its original surface soil through erosion, but in other respects it is similar to Russell silt loam, 6 to 12 percent slopes. It occurs on short slopes and breaks around areas of more gently sloping Russell soils. Surface runoff is medium or rapid. Many rills and a few gullies occur. Included in areas mapped as this soil are small areas of severely eroded soils.

This soil has serious limitations and is only moderately productive. If cropping is intensive, stripcropping, terracing, and other practices are needed to control erosion. The soil is best suited to small grain and hay. (Capability unit IIIe-1; woodland group 1)

Russell silt loam, 12 to 18 percent slopes (RsD).—This soil occurs in woods and on moraines along the valley of the Wabash River. Little erosion has occurred, and the surface layer is 5 to 7 inches thick. Surface runoff is rapid. Included in areas mapped as this soil are small areas of moderately eroded soils.

This soil is low in productivity, for it has severe limitations. It is best suited to hay and an occasional crop of small grain. (Capability unit IVe-1; woodland group 1)

Russell silt loam, 12 to 18 percent slopes, moderately eroded (RsD2).—The surface layer of this soil is a mixture of the original surface soil and subsoil, but in other respects the soil is similar to Russell silt loam, 12 to 18 percent slopes. The soil is at the base of the steeper slopes and next to breaks. Surface runoff is rapid, permeability is moderate to rapid, and the depth to carbonates ranges from 40 to 45 inches. Included in areas mapped as this soil are areas that have many shallow gullies and are severely eroded.

This soil is low in productivity, for it has severe limitations caused by the slope and erosion. Its use as cropland is limited, and it is best suited to pasture and an occasional crop of small grain. Erosion control practices are needed. (Capability unit IVe-1; woodland group 1)

Russell silt loam, 18 to 25 percent slopes (RsE).—Most of this soil is in Wabash and Fulton Townships and other areas where the deposits of loess are deep. It occurs just above the steeper, very shallow Hennepin soils and is mostly wooded. It is much like the more gently sloping Russell soils, but it is thinner and more shallow to carbonates. Surface runoff is very rapid. In some places, grit occurs on the surface and calcareous loam till is at a depth of 36 to 45 inches. Included in areas mapped as this soil are a few areas of Miami soils and of moderately eroded areas.

This soil is low in productivity because it has very severe limitations. Its best use is for permanent pasture or pine trees. (Capability unit VIe-1; woodland group 2)

Russell silt loam, 18 to 25 percent slopes, moderately eroded (RsE2).—The surface layer of this soil is 5 to 7 inches thick and consists of a mixture of the subsoil and the original surface soil, but in other respects the soil is similar to Russell silt loam, 18 to 25 percent slopes. At one time the soil may have been cleared and pastured. Grit, pebbles, and a few stones are on the surface. Surface runoff is very rapid. Included in areas mapped as this soil are small areas that are severely eroded and areas that are gullied.

This soil is low in productivity, for it has very severe limitations. It is not suited as cropland, because slopes are steep and further erosion is likely. It is best suited to pine trees and permanent pasture. (Capability unit VIe-1; woodland group 2)

Russell soils, 2 to 6 percent slopes, severely eroded (RtB3).—These soils occur in small to medium-sized areas throughout areas of other Russell soils. In many places they are on the breaks of knobs and moraines, and in some places they are on long slopes. They are surrounded by flat to rolling, somewhat poorly drained to moderately well drained soils. In most places the depth to carbonates is between 42 and 50 inches. The plow layer is dark yellowish-brown silty clay loam or clay loam that is low in organic-matter content. Erosion has removed most of the original surface soil. Runoff is medium. Gullies and rills occur in small areas.

These soils are only moderately productive because they have severe limitations as cropland. They are fairly difficult to cultivate. In cultivated areas strip-cropping, terracing, or other practices are needed to control erosion. (Capability unit IIIe-1; woodland group 1)

Russell soils, 6 to 12 percent slopes, severely eroded (RtC3).—These soils have lost three-fourths or more of their original surface soil through erosion, and the surface layer consists of 6 to 8 inches of silty clay loam or clay loam. Many pebbles and stones are on the surface, and many small gullies occur. Surface runoff is rapid. Included in areas mapped as these soils are small areas that have deep gullies.

These soils are low in productivity, for they have severe limitations. Erosion is active. The soils are difficult to cultivate because their content of clay is high. If row crops are grown, terracing and other practices are needed to control erosion. These soils are best suited to pasture, hay, and an occasional crop of small grain. (Capability unit IVe-1; woodland group 1)

Russell soils, 12 to 18 percent slopes, severely eroded (RtD3).—These soils occur on the ridgetops, knobs, and slopes of till plains and moraines. The plow layer is a yellowish-brown silty clay loam or clay loam. Surface runoff and internal drainage are rapid or very rapid. Many pebbles and small stones are on the surface, and small gullies and rills are fairly common. Included in areas mapped as these soils are a few areas of gullied land and areas of steep soils.

Productivity is low, for these soils have very severe limitations. Intensive cropping is impractical because erosion is active. The soils are best suited to pasture or trees. (Capability unit VIe-1; woodland group 1)

Shadeland Series

The Shadeland series consists of moderately dark colored, moderately deep, somewhat poorly drained soils that are nearly level and occur on rocky benches and on the top of bedrock ridges. These soils developed in material weathered from glacial till that is about 15 to 36 inches thick and is underlain by interbedded sandstone and shale. The native vegetation on these soils was hardwood trees.

The surface layer is very dark gray to grayish-brown, friable silt loam that is 3 to 5 inches thick and is mottled in the lower part. It is underlain by a subsurface layer of gray silt loam about 5 to 8 inches thick. The subsoil, 15 to 20 inches thick, is mottled yellowish-brown and pale-brown silty clay loam that contains fragments of sandstone in the lower part. Underlying the subsoil is

partly weathered sandstone that grades to unweathered sandstone.

Because these soils are wet and are shallow to bedrock, they are not very well suited to cultivated crops.

Shadeland soils are more acid in the subsoil and more shallow to underlying material than are Crosby and Fincastle soils. Also, the underlying material in Shadeland soils is sandstone or shale rather than calcareous till, as it is in the Crosby and Fincastle soils.

Shadeland soils occur with the moderately dark colored, well-drained High Gap soils and the dark colored, very poorly drained Westland soils that have a thin solum.

Shadeland silt loam (Sa).—This nearly level soil is on breaks between more sloping soils and very steep shallow soils. It is at the foot of the more sloping soils. Very small shallow drainageways are scattered in areas of this soil. Surface runoff is very slow, and permeability is slow.

This soil is best suited to pasture and trees, but the stands of timber are poor. (Capability unit IIIw-7; woodland group 5)

Shoals Series

Soils of the Shoals series are moderately dark colored, deep, slightly acid to calcareous, and somewhat poorly drained. They occur on the flood plains of the Wabash River and of the small streams throughout the county.

The surface layer of these soils is very dark grayish-brown silt loam to silty clay loam 4 to 10 inches thick. It is underlain by very dark gray to dark gray silt loam, loam, or silty clay loam that is mottled with strong brown to reddish brown.

The surface layer is lighter colored than normal in some areas. The layers underlying the surface layer vary greatly in thickness, sequence, color, and texture.

These soils have high available moisture capacity. The water table is high, and occasional flooding is likely. Also, excess water runs in from adjacent hillsides. Fertility, however, is high, and additional lime is not needed.

Shoals soils occur with the very poorly drained, dark-colored Sloan soils in depressions and with the moderately well drained Eel and the well drained Genesee and Landes soils on the higher parts and on the natural levees of the bottom lands.

Shoals silt loam (Sb).—This soil occurs on the bottoms along smaller streams and is dissected by the streams in many places. It also occurs along the Wabash River. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas that have a loam and fine sandy loam surface layer and small areas of very poorly drained soils.

This soil is fertile and easily cultivated, and most of it is cultivated. Corn, beans, and grain sorghum are the main crops. Because of the excess water, some small areas are too wet for farming and are ponded after floods. (Capability unit IIw-7; woodland group 13)

Shoals silty clay loam (Sc).—This soil occurs on bottom lands along the Wabash River next to the uplands and terraces. Much of it is in abandoned oxbows and stream channels. In the top 10 to 12 inches, the content of clay is higher than that in Shoals silt loam. Surface runoff is very slow. Included in areas mapped as this soil are

small areas of Shoals silt loam and small areas of poorly drained soils.

This nearly level soil is fertile, but it is fairly difficult to cultivate. Occasional flooding is likely, and the undrained areas are saturated or are under water much of the growing season. Areas that are not in timber are cultivated. Corn, soybeans, and grain sorghum are the main crops. (Capability unit IIw-7; woodland group 13)

Sidell Series

The Sidell series consists of dark-colored, deep, well-drained soils that occur on moraines and till plains in nearly level and gently sloping areas that are covered by windblown silt. These soils developed under prairie grasses.

The surface layer is very dark brown, friable silt loam 7 to 9 inches thick, and the subsurface layer is very dark grayish-brown silt loam 3 to 5 inches thick. The dark-brown to yellowish-brown subsoil is 35 to 45 inches thick and is silty clay loam in the upper part and clay loam in the lower. Underlying the subsoil is brown to grayish-brown calcareous loam till.

Sidell soils range from 42 to 70 inches in depth to carbonates. The surface layer and subsurface layer combined range from 10 to 14 inches in thickness. In some places there is a few inches of sandy material just above the till.

These soils have high available moisture capacity and moderate internal drainage. Their organic-matter content is high, but occasional additions of lime are needed in intensively farmed areas.

Sidell soils have a thicker and darker colored surface layer than Russell soils and generally a darker colored subsoil. They are deeper to the calcareous material than the Parr soils. Calcareous material is at a depth of only 24 to 42 inches in the Parr soils. Also, the cap of wind-blown silt of the Sidell soils ranges from 18 to 40 inches in thickness, but that of the Parr soils is only 0 to 18 inches thick.

Sidell soils occur with the very poorly drained, dark colored Ragsdale soils and the very dark colored Romney soils in depressions; the somewhat poorly drained, dark colored Raub soils in nearly level areas; and the moderately well drained, dark colored Dana soils in nearly level and gently sloping areas.

Sidell silt loam, 0 to 2 percent slopes (SdA).—This soil occurs in Richland and Logan Townships on till plains and on the borders of moraines. In most places it is near glacial outwash plains in areas where porous material underlies the till. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas of moderately eroded soils and of moderately well drained soils. Also included are small areas that have 2 to 4 inches of gray material just below the plow layer.

This soil is productive, for it has few limitations. It can be farmed intensively and is used mostly for grain. (Capability unit I-1; woodland group 23)

Sidell silt loam, 2 to 6 percent slopes (SdB).—This soil occurs on low, rolling knolls that are scattered throughout areas of Sidell soils. Most of the original surface soil remains, for little erosion has occurred. Surface runoff is slow or medium. Included in areas mapped as this soil are small areas of nearly level soils and of moderately

eroded soils. Also included are small areas that have a gray surface layer 2 to 4 inches thick.

This soil has no severe limitations and is productive. If farming is intensive, contour tillage and other practices are needed to control erosion. The soil is of minor extent and is not farmed in separate units. (Capability unit IIe-2; woodland group 23)

Sidell silt loam, 2 to 6 percent slopes, moderately eroded (SdB2).—This is the most extensive Sidell soil in the county. It is in the northeastern part of the county on rolling ridges and at the base of slopes of the till plain and morainic areas. The plow layer consists of a mixture of the original surface soil and yellowish-brown subsoil. Surface runoff is medium. Included in areas mapped as this soil are small areas that are slightly or severely eroded, areas with a gray subsurface layer, and small areas with a dark, thick surface layer.

This soil is medium to high in productivity, for it has only moderate limitations. If cultivation is intensive, contour tillage and other practices are needed to control erosion. (Capability unit IIe-2; woodland group 23)

Sidell soils, 2 to 6 percent slopes, severely eroded (SeB3).—These soils occur in small areas that are scattered throughout areas of other Sidell soils. In many places they are on knobs and ridges in morainic areas and are surrounded by areas of moderately eroded and of somewhat poorly drained soils. Most of the original surface soil has been removed by erosion, and the plow layer is largely yellowish-brown clay loam or silty clay loam. Surface runoff is medium.

These soils have some limitations, but they produce moderate yields of most crops grown in the county. Contour tillage, strip cropping, or terracing is needed in cultivated areas. The soils are fairly difficult to cultivate because the surface layer has a high content of clay. (Capability unit IIIe-2; woodland group 23)

Sleeth Series

Soils of the Sleeth series are moderately dark colored, deep, and somewhat poorly drained. These soils occur throughout the county in nearly level areas on outwash plains and high terraces that are covered by silt. They developed under hardwood forest.

The surface layer of these soils is dark grayish-brown, friable silt loam, and the subsurface layer is grayish-brown to brownish-gray silt loam 3 to 5 inches thick. The subsoil, about 40 to 55 inches thick, is gray to brownish-gray silty clay loam to sandy clay loam that is mottled with yellowish brown to brown. Underlying the subsoil is light olive-brown, stratified calcareous sand and gravel.

Sleeth soils generally range from 42 to 70 inches in depth to carbonates. In Richland Township, where the largest areas of Sleeth soils occur, silty and loamy outwash material has covered the undulating glacial till plains. In these areas the outwash material is underlain by calcareous till at a depth of 8 to 16 feet. The silt ranges from 20 to 36 inches in thickness and in most places is almost 36 inches thick. The lower subsoil ranges from clay loam to gravelly sandy loam.

Sleeth soils are underlain by stratified sand and gravel, but Whitaker soils are underlain by stratified sand and silt and a small amount of gravel. Also, the

Sleeth soils are less gritty throughout the profile than the Whitaker soils. Sleeth soils have a thinner, lighter colored surface layer than the Crane soils and a somewhat lighter colored subsoil.

The Sleeth soils occur with the very poorly drained, dark colored Romney and Westland soils in depressions and with the well-drained, moderately dark colored Ockley soils in nearly level to strongly sloping areas.

Sleeth silt loam (Sh).—This soil is fairly extensive in the east-central part of the county. The surface layer ranges from 5 to 10 inches in thickness, its thickness depending on whether the soil is woodland or cropland. In woodland the surface layer is generally 10 inches thick. Surface runoff is slow. Flat or slightly depressional areas have been covered by a few inches of silt that has been brought in from adjacent higher soils. Included in areas mapped as this soil are small areas of gently sloping soils that are moderately eroded.

This soil has only slight limitations. Because it is wet, it warms up slowly in spring. If cropping is intensive, artificial drainage is needed. (Capability unit IIw-2; woodland group 5)

Sloan Series

The Sloan series consists of dark-colored, deep, very poorly drained soils that occupy nearly level and slightly depressional areas of bottom land along the Wabash River. These areas were covered with swamp grasses and water-tolerant trees and shrubs.

The surface layer is very dark brown, friable silt loam to silty clay loam. The subsoil is made up of stratified layers of silty clay loam that range from 10 to 25 inches in thickness. These layers are very dark gray mottled with dark reddish brown and yellowish brown. Mottles are many and distinct. Beneath the subsoil the stratified material is neutral to calcareous and variable in texture.

The number and thickness of the layers in the subsoil vary considerably. In a few places silt or sand lenses, 1 to 3 inches thick, are between the silty clay loam layers. The thickness, color, and organic-matter content of the surface layer varies considerably within short distances.

These soils have high available water capacity. Their main limitation is wetness.

Sloan soils are deeper to underlying material than Westland soils. Also, Sloan soils are underlain by neutral to calcareous stratified sand, silt, and clayey material, but the Westland soils are underlain by calcareous sand and gravel. Sloan soils have a darker colored surface layer than Shoals soils and are higher in organic-matter content.

The Sloan soils occur with the moderately dark colored, well drained Landes and Genesee soils; the light-colored, moderately well drained Eel soils, and the moderately dark colored, somewhat poorly drained Shoals soils.

Sloan silt loam (Sm).—This soil is flooded more frequently than Sloan silty clay loam and receives larger amounts of alluvium. Its surface layer is very dark brown to very dark gray silt loam about 10 to 15 inches thick. The surface layer is lighter colored in cultivated areas than it is in undisturbed areas, for material from

the lighter colored subsoil is mixed with it. Surface runoff is ponded, and internal drainage is very slow. Included in areas mapped as this soil are small areas that are sandier than silt loam.

This soil is flooded periodically. Natural drainage outlets are not adequate. (Capability unit IIIw-9; woodland group 11)

Sloan silty clay loam (Sn).—This soil occurs in deeper depressions than Sloan silt loam and is farther from the source of water that floods it. The surface layer is darker and higher in organic-matter content than Sloan silt loam. Surface runoff is ponded, and internal drainage is very slow.

This soil produces good yields if drainage outlets are available and adequate drainage is installed. (Capability unit IIIw-9; woodland group 11)

Stony Alluvial Land (St)

Stony alluvial land is moderately dark colored, very shallow, and well drained. It occurs in a single area along the Wabash River in the northeastern part of Davis Township, within one-half mile of the Tippecanoe County line.

The surface layer is dark-brown to very dark grayish-brown flinty silt loam 4 to 8 inches thick. Mixed throughout this layer are many pieces of flint 1 to 4 inches across. Below the surface layer is material consisting of medium or large, broken pieces of flint and silt loam alluvium between the pieces.

This land occurs with the well-drained, moderately dark colored Genesee soils; with the very poorly drained, dark colored Sloan soils in depressions and swamps along the river; and with the well-drained, moderately dark colored, very shallow Muskingum soils in gently sloping areas.

This land has serious limitations and very low productivity. The sharp edges of the flint make farming with rubber-tired equipment impractical. Also, the land is too stony to plow and cultivate. It is best suited to permanent pasture and to trees. (Capability unit VIIc-1; woodland group 16)

Sunbury Series

The Sunbury series consists of dark-colored, deep, somewhat poorly drained soils that are on nearly level slopes in the upland of the glacial till plains. These soils developed under prairie grasses and scattered hardwoods.

The surface layer is very dark grayish-brown, friable silt loam about 7 inches thick. It is underlain by 3 to 5 inches of dark-gray silt loam. The subsoil, about 30 to 40 inches thick, is grayish-brown silty clay loam in the upper part and pale-brown silt loam in the lower part. Many, distinct, yellowish-brown mottles occur throughout this layer. Underlying the subsoil is mottled brownish-gray and brownish-yellow, neutral to calcareous silt that is underlain, in turn, by calcareous loam glacial till.

Sunbury soils range from about 48 to 84 inches in depth to till. In some areas they are underlain by stratified outwash material, primarily sand.

Sunbury soils are moderately high in organic-matter content. In cropped areas occasional additions of lime and artificial drainage are needed.

The native vegetation of Sunbury soils was primarily prairie grasses rather than the hardwood forest that was on the Reesville soils. Consequently, Sunbury soils are darker colored than the Reesville soils and have a thicker surface layer and higher organic-matter content.

Sunbury soils occur with the dark-colored, very poorly drained Ragsdale soils.

Sunbury silt loam (Su).—This soil occurs in broad, nearly level areas that are near areas of better drained soils on slight rises or small low knolls. Surface runoff is very slow, and permeability is slow. Included in areas mapped as this soil are small areas of better drained soils, of moderately eroded soils, and of soils that are not so deep to the underlying material.

This nearly level soil is productive, for it has no severe limitations. Artificial drainage is needed if yields are to be high. (Capability unit IIw-2; woodland group 23)

Tawas Series

Soils of the Tawas series are dark colored, moderately deep, and very poorly drained. They occur in nearly level or depressional areas on bottom lands near terrace breaks.

The surface layer of these soils is very dark brown muck about 4 to 6 inches thick. It is underlain by subsurface layers consisting of very dark gray to black muck 10 to 36 inches thick. The underlying material is pale-olive to gray calcareous sandy loam to loose sand that contains some gravel. The depth to sand and gravel ranges from 12 to about 42 inches.

The surface layer varies in degree of decomposition. In many places root channels in the upper mucky layers are filled with sand.

These soils have good available moisture capacity and very slow surface runoff. Wetness is the major problem, and wind erosion is likely on bare areas.

Tawas soils are underlain by sand and gravel rather than by marl as are Marl beds. Muck is at the surface of Tawas soils, but Wallkill soils have 10 to 40 inches of silt loam to silty clay loam over thick muck.

Tawas soils occur with the very poorly drained, dark colored Sloan soils in depressions of bottom lands and with the somewhat poorly drained, moderately dark colored Shoals soils on nearly level bottom lands.

Tawas muck (Ta).—This soil occurs on bottom lands adjacent to terrace breaks and in the abandoned channels of the Wabash River in Fulton Township. The underlying material ranges from loamy sand to loose sand. Included in areas mapped as this soil are a few peatlike areas, areas underlain by silty clay loam, and areas with a thin layer of recently deposited alluvium.

This soil is productive if it is drained, properly fertilized, and managed correctly. It is likely to be flooded by water from the river. When this flooding recedes, water is cut off and pocketed by surrounding areas of higher soils. The pocketed water has to seep out before these areas are useful. Excess water also runs in from upland areas. In dry periods there is a slight hazard of wind erosion. Most of this soil, however, has been abandoned

because it is wet. (Capability unit IVw-3; woodland group 23)

Tippecanoe Series

Soils of the Tippecanoe series are dark colored, deep, and moderately well drained. They occur in nearly level areas of the outwash plains and terraces in Richland, Shawnee, and Logan Townships. These soils developed under prairie grasses.

The surface layer is very dark brown silt loam 7 to 9 inches thick, and the subsurface layer is black to dark-gray silt loam 6 to 8 inches thick. The subsoil is about 30 to 50 inches thick. It is dark-brown silty clay loam in the upper part and grades to grayish-brown sandy loam mottled with brownish yellow in the lower part. The material below the subsoil is grayish-brown to gray, calcareous, loose sand and gravel.

Tippecanoe soils have a silt cap that is 18 to 36 inches thick. These soils range from 42 to 70 inches in depth to carbonates. Depth to mottling ranges from 15 to 30 inches and is shallowest in areas near Crane soils.

Internal drainage is moderate to moderately slow. Organic-matter content and available moisture capacity are high. In intensively cropped areas, however, occasional additions of lime are needed.

Tippecanoe soils have a brown, well-drained upper subsoil rather than a gray subsoil as have the Crane soils or an entire brown subsoil as have the Wea soils. They are moderately well drained rather than well drained as are the Wea soils.

The Tippecanoe soils occur with the very poorly drained, dark colored Westland soils and the very dark colored Romney soils with gravelly substratum in flats and depressions; the somewhat poorly drained, dark colored Crane soils in nearly level areas; and the well-drained, dark colored Wea soils in nearly level to sloping areas.

Tippecanoe silt loam, 0 to 2 percent slopes (TcA).—Most of this soil is on outwash plains in small scattered areas and in large flat areas. Surface runoff is slow or very slow. Included in areas mapped as this soil are small moderately eroded areas, areas covered by a thin layer of silt loam from surrounding soils, and small areas that have a brown to dark-brown upper subsoil and a grayish-brown subsurface layer 2 to 4 inches thick.

This soil is productive, for it has no severe limitations. It is easy to cultivate, but some areas are limited in wet periods because their water table is high. (Capability unit I-1; woodland group 23)

Wallkill Series

Soils of the Wallkill series are moderately dark colored, deep, and very poorly drained. They occur on flats and in abandoned channels of the Wabash River and in low pockets of bottom land along the small streams. Most of their acreage is in Troy Township.

The surface layer is 6 to 9 inches of dark grayish-brown silty clay loam to silt loam that is mottled with yellowish brown. The subsurface layer, about 5 to 7 inches thick, is very dark gray fine silt loam that is mottled with grayish brown. It is underlain by layers of very dark brown to black weathered muck in which

partly decomposed roots and grass fibers are scattered. The material at a depth of 30 to 40 inches is slightly alkaline, grayish-brown, unweathered peat.

In Wallkill soils the alluvium over the muck ranges from 10 to 30 inches in thickness, but average thickness is 15 inches. These soils are flooded periodically by water from the river, and the receding water is cut off and pocketed by higher areas. As this pocketed water seeps out, fresh alluvium is left in these areas. Woody fragments are scattered throughout the unweathered peat, which has weak platy layers.

Wallkill soils have high or very high available moisture capacity and moderate internal drainage. Most of the time, however, the water table is very high.

In Wallkill soils the muck is at a depth of 10 to 30 inches and is overlain by mineral material, but in Tawas soils muck extends from the surface to sand and loamy sand at a depth of 12 to 42 inches. In Marl beds muck is underlain by marl at a depth of as much as 12 inches.

The Wallkill soils occur with the very poorly drained, dark-colored Sloan soils in swales and depressions.

Wallkill silty clay loam (Wa).—This soil occurs almost entirely in the abandoned channels of the Wabash River northeast of Covington. Runoff is very slow or ponded. Included in areas mapped as this soil are small areas in which less than 8 inches of alluvium is over the muck. Also included are areas of very poorly drained, fine-textured soils.

This soil is high in fertility, and it would produce crops if it were drained. Besides drainage, limitations are only slight. Most of the soil is idle because it is saturated most of the time and is frequently flooded. (Capability unit IIw-7; woodland group 23)

Warsaw Series

Soils of the Warsaw series are dark colored, moderately deep to deep, and well drained. They occur on nearly level to moderately sloping areas of terraces along the Wabash River, in Troy Township and elsewhere on outwash plains. These soils developed under prairie grasses.

The surface layer is very dark brown to black loam or silt loam 7 to 10 inches thick, and the subsurface layer is very dark brown to dark brown loam or silt loam about 3 to 6 inches thick. The subsoil, about 15 to 25 inches thick, is dark-brown, dark yellowish-brown, and very dark grayish-brown gravelly loam to gravelly clay loam. Underlying the subsoil is brownish-gray, stratified, calcareous coarse gravel and sand.

These soils range from 24 to 42 inches in depth to carbonates. In many places tongues of material from the subsoil extend for 8 to 12 inches into the parent material.

These soils have low to medium available moisture capacity and moderate to rapid internal drainage. The organic-matter content is high. In intensively cropped areas occasional additions of lime are needed.

Warsaw soils have a thicker, darker colored surface soil than Fox soils and generally a darker colored subsoil. They developed under a prairie grass vegetation, but the Fox soils developed under timber. Warsaw soils developed in less sandy material than the Elston soils

and are not leached so deeply. The Elston soils are leached to a depth of 55 to 80 inches or more.

The Warsaw soils occur with the well-drained, dark-colored Elston soils; the well-drained, light-colored Fox soils; and the very poorly drained, dark-colored Westland soils in depressions and depressed flats.

Warsaw loam, 0 to 2 percent slopes (WbA).—This is the most extensive Warsaw soil in the county. It occurs on broad, nearly level areas of terraces. Surface runoff is slow or very slow. The surface layer and subsurface layer combined range from 10 to 14 inches in thickness. The surface layer is lighter colored than normal in areas where this soil grades toward the Fox soils. In some places the parent material contains large boulders. Included in areas mapped as this soil are a few areas of silt loam and of sandy loam.

This soil is moderately limited by drought and is moderately productive. It is suitable for irrigation. Although most areas are in row crops, legumes and fall-seeded small grain are best suited. (Capability unit IIs-1; woodland group 23)

Warsaw loam, 2 to 6 percent slopes, moderately eroded (WbB2).—This soil occurs on gentle slopes of drainage-ways and in gently sloping or knobby areas on terraces and outwash plains. Varying amounts of sand or gravel occur on the surface. The plow layer is dark brown and is a mixture of the yellowish-brown subsoil and the original surface soil. Included in areas mapped as this soil are a few slightly eroded areas, severely eroded areas, and sloping areas.

This soil is moderately productive. It is limited by drought and erosion. If farming is intensive, contour tillage and other practices should be used. Legumes and small grain are best suited. (Capability unit IIe-9; woodland group 23)

Warsaw silt loam, 0 to 2 percent slopes (WcA).—This soil has a small acreage in this county. It occurs in long, narrow natural waterways in areas where silt has been deposited on gravel and gravelly material. It has a silt loam surface layer and, in some places, a silty clay loam upper subsoil, but in most other respects it is similar to Warsaw loam, 0 to 2 percent slopes. The silt loam holds more moisture than the loam and can be farmed more intensively. Included in areas mapped as this soil are small moderately eroded areas, slightly eroded areas, and sloping areas.

This soil is moderate to high in productivity; it has no serious limitations. During periods of heavy rainfall, excess water may stand on the surface. Only the largest areas can be farmed as separate units. This soil can be farmed intensively, and it is easy to cultivate. (Capability unit IIs-1; woodland group 23)

Warsaw soils, 6 to 12 percent slopes, severely eroded (WdC3).—These soils occur in small areas on terraces along the Wabash River. They are on ridgetops, breaks, and knobs among areas of other Warsaw soils. The plow layer is mostly yellowish-brown to brown material from the subsoil. Most of the original surface soil has eroded away. Surface runoff is medium. The depth to carbonates ranges from 20 to 36 inches. In a few places gravel, sand, and some stones are on the surface. Included in areas mapped as these soils are small areas of gently sloping or moderately sloping Elston soils and of strongly sloping Warsaw soils.

These soils are low in productivity, for they have serious limitations and are difficult to cultivate. They are droughty and better suited to pasture and small grain than to row crops. (Capability unit IVE-9; woodland group 23)

Washtenaw Series

In the Washtenaw series are poorly drained and very poorly drained soils that occupy shallow to deep kettles and depressions that are widely scattered in uplands and outwash plains. Because material has been deposited recently on these soils, the natural vegetation is not characteristic.

The surface layer of these soils is light grayish-brown to dark grayish-brown, friable silt loam about 6 to 8 inches thick. The subsurface layer consists of about 15 inches of dark grayish-brown to very dark gray, friable silt loam. The subsoil, about 30 to 40 inches thick, is black silty clay loam in the upper part and gray clay loam in the lower part. Calcareous glacial till or stratified sand and silt make up the underlying material.

Washtenaw soils vary primarily in thickness of the surface and subsurface layers. The combined thickness of these layers may be as little as 10 inches or as much as 40 inches. Also variable is the color of the subsoil, the depth to the underlying material, and the kind of underlying material.

The major limitation to the use of these soils is wetness. Occasional additions of lime are needed in cultivated areas.

Washtenaw soils are covered with moderately dark colored mineral material that has been washed in recently, but the very poorly drained, dark colored Brookston and Westland soils are not. In the Washtenaw soils this mineral material was deposited on other mineral material, but in the Wallkill soils the material was deposited on organic material.

Washtenaw silt loam (Wh).—This soil occurs in scattered areas; it has a small total acreage in this county. Water is likely to stand on the surface during heavy rains. Unless erosion is controlled on the surrounding higher lying soils, additional material will be washed in. Surface runoff and permeability are very slow.

Artificial drainage is needed if yields are to be high. Generally, however, the small areas of this soil are farmed the same as are surrounding soils. (Capability unit IIw-1; woodland group 11)

Wea Series

Soils of the Wea series are dark colored, deep, and well drained. They occur in broad, nearly level to sloping areas of the silt-covered outwash plains, mostly in Richland, Shawnee, and Logan Townships. These soils developed under prairie grasses.

The surface layer is very dark brown silt loam 6 to 9 inches thick, and the subsurface layer is very dark brown silt loam about 7 to 10 inches thick. The subsoil, about 30 to 50 inches thick, is dark-brown to yellowish-brown silty clay loam in the upper part and sandy clay loam to sandy loam in the lower part. Underlying the subsoil is dark-brown, brown, or gray, calcareous stratified coarse sand and gravel that is underlain by till.

The silt cap of Wea soils ranges from 20 to 36 inches or more in thickness. The depth to carbonates ranges from 42 to 70 inches. Over the till, the gravel and sand are a few or several feet thick.

These soils have high available moisture capacity and moderate internal drainage. They are high in organic-matter content. Occasional additions of lime are needed in intensively cropped areas.

Wea soils have a deeper, darker colored surface soil than Ockley soils and generally a darker colored subsoil. In some places the silt cap of Wea soils is thicker than that of the Ockley soils. Wea soils are deeper than Warsaw soils, in which carbonates occur at a depth of only 24 to 42 inches.

The Wea soils occur with the very poorly drained, dark-colored Westland soils in depressions; the somewhat poorly drained, dark-colored Crane soils; and the moderately well drained, dark-colored Tippecanoe soils in nearly level areas.

Wea silt loam, 0 to 2 percent slopes (WmA).—This is the most extensive Wea soil in the county. It occurs on broad, nearly level areas in Richland and Shawnee Townships. Surface runoff is slow or very slow. In some places the surface layer is light brown and the subsurface soil is light grayish brown.

This soil is productive, for it has only slight limitations. It can be cultivated intensively and is suited to all crops grown in the area. Fertilization and conservation of moisture are the main requirements of management. (Capability unit I-1; woodland group 23)

Wea silt loam, 2 to 6 percent slopes (WmB).—This soil occurs in small scattered areas on the broad outwash plains. The slopes are short and uneven. Surface runoff is slow or medium. Some of the surface soil has washed away, but in other respects this soil is similar to Wea silt loam, 0 to 2 percent slopes. In some places the surface layer is lighter colored than normal, and the subsurface layer is light grayish brown.

This soil is productive because it has only a few limitations. It occurs with Wea silt loam, 0 to 2 percent slopes, and is used the same way as that soil. If practical, contour tillage or other practices should be used to control erosion. Yields are somewhat lower on this soil than they are on Wea silt loam, 0 to 2 percent slopes. (Capability unit IIe-2; woodland group 23)

Wea silt loam, 2 to 6 percent slopes, moderately eroded (WmB2).—This soil occurs in gently sloping areas around drainageways and at the foot of steep slopes. Slopes are long and short. Surface runoff is slow or medium. The plow layer is a mixture of the original surface soil and the yellowish-brown subsoil. Although the subsoil is exposed in some areas, the surface layer is generally 4 to 7 inches thick. In some areas the surface layer is lighter colored than normal, and the subsurface layer is light brown to grayish brown. The lower subsoil is slightly mottled in some areas.

This soil has only a few limitations and is productive. In intensively farmed areas, contour tillage and other practices should be used to control erosion. This soil is suited to all crops grown in the area, especially small grain. (Capability unit IIe-2; woodland group 23)

Wea soils, 2 to 6 percent slopes, severely eroded (WnB3).—These soils occur in small areas on the outwash

plains and on ridges of morainic areas. They are surrounded by nearly level, somewhat poorly drained and moderately well drained soils. Surface runoff is medium. It is more rapid than on Wea silt loam, 2 to 6 percent slopes, moderately eroded, and erosion is active in most places. The plow layer is material from the yellowish-brown subsoil and a small amount of the original surface soil. The lower subsoil of the gently rolling areas has more sand and gravel than that of Wea silt loam, 0 to 2 percent slopes. The depth to carbonates is 45 to 55 inches.

These soils are low to moderate in productivity, for they are severely eroded and have other limitations. They are fairly difficult to cultivate and are slightly droughty in dry periods. If cropping is intensive, stripcropping, contour tillage, and other practices should be used to control erosion. These soils are well suited to legumes and small grain. (Capability unit IIIe-2; woodland group 23)

Wea soils, 6 to 12 percent slopes, severely eroded (WnC3).—These soils occur on the higher exposed slopes that border morainic areas and outwash plains. Surface runoff is rapid. Most of the original surface soil has eroded away, and the yellowish-brown subsoil is exposed in most places. The surface layer is silty clay loam or clay loam. The depth to carbonates is only 40 to 55 inches. Many pebbles are on the surface. Included in areas mapped as these soils are small areas of strongly sloping soils and of moderately eroded soils.

These soils have severe limitations and are moderate to low in productivity. Erosion is active, the soil is slightly droughty, and slopes are too steep for intensive cropping. Also, these soils are fairly difficult to cultivate because their content of clay is high. In areas planted to row crops, contour tillage, stripcropping, and other practices are needed to control erosion. These soils are best suited to legumes and small grain. (Capability unit IVe-2; woodland group 23)

Westland Series

Soils of the Westland series are dark colored, deep, and very poorly drained. They occur on nearly level, broad, depressional areas of the outwash plains and terraces. These soils developed under swamp forest and marsh grasses.

The surface layer is black, friable silty clay loam 8 inches thick. It is underlain by about 3 to 5 inches of black to dark-gray silty clay loam. The subsoil, about 35 inches thick, is dark-gray to olive silty clay loam in the upper part and gray gravelly clay loam in the lower part. Common, yellowish-brown mottles occur through the subsoil. The underlying material generally is slightly acid or neutral gravelly loam that grades to poorly assorted, stratified, calcareous sand and gravel.

In some areas the underlying material is calcareous stratified fine sand and silt. Sandstone bedrock is at a depth of only 25 to 45 inches in some places.

These soils are high in organic-matter content and have high available moisture capacity. Wetness is the major hazard.

Westland soils are generally underlain by sand and gravel, but Brookston soils are underlain by till.

Westland soils occur with the well-drained Ockley, Fox, Warsaw, and Wea soils and with the somewhat poorly drained Sleeth and Whitaker soils.

Westland silt loam (Wo).—In many places this soil has received silt from adjacent higher soils on uplands and terraces. The soil in these places has less organic matter than normal, and the surface layer is dark grayish brown. Surface runoff is very slow or ponded, and permeability is very slow. Included in areas mapped as this soil are small areas in which the surface layer is coarser than silt loam.

Natural drainage is very poor and is the chief limitation of this soil. Artificial drainage is needed if yields are to be high. (Capability unit IIw-1; woodland group 11)

Westland silty clay loam (Wp).—This is the most extensive Westland soil in the county. It is more fertile than Westland silt loam, and its surface layer is darker and contains more organic matter. Surface runoff is very slow or ponded, and permeability is very slow.

Artificial drainage is needed if yields are to be high. (Capability unit IIw-1; woodland group 11)

Westland silty clay loam, loamy substratum (Wr).—This soil is of considerable extent in Fulton and Millcreek Townships, where it occurs on broad flats and in depressions of the outwash plains. Runoff is very slow or ponded. The subsoil ranges from gray mottled with yellowish brown to black or unmottled gray. It is unmottled black or unmottled gray in depressions. The underlying material is calcareous stratified fine sand and silt.

This nearly level or depressional soil is fairly difficult to cultivate but is high in fertility. If adequately drained, this soil can be cropped intensively to most crops grown in the area. Yields are high. (Capability unit IIw-1; woodland group 11)

Westland silty clay loam, moderately deep (Ws).—This soil occurs in broad areas on terraces. Most of it is in Shawnee and Van Buren Townships. In some places pebbles are in the surface layer. Sand and gravel occur at a depth of 25 to 45 inches. Surface runoff is very slow or ponded. In the lower areas where the water table is high, the subsoil is dominantly gray.

This soil is fertile, and it produces high yields if it is drained. Other than drainage, there are no severe limitations. The cultivation, however, is fairly difficult because the content of clay is high. The soil can be farmed intensively and is used mostly for row crops. (Capability unit IIw-4; woodland group 11)

Westland silty clay loam, thin solum variant (Wt).—This soil occurs mostly in Davis and Logan Townships in small to large areas that are suitable for farming. Bedrock occurs at a depth of only 25 to 45 inches. Surface runoff is very slow or ponded. Included in areas mapped as this soil are more poorly drained areas that have a darker surface layer, are higher in organic-matter content, and have a grayish subsoil free of mottles. Also included are areas underlain by gravel and sand that are more than 45 inches to bedrock.

This soil is medium to high in fertility, but it has severe limitations. Because bedrock is near the surface, drainage is difficult. Few crops can be grown without drainage, but farming can be intensive if this soil is drained. Crops sown in spring are best suited. Those sown in fall are

generally winterkilled because water is excessive. (Capability unit IIw-5; woodland group 11)

Whitaker Series

The Whitaker series consists of moderately dark colored, deep, somewhat poorly drained soils that occur on the nearly level glacial outwash plains along small streams and around outlets of old drainageways. These soils developed under hardwood forest.

The surface layer is grayish-brown, friable loam or silt loam about 8 inches thick. The subsoil is about 30 to 45 inches thick and is light-gray silty clay loam or clay loam in the upper part and sandy clay loam in the lower part. Many, distinct, yellowish-brown mottles occur throughout the subsoil. The underlying material is light-gray to gray, calcareous, stratified sand, silt, and a small amount of gravel.

Some areas of these soils are covered with as much as 30 inches of windblown silty material. In others the amount of gravel in the underlying material is greater than normal, or there are pockets of silt. Depth to the underlying material varies considerably within short distances.

Whitaker soils have high available moisture capacity and low organic-matter content. Occasional additions of lime are needed in cultivated areas.

Whitaker soils are underlain by stratified sand, silt, and a small amount of gravel, but the Sleeth soils are underlain by stratified sand and gravel. In some places Whitaker soils are covered with windblown silt, but Ayrshire soils developed entirely in windblown fine sand and coarse silt.

Whitaker soils occur with the moderately dark colored, well-drained Camden soils.

Whitaker loam (Wu).—This soil occurs on low bench-like terraces that are surrounded by areas of more poorly drained soils on lower terraces and bottom lands. Surface runoff is very slow, and permeability is slow. Included in areas mapped as this soil are small areas of Whitaker soils that have a surface layer finer textured than loam. Also included are small areas of more strongly sloping, moderately eroded soils.

This soil has few limitations other than drainage. If it is artificially drained, it produces high yields. (Capability unit IIw-2; woodland group 5)

Whitaker silt loam (Ww).—This soil has a dark grayish-brown surface layer. The soil is slightly darker colored than Whitaker loam. Surface runoff is very slow, and permeability is slow. A small amount of silty material from adjacent higher lying soils has accumulated in some places. Included in areas mapped as this soil are areas of gently sloping soils and of gently sloping, moderately eroded soils.

This soil has few limitations other than drainage. Artificial drainage is needed if yields are to be high. (Capability unit IIw-2; woodland group 5)

Wingate Series

The Wingate soils are dark colored, deep, and moderately well drained. They occur in the eastern half of the county in nearly level to gently rolling areas of the

uplands that are covered with windblown silt. These soils developed under prairie grasses.

The surface layer is very dark brown to very dark gray silt loam 8 to 10 inches thick, and the subsurface layer is brown to light-brown silt loam about 2 to 4 inches thick. The subsoil is about 35 to 50 inches thick. It is dark-brown to dark yellowish-brown silty clay loam in the upper part and yellowish-brown to pale-brown silty clay loam or clay loam in the lower part. Underlying the subsoil is grayish-brown and yellowish-brown, calcareous loam till.

Wingate soils range from 42 to 70 inches in depth to carbonates. The windblown silt is 18 to 40 inches thick. Mottling is at a greater depth in the gently sloping areas than in the nearly level areas. The light-brown subsurface layer is more distinct in the nearly level areas. The surface layer is lighter colored than normal where Wingate soils grade toward Xenia soils. It is darker colored than normal where Wingate soils grade toward Dana soils.

These soils have high available moisture capacity. Internal drainage is moderate in the upper subsoil and slow in the lower subsoil. The content of organic matter is high, but occasional additions of lime are needed if cropping is intensive.

Wingate soils have a thicker, darker colored surface layer than Xenia soils. They are somewhat lighter colored than Dana soils and have a thinner surface layer and generally a lighter colored subsoil.

The Wingate soils occur with the very poorly drained, dark colored Ragsdale soils and the very poorly drained, very dark colored Romney soils in depressions. They also occur with the well-drained, dark colored Sidell soils in gently sloping or moderately sloping areas.

Wingate silt loam, 0 to 2 percent slopes (WyA).—This nearly level, moderately well drained soil is between lower, somewhat poorly drained soils and gently sloping to moderately rolling, well drained soils. Surface runoff is slow or very slow. Included in areas mapped as this soil are small areas of slightly lighter colored soils that have 0 to 18 inches of loess and gritty material in their subsoil.

This soil has no severe limitations and is high in productivity. Some artificial drainage may be needed in intensively farmed areas, for wet spots occur during periods of heavy rainfall. This soil is suited to all crops grown in the area. (Capability unit I-1; woodland group 23)

Wingate silt loam, 2 to 6 percent slopes (WyB).—This soil is more sloping than Wingate silt loam, 0 to 2 percent slopes, but it is similar to that soil in other respects. It occurs in small patches. Most of the slopes are short, and little erosion has occurred. Surface runoff is slow or medium. Included in areas mapped as this soil are small areas of somewhat poorly drained soils and of moderately eroded soils.

This soil has only slight limitations and is high in productivity. It occurs in areas that are so small that they are generally farmed the same way as surrounding soils. If this soil is farmed as a separate unit, contour tillage or other practices should be used to control erosion. (Capability unit IIe-2; woodland group 23)

Wingate silt loam, 2 to 6 percent slopes, moderately eroded (WyB2).—This soil occurs in gently sloping areas next to areas of well-drained soils. The plow layer is a

mixture of the original surface soil and a small amount of yellowish-brown subsoil. Surface runoff is slow or medium. Included in areas mapped as this soil are areas of Wingate soils that have a surface layer ranging from silt to silty clay loam. Also included are severely eroded areas and well-drained areas.

This soil has moderate to high productivity and has only moderate limitations. If cultivation is intensive, contour tillage, stripcropping, and other practices are needed to control erosion. This soil is suited to all crops grown in the area. (Capability unit IIe-2; woodland group 23)

Xenia Series

Soils of the Xenia series are moderately dark colored, deep, and moderately well drained. They are nearly level or gently sloping and occur on the glacial till plains that have been covered with windblown silt. These soils developed under hardwood forest.

The surface layer is dark yellowish-brown, friable silt loam 7 or 8 inches thick. It is underlain by grayish-brown, friable silt loam 3 or 4 inches thick. Below this layer is the subsoil, which is about 35 to 50 inches thick. The subsoil is yellowish-brown to dark-brown silty clay in the upper part, and gritty clay loam in the lower part. Gray mottles are common and prominent in the lower part of the subsoil. The underlying material is yellowish-brown to brown loam till that is increasingly calcareous with depth.

The thickness of the windblown silt ranges from 18 to 40 inches and varies considerably within short distances. Depth to mottles ranges from 18 to 29 inches, and depth to the underlying calcareous till ranges from 42 to 70 inches.

Xenia soils have good available moisture capacity and are low in organic-matter content. Liming is needed occasionally in cultivated areas. Erosion is the major hazard.

The layer of windblown silt in the Xenia soils is thicker than that in the Celina soils, where it is 0 to 18 inches thick. Xenia soils developed in silt-capped glacial till, but the Birkbeck soils developed entirely in windblown silt. The organic-matter content of the Xenia soils is less than that of the Dana and Wingate soils.

Xenia soils occur with the moderately dark colored, well-drained Russell soils; the moderately dark colored, somewhat poorly drained Fincastle soils; the light-colored, poorly drained Delmar soils; and the dark colored, very poorly drained Brookston soils.

Xenia silt loam, 0 to 2 percent slopes (XnA).—This soil occurs along ridges and on the tops of more sloping, better drained areas. It also occurs at the fringe of more poorly drained areas and at the head of shallow depressions within these areas. Surface runoff is very slow, and permeability is moderate.

This nearly level soil is productive. Its only limitation is fairly slow drainage in the lower subsoil. (Capability unit I-1; woodland group 1)

Xenia silt loam, 2 to 6 percent slopes, moderately eroded (XnB2).—This soil occurs at the head of shallow drainageways and at the fringe of areas of more poorly drained soils. The surface layer of this soil is a mixture

of the original surface soil and a moderate amount of subsoil. In plowed fields a few small rills occur, and in a few areas the yellowish-brown subsoil is exposed. Some small areas are only slightly eroded. Surface runoff is slow, and permeability is moderate. Included in areas mapped as this soil are areas of better drained soils.

Contour tillage and other practices are needed to control erosion in intensively cultivated areas. (Capability unit IIe-1; woodland group 1)

Formation and Classification of Soils

This section was written for soil scientists and others interested in the nature and origin of the soils in Fountain County. The section consists of five main parts. The first part discusses the factors of soil formation and how they affect the formation of soils in Fountain County. The second part discusses some of the processes of soil formation that go on while soils, including their horizons, are forming. In the third part the classification of soils is discussed, and the soil series in the county are placed in their great soil groups. The great soil groups in the county are described in the fourth part, and the soil series in the fifth. For each soil series there is a description of a profile representative of that series.

Factors of Soil Formation

Soil is a function of living organisms, parent material, time, climate, and topography. The nature of the soil at any given point on the earth depends on a combination of the effects that these five major factors have had in the development of the soil at that point. All five factors affect the formation of every soil. The relative importance of each factor differs from place to place; in some places one is more important than the others.

In a few places one factor may dominate the formation of the soil and fix most of its properties, as is common in areas where the parent material consists chiefly of pure quartz sand. Little can happen to quartz sand, and the soils derived from it generally have only faint horizons. Even in quartz sand, however, distinct profiles can be formed under certain kinds of vegetation, if climate is favorable, the relief is low and flat, and the water table is high. Thus, for every soil the past interaction of the five major factors is of first importance in determining its present character.

Living organisms

Before the white man settled in Fountain County, the native vegetation was important in the complex of living organisms that affected soil development. Higher plants, micro-organisms, earthworms, and other forms of life that live in and on the soil contribute to soil morphology. Bacteria and fungi cause raw plant waste to decompose into organic matter and to be incorporated into the soil. The higher plants return organic matter to the soil and bring up moisture and plant nutrients from the lower part of the soil to the upper part.

The native vegetation of Fountain County can be placed in three main groups, each of which played an important role in forming different kinds of soil. Prairie grasses covered the northern third of the county, and

trees covered the southern two-thirds. Water-tolerant grasses, sedges, and reeds were in large, scattered, level or depression areas that were covered by water much of the time.

Only a small amount of organic matter is in soils of forests that have never been cleared. These soils are covered with a thin layer of forest litter and leaf mold that comes from fallen leaves and twigs. This thin layer supplies organic matter that is mixed throughout the top 1 or 2 inches of surface soil.

Prairie grasses, on the other hand, add a large amount of organic matter that comes from the leafy material and from the large system of fine, fibrous roots. Because much of the year is cold, microbial activity is arrested, the organic matter does not decompose excessively, and much of it accumulates in the mineral soils. Consequently, prairie soils in the northern third of the county have a dark surface layer that is high in organic-matter content.

Micro-organisms need a certain amount of oxygen to decompose organic matter. They cannot get the oxygen they need if the soil is waterlogged. Although less vegetative matter accumulates each year in swampy areas than in prairie areas, less is decomposed and a large amount of the organic matter remains. Hence, the organic-matter content is high in soils that are covered by water most of the year.

The different kinds and amounts of vegetation in the different parts of the county have had much to do in determining the kinds of soils that developed.

Parent material and geology

The soils of Fountain County developed in parent material that derived from (1) glacial drift, outwash, and till of Wisconsin age; (2) loess, or windblown silt and sand; and (3) residuum of sandstone and shale.

The county is covered by a mantle of glacial drift that ranges from less than 5 feet in thickness on rock terraces along the valley of the Wabash River to more than 200 feet in some of the preglacial valleys. The glacial drift consists of silty and clayey calcareous material and a mixture of boulders, cobblestones, gravel, and sand in varying proportions.

The Bloomington and Champaign morainic systems are partly in this county. Part of the outer border of the Bloomington system lies just north of State Route 55 on the eastern side of the county and extends westward to a point just south of the Portland Arch. One arm of the Champaign morainic system roughly parallels the Wabash River from just south of the hamlet of Silver Wood to several miles north of State Route 32 and then angles northwestward between Covington and Veedersburg. Another arm enters the east side of the county north of U.S. Highway No. 136 and angles southwestward until it ends east of the town of Coal Creek. The moraines in these systems consist mainly of calcareous loam till, but in the northern part of the county, the Bloomington system has areas of stratified sand and gravel. These areas vary in size.

The only major glacial sluiceway in the county starts about 2 miles southeast of Covington. It is approximately one-fourth mile wide and 6 miles long. An underfit stream, Graham Creek, is in this valley and empties

into Coal Creek at a point $2\frac{1}{2}$ miles east of the hamlet of Coal Creek. The sluiceway is believed to have originated from an overflow of glacial melt water from the Wabash Valley just south of Covington.

The terrace material along the Wabash River was brought in by glacial melt water. As the glacial ice receded, it released a tremendous volume of water. This torrent carried an enormous amount of material that ranged in size from large boulders to very fine sand, silt, and clay. When the water lost its velocity, the material was deposited in very thick stratified beds along the stream channel.

Several outwash plains occur in the county. The largest lies generally between State Route 28 and U.S. Highway No. 136 on the east and tapers to its outlet between Attica and Fountain on the west. This plain is interrupted only by two moraines that extend into it. The glacial melt water that formed this plain spilled over into the glacial Wabash River in several places. A broad shallow outlet occurred between the hamlets of Aylesworth and Portland Arch on the south and Attica on the north, a distance of 6 miles. As the level of melt water lowered, this outlet became clogged with its own sediments, and the remaining water flowed through the Shawnee and upper Coal Creek drainage system, as it does today.

Fountain County is completely covered by a loess mantle that ranges from a few inches to more than 6 feet in thickness and is underlain by landforms that existed when the loess was deposited. Deposits of as much as 7 feet thick have been found in small areas. In about half of the county the loess mantle is 18 to 42 inches thick. The loess is believed to have been blown from the valleys of the Missouri, Mississippi, and Wabash Rivers. Silt grains range from $\frac{1}{16}$ to $\frac{1}{256}$ millimeter in diameter. The larger and heavier grains were deposited closest to their source, and the finer grains were blown a greater distance.

In two general areas in the county, the silt is at least $3\frac{1}{2}$ feet thick over glacial drift. The smallest area is northeast of Covington, approximately in a locality called Scotts Prairie. The other covers an extensive area around the town of Kingman and in the southwestern corner of the county.

The county is underlain by bedrock of different kinds and age. Outcrops of sandstone and shale are along most of the valleys of permanently flowing streams. Pennsylvanian bedrock of the Pottsville and Allegheny formations is exposed in the western four-fifths of the county. This bedrock is primarily sandstone, but there is some shale and coal. Mississippian bedrock of the Osage and Kinderhook groups is near the eastern border of the county. It is exposed along the valley of the Wabash River from Portland Arch to the northeastern corner of the county, as well as along the valleys of small streams near the eastern border.

Time

In Fountain County the most fully developed soil profiles generally occur in places where the parent material has remained in place longest.

Because of the differences in parent material, in relief, and in climate, some soils mature more slowly than

others. For example, Alluvial soils are immature because the parent material is young and new material is deposited periodically. Soils on steep slopes are likely to be immature because geologic erosion removes the soil material as fast as it accumulates. Also, because runoff is great on steep slopes, less water infiltrates down through the soil. Some kinds of parent rock are so resistant to weathering that soil development is very slow, even though other conditions are favorable for development. A mature soil is one that has well-developed A and B horizons that were produced by the natural processes of soil formation. An immature soil has little or no horizon differentiation.

In Fountain County the geologically oldest soils that developed from the residual sandstone are along the steep breakovers adjacent to the Wabash River. But these soils are not so deep nor so mature as those developed in Wisconsin till and drift. Natural geologic erosion is rapid on these steep soils, and the material has not been allowed to accumulate and mature.

The soils derived from glacial till and drift of Wisconsin age have well-developed profiles and are mature or nearly so.

The thick loess in this county was laid down shortly after the glacial material. These soils developed in this loess at the same time soils developed in glacial material, or shortly thereafter.

The youngest soils in the county are on bottom lands where new material is deposited periodically.

Climate

Fountain County has hot summers and humid, cold winters. Its climate is continental (6). Rainfall is moderately heavy and averages 38.6 inches annually. It is well distributed throughout the year but is slightly greater in spring than in other seasons. The driest month in summer has more than 1.9 inches of rain.

The climate throughout the county is so uniform that differences among the soils are not the result of differences in climate.

Rain, wind, heat and cold, freezing and thawing, and other climatic forces act on rocks and help change them into the parent material from which the soils formed. The climate also greatly influences the activity of living organisms that, in turn, influences the development of many important characteristics. Without the changes brought about by plants and animals, most soils would consist merely of residual and transported material derived from weathered rocks. Some soils, however, might have definite layers formed by different degrees of weathering and leaching.

Climate acting alone on the parent materials would be largely destructive, for it would cause the soluble materials to be washed out of the soils. But the processes of climate are constructive when they are combined with the activities of plants and animals. A reversible cycle is established between intake and outgo of plant nutrients. Plants draw nutrients from the lower part of the soil profile; then when the plants die, the surface soil is renewed in varying degrees by the plant nutrients that are returned to the upper part of the soil. In Fountain County the leaching of nutrients is greater than replace-

ment, and free calcium carbonates are kept from accumulating in all soils. This accounts for most soils being leached and slightly acid.

For more complete information on the climate of Fountain County see the section "Climate of the County."

Topography

The topography of Fountain County ranges from nearly level on bottom lands, terraces, and upland flats to very steep on breaks. Except in the immediate area of the major streams, mainly in the western part of the county, most of the county has not been severely dissected by weathering and stream cutting. The lowest point in the county, where the Wabash River leaves the county in the southwest corner, is 490 feet above sea level, and the highest point is 780 feet.

The county gradually slopes southwestward, and its streams flow westward and southward. All of the county is within the drainage basin of the Wabash River. Most of the county drains into the river through two main tributaries and their branches. In the north Shawnee Creek flows westward and empties into the river 3 miles south of Attica. Coal Creek, which drains a much larger area than Shawnee Creek, heads in the east-central part of the county and flows southwestward. It empties into the river just south of the county line.

Several other creeks that have small watersheds empty into the Wabash River at various places. Bear Creek, the most scenic, flows through the Portland Arch area and empties into the river just west of the hamlet of Fountain.

Relief has affected drainage and the development of the soils in the county. Relief influences soil formation by greatly affecting drainage, including runoff, and normal or accelerated erosion. In Fountain County differences in relief have much to do with the content of moisture and of air in the soils. Less strongly developed soil profiles formed on steep slopes than on more nearly level ones in areas where the parent material and climate of the two areas are the same. This greater degree of development of the strong slopes is due to (1) rapid normal erosion, (2) increased percolation of water through the soil, and (3) lack of enough water for vigorous plant growth. The amount of water passing through a soil largely determines the degree to which a profile develops in a given time, from a given parent material, and under a given kind of vegetation.

Figure 13 shows some of the major soil series in the county in relation to their topography and underlying material.

The soils in the Russell-Fincastle-Delmar-Xenia catena are good examples for showing the effects of different relief on soil profiles of different kinds that developed in the same kind of parent material. The Fincastle and Delmar soils formed in level and nearly level areas and are somewhat poorly drained, gray, mottled, and very slowly permeable. The Xenia soils formed on gentle slopes and are moderately well drained, yellowish brown, mottled in the subsoil, and moderately slowly permeable. Russell soils formed on moderate to strong slopes and are well drained, brown to dark brown, and moderately permeable.

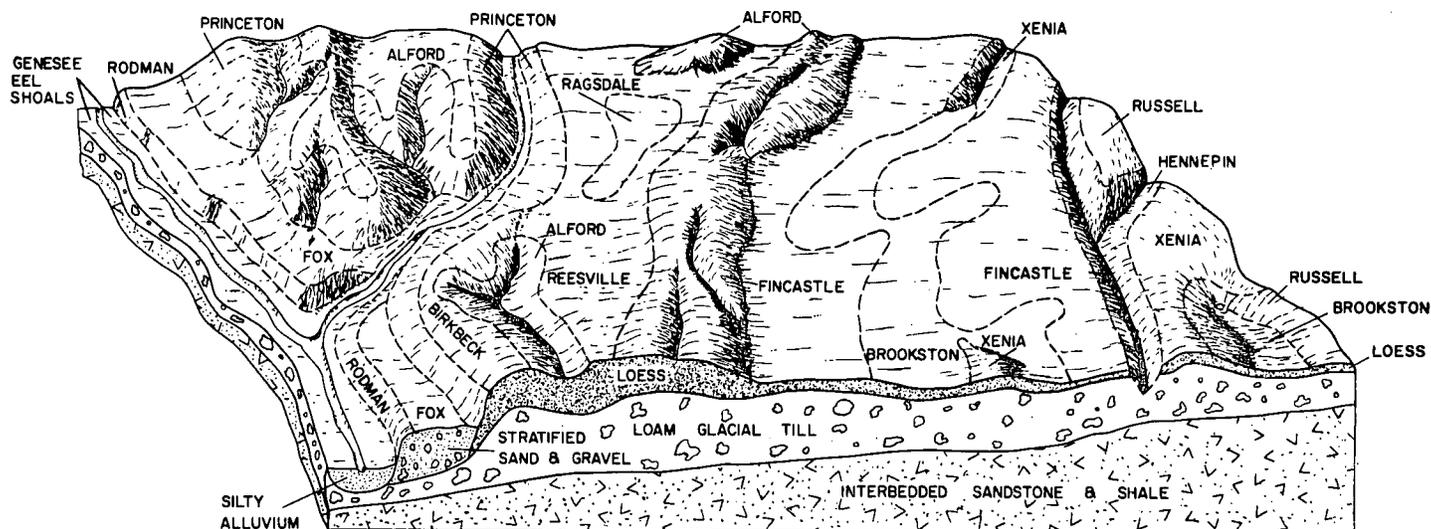


Figure 13.—Major soil series in the county in relation to their topography and underlying material.

Processes of Soil Formation

In Fountain County soil morphology is expressed in strong, distinct horizons, except in Alluvial soils, Regosols, Lithosols, and Brown Forest soils.

The formation of different horizons in the soils is the result mainly of (1) the accumulation of organic matter; (2) the leaching of carbonates and salts more soluble than calcium carbonates; (3) the translocation of the silicate clay minerals and probably of some silt-sized particles from one horizon to another; and (4) the reduction and transfer of iron. In all the soils in the county, these processes have taken place, or are beginning to take place, but the degree of activity or strength of each process varies from soil to soil.

Organic matter has accumulated in the top layer of all soils in the county, and an A1 horizon has formed. In some places the A1 horizon has lost its identity as a result of plowing and cultivation, and in severely eroded areas it has washed away. Much of the organic matter is in the form of humus. Little humus is in the Chelsea soils, but there are large amounts in the Tippecanoe and Sidell soils, and very large amounts in Tawas muck.

Carbonates and salts have been leached in most all soils of the county, though this leaching has been of little importance in horizon differentiation. The effects of the leaching have been indirect. In most of the soils leaching permitted translocation of silicate minerals, and in most well-drained soils carbonates and salts have been carried completely out of the profile. Even in most of the wettest soils, some leaching is indicated by the absence of carbonates and by the acid reaction. The very wet Tawas soils are the only soils in the county that are calcareous in the surface layer. Leaching of the wet soils is slow because water moves slowly through the profile. Leaching has also been slight in some areas near the channel of the Wabash River and its tributaries where sediments are most recent and are generally calcareous.

The translocation of silicate clay minerals has had a strong influence on the development of horizons in most

of the soils of the county. Some clay has been removed from the A1 and A2 horizons and has become immobilized, or nearly so, in the B horizon. This is true of all soils that have a textural B horizon. Other than the Alluvial soils, only a few soils in Fountain County do not have a noticeable textural B horizon.

Reduction and transfer of iron has taken place in all of the very poorly drained, poorly drained, and somewhat poorly drained soils. Brookston, Delmar, and Fincastle soils are examples. This reduction and transfer has also occurred to some extent in deeper horizons of Celina, Xenia, and other moderately well drained soils. In large areas of naturally wet soils, the reduction and transfer of iron, a process called gleying, has been important in horizon differentiation.

In the wet soils the gray colors of the deeper horizons indicate the reduction of iron oxides. This reduction is commonly accompanied by some transfer of the iron, which may be local or general. After iron has been reduced, it may be removed completely from a horizon, or it may even be removed from the soil profile. In the soils of Fountain County, however, the iron generally moves a short distance and stops either in the horizon of its origin or in a horizon nearby. In the deeper horizons of many of the soils, iron is segregated in the form of yellowish-red, yellowish-brown, or brown mottles, or in the form of concretions.

In the formation of silicate clays, some iron is usually freed as a hydrated oxide. These oxides are reddish; the strength of the red depends on the degree of hydration. A small amount of these oxides is sufficient to color a soil, particularly if silicate clay minerals are not abundant and if the parent material is fairly coarse textured. Under these conditions, a strongly colored subsoil, or a color B horizon, forms, even if there has not been enough accumulation of clay minerals to form a textural B horizon. The Chelsea soils have a color B horizon but only a weak textural B horizon. In most well-developed, oxidized soils, however, the subsoil is a strongly colored, textural B horizon.

Classification of Soils

Soils may be classified in several ways to bring out their relationship to one another. The classes commonly used in the field are the series, type, and phase. The soil type is the basic classification unit. It consists of soils having layers that are similar in kind, thickness, and arrangement in the profile.

A soil type may be subdivided into several phases according to variations in slopes, degree of erosion, topographic position, kind of substratum material, or other characteristics that affect management. The soil phase, or the soil type, if it has not been subdivided, is the unit shown on the soil map.

Soil types are grouped into soil series. The soil series consists of one or more soil types that differ in surface texture but that are otherwise similar in kind, thickness, and arrangement of soil layers. Each series is named for the place near where it was first mapped. For example, the Tippecanoe series is named for Tippecanoe County, Indiana.

In this report, most of the names of the soils consist of the series name and words that indicate the type and phase. Consider, for example, Russell silt loam, 2 to 6 percent slopes, moderately eroded. Russell is the series name; silt loam indicates the type; and 2 to 6 percent slopes, moderately eroded, designates the phase. A few soil names consist only of the series and type because the variations in slope or erosion are not significant. Genesee silt loam is an example.

Soil series are grouped in great soil groups (?). The soils of a great soil group have similar major characteristics. Their horizons are similar and are arranged in the same sequence, though the soils may differ in thickness of profile, development of the different horizons (9), and other features.

The soil series in Fountain County are listed in their great soil groups as follows:

Great soil group	<i>Series</i>
Gray-Brown Podzolic soils	Alford, Birkbeck, Camden, Celina, Fox, High Gap, Miami, Ockley, Princeton, Russell, Xenia.
Intergrading toward Low-Humic Gley soils	Ayrshire, Crosby, Fincastle, Reesville, Shadeland, Sleeth, Whitaker.
Intergrading toward Brunizems	Sunbury, Wingate.
Intergrading toward Regosols	Chelsea.
Brunizems	Dana, Elston, Parr, Sidell, Tippecanoe, Warsaw, Wea.
Intergrading toward Humic Gley soils	Crane, Raub.
Humic Gley soils	Brookston, Ragsdale, Romney, Sloan, Westland.
Low-Humic Gley soils (intergrading toward Planosols)	Delmar.

Great Soil Group	<i>Series</i>
Alluvial soils	Eel, Genesee, Huntsville, Landes, Shoals, Walkill, Washtenaw.
Regosols (intergrading toward Gray-Brown Podzolic soils)	Hennepin.
Brown Forest soils (intergrading toward Gray-Brown Podzolic soils)	Rodman.
Sols Bruns Acides	Muskingum.
Bog soils	Tawas.

Great Soil Groups in the County

This subsection describes the great soil groups in the county. These groups are Gray-Brown Podzolic soils, Brunizems, Humic Gley soils, Low-Humic Gley soils, Alluvial soils, Regosols, Brown Forest soils, Sols Bruns Acides, and Bog soils.

Gray-Brown Podzolic soils

Gray-Brown Podzolic soils formed under deciduous trees in a temperate, humid continental climate. In virgin areas these soils have a fairly thin organic AO horizon that is underlain by an organic-mineral A1 horizon 1 to 3 inches thick. The A2 horizon is light colored (grayish brown) and leached. It is underlain by an alluvial, brown B horizon that is finer textured than the A and C horizons in most places. Some of the clay that accumulated in the B horizon probably came down from the A horizon, and some developed in place. The thin AO horizon is high in content of organic matter and of soluble bases, especially calcium, because it contains decaying leaves and other organic materials. It is less acid than either the A1 or the A2 horizon.

The A2 horizon is lighter colored, coarser textured, higher in silica, and lower in sesquioxides than the B horizon. The A2 horizon has been leached of soluble bases and is acid.

The base saturation of the B horizon of these soils is 50 to 70 percent, and the ratio of calcium to magnesium is 2 to 1 or higher. Soils in this group developed in loess, outwash, and till of Wisconsin age.

The thickness of the A and B horizons varies, but together these horizons are more than 4 feet thick in only a few places. The C horizon contains less clay and less colloidal material than the B horizon.

Soils of the Miami, Russell, Alford, and Ockley series are some of the well-drained soils in this group. These soils have well-defined textural and color horizons. They range from nearly level to steep and developed from various kinds of parent material.

The Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils are the somewhat poorly drained Ayrshire, Crosby, Fincastle, Reesville, Shadeland, Sleeth, and Whitaker soils. Because these soils are somewhat gleyed, they are considered intergrades toward the Low-Humic Gleys.

The well-drained Chelsea soils are Gray-Brown Podzolic soils that intergrade toward Regosols. The thick horizon of sand between the argillaceous banded horizons have developed few clearly expressed soil characteristics,

and Chelsea soils, therefore, have some characteristics of Regosols.

The Gray-Brown Podzolic soils that intergrade toward Brunizems are the moderately well drained Wingate and the somewhat poorly drained Sunbury soils. Although the chief characteristics of the Wingate and Sunbury soils cause them to be classified as Gray-Brown Podzolic soils, they have dark-colored surface layers and are considered intergrades toward the Brunizem great soil group.

Brunizems

Brunizems have formed in a humid, temperate climate under grasses on the prairie. They have a dark, thick A1 horizon that is high in content of organic matter and nitrogen. An A2 horizon has not formed. The B horizon is lighter colored than the A1 but is higher in content of clay and has stronger, more distinct structure.

The Brunizems in this county include the well drained Parr and Sidell soils, the moderately well drained Dana and Tippecanoe soils, and the well drained to excessively drained Elston, Warsaw, and Wea soils.

The somewhat poorly drained Raub and Crane soils have gray mottles in the subsoil—a characteristic of Humic Gley soils—and therefore are Brunizems that intergrade toward Humic Gleys.

Humic Gley soils

Humic Gley soils are very poorly drained and have a dark-colored, moderately thick surface layer that consists of mixed organic and mineral materials. The surface layer is underlain by mineral layers that show the effects of poor aeration. Humic Gley soils developed under swamp or marsh vegetation.

The development of these soils is dominated by gleization. The undisturbed soils have been covered with water for long periods. They developed in nearly level to depressional relief under very slow internal and external drainage. Runoff and seepage water from nearby higher soils collect on these soils. This additional water carries colloidal materials and fine sediments, most of which are high in content of organic matter and bases. Because oxygen is lacking in these wet soils, the decay of organic matter is slowed and much of the organic matter is retained in surface layers. These conditions also reduce the iron compounds to soluble (ferrous) forms. Mottled yellowish and grayish colors are common, if they are not masked by dark organic matter.

The Humic Gley soils in Fountain County include the Brookston, Romney, and Ragsdale soils of the uplands, the Westland soils of outwash and terrace areas, and Sloan soils of the bottom lands.

Low-Humic Gley soils

Low-Humic Gley soils are very poorly drained and developed under forest in areas that are saturated most of the year. These soils are light colored, have a thin surface horizon, are moderately high in organic-matter content and are underlain by mottled gray and yellowish-brown, gleyed mineral horizons that have little textural differentiation.

Delmar soils are the only Low-Humic Gley soils in Fountain County, and they intergrade toward Planosols.

Alluvial soils

Alluvial soils developed in alluvial material that was recently deposited. These soils have little or no profile development, are immature, and receive fresh sediments during each flood.

In Fountain County the Alluvial soils belong to the Genesee, Eel, Shoals, Huntsville, Landes, Washtenaw, and Wallkill series. Genesee, Eel, and Shoals soils derived largely from alluvium that washed from forested areas of Wisconsin glacial drift. Huntsville soils derived from alluvium that washed from prairie areas of Wisconsin glacial drift. Washtenaw soils developed in recent alluvium or colluvium that was deposited on older, darker colored Humic Gley soils. Wallkill soils consist of alluvium that was recently washed in and deposited on partly decomposed organic material.

Regosols

The Regosols in Fountain County occur on relatively steep slopes where geologic erosion keeps pace with soil development. In these soils the horizon development beneath the surface layer enriched with organic matter is not definite, and the underlying material consists of deep calcareous loam till.

Hennepin soils are the only Regosols in the county. Since they have weakly expressed characteristics of the Gray-Brown Podzolic soils, they are intergrades to that great soil group.

Brown Forest soils

Brown Forest soils generally developed under deciduous trees and have a dark-brown surface horizon that is relatively rich in humus. It is underlain by lighter colored material that grades to the parent material.

Rodman soils are the only Brown Forest soils in Fountain County, and they intergrade toward Gray-Brown Podzolic soils. Rodman soils are on steep slopes of terraces and are relatively shallow. The underlying material consists of calcareous gravel and sand.

Sols Bruns Acides

Sols Bruns Acides have no clearly expressed soil morphology. These soils consist of a slightly weathered mass of soil particles. They are largely in hilly or steep areas and in areas that are very shallow over acid bedrock. Their profiles are very weakly developed, for geologic erosion almost keeps pace with the weathering of the rock.

Because some soils on uplands in Fountain County have steep slopes, much of the soil material that developed has been removed by geologic erosion. Also, much of the rainfall has run off instead of infiltrating and then percolating downward through the soil profile. The normal effects of climate and vegetation have been modified or overcome by the influence of relief. These soils, therefore, do not have developed profiles. They have few of the characteristics of normal soils, but they have reached the stage where soil-forming processes are in equilibrium with natural erosion.

In Fountain County the Muskingum soils are Sols Bruns Acides that intergrade toward Lithosols. Muskingum soils formed in residuum from acid sandstone and shale. Their A horizon is silty or loamy, and a B horizon has not developed or is only weakly developed. The depth to bedrock ranges from 5 to 22 inches.

Bog soils

Bog soils developed in flat areas that are covered most of the time with shallow water. Swamp vegetation grows in these areas. As the leaves and stems fall into the water, they settle on the bottom, where they remain submerged most of the year. Organic matter builds up because oxidation and decomposition are slower than the accumulation of vegetative matter.

Tawas muck is the only Bog soil in Fountain County. It consists of 12 to 40 inches of muck over sand and silt.

Descriptions of the Soil Series

This subsection describes each soil series in the county and the profile of a soil representative of the series. The colors given in the profile descriptions are those of a moist soil. The section "Descriptions of the Soils" also describes the soil series, but in language that is probably easier for the layman to understand. Also in that section is a description of each mapping unit, including the land types in the county. These mapping units are shown on the large soil map.

Alford series

The Alford series consists of well-drained Gray-Brown Podzolic soils developed in loess that is generally more than 5 feet thick. These soils developed under deciduous forest in nearly level to sloping areas.

The Alford soils are the well-drained members of the catena that includes the dark-colored, very poorly drained Ragsdale soils. Surface runoff is medium on the nearly level slopes of Alford soils and is rapid on the steeper ones. Permeability is moderate.

Alford soils developed in finer silt than the Princeton soils and have a thicker solum and more clay in the B horizon. The lower subsoil of Alford soils developed in loess, in contrast to Ockley soils, which developed in gravelly and sandy outwash and to Russell soils, which developed in loam till.

Profile of Alford silt loam in a wooded area (SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 14, T. 18 N., R. 9 W.):

- O2—1 inch to 0, partly decomposed litter from deciduous trees.
 A1—0 to 5 inches, very dark brown (10YR 2/2) silt loam; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.
 A2—5 to 11 inches, dark-brown (10YR 4/3) to dark yellowish-brown (10YR 4/4) silt loam; weak, medium, granular structure; friable; medium acid; clear, smooth boundary.
 B1—11 to 16 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, smooth boundary.
 B2t—16 to 29 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium and coarse, subangular blocky structure; firm; light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 3/4) clay films on ped faces; very strongly acid; abrupt, smooth boundary.

B3—29 to 52 inches, dark yellowish-brown (10YR 4/4 to 3/4) heavy silt loam; moderate, medium and coarse, subangular blocky structure; firm; light brownish-gray (10YR 6/2) and dark yellowish-brown (10YR 3/4) clay films on ped faces; strongly acid; abrupt, smooth boundary.

C1—52 to 64 inches, dark yellowish-brown (10YR 4/4) loam; massive; firm; medium acid or slightly acid in upper part and neutral in lower; abrupt, smooth boundary.

IIC2—64 inches +, loam to clay loam till; calcareous.

The loess ranges from 3 to 7 feet in thickness but is generally 40 to 60 inches thick in this county. In areas where Alford soils grade toward Russell soils, the loess is 36 to 40 inches thick. The depth to which the soil is leached varies, but in most places leaching is to the underlying till. Where Alford soils grade toward the Princeton soils, a few inches of sand is above the till in some places. Silt loam is the only type mapped in this county.

Ayrshire series

The Ayrshire series consists of somewhat poorly drained Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Ayrshire soils developed in thick deposits of windblown coarse silt and fine sand. These soils are nearly level or slightly depressional. They developed under deciduous forest.

The Ayrshire soils are the somewhat poorly drained members of the catena that includes the well-drained Princeton soils and the dark-colored, very poorly drained Ragsdale soils.

The surface layer and subsoil of Ayrshire soils are coarser textured than those of the Reesville soils. Ayrshire soils developed in fine sand and coarse silt rather than in silt-capped loam till, as did the Fincastle soils.

Profile of Ayrshire loam in a clover field (SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 25, T. 20 N., R. 9 W.):

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; abundant roots; slightly acid; abrupt, smooth boundary.
 A21—8 to 10 inches, grayish-brown (10YR 5/2) loam; weak, fine, granular structure; friable; abundant roots; slightly acid; abrupt, smooth boundary.
 A22—10 to 18 inches, light brownish-gray (10YR 6/2) to grayish-brown (10YR 5/2) light loam; many, medium, distinct, yellowish-brown (10YR 5/8) and dark yellowish-brown (10YR 3/4) mottles; weak, medium and thick, platy structure; friable when moist, weakly cemented and fragile when dry; few fine roots; few, black, soft manganese and iron concretions; medium acid; clear, smooth boundary.
 B1—18 to 24 inches, light brownish-gray (10YR 6/2) light loam; many, medium, distinct, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable when moist, weakly cemented and fragile when dry; few fine roots; few, black, soft manganese and iron concretions; medium acid; clear, wavy boundary.
 B21t—24 to 31 inches, grayish-brown (10YR 5/2) light sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) and dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure; friable; very few fine roots; few, black, soft concretions; few $\frac{1}{2}$ -inch vertical tubules of sandy loam; medium acid; clear, smooth boundary.
 B22t—31 to 44 inches, dark-gray (10YR 4/1) to gray (10YR 5/1) clay loam; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; firm; very few roots; few $\frac{1}{2}$ -inch vertical tubules of sandy loam; slightly acid; clear, wavy boundary.
 C—44 to 56 inches +, yellowish-brown (10YR 5/8) fine sandy loam and coarse silt; massive; very friable; neutral.

The windblown deposits range from 5 to 10 feet in thickness. Calcareous material is at a depth of 40 to 70 inches or more. The upper part of the A horizon is darker colored in wooded areas than it is in plowed areas. The A horizon ranges from 10 to 18 inches in thickness.

Birkbeck series

The Birkbeck series consists of Gray-Brown Podzolic soils developed in 3 to 6 feet of loess that is underlain by calcareous loam till of Wisconsin age. Birkbeck soils developed under oak, hickory, elm, and other deciduous hardwoods in nearly level and gently sloping areas of the upland till plains.

The Birkbeck soils are the moderately well drained members of the catena that includes the somewhat poorly drained Reesville soils and the very poorly drained, dark-colored Ragsdale soils. Surface runoff of Birkbeck soils is slow or medium, and permeability is moderate in the upper part of the solum and moderately slow in the lower. The surface soil is low in organic-matter content.

Birkbeck soils developed entirely in windblown silt, but the lower subsoil of the Xenia soils developed in loam till.

Profile of Birkbeck silt loam (NW. corner of NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 17, T. 19 N., R. 6 W.):

- A1—0 to 3 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
- A2—3 to 11 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine and medium, granular structure; friable; neutral; clear, smooth boundary.
- B1t—11 to 18 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.
- B21t—18 to 31 inches, yellowish-brown (10YR 5/4) to light yellowish-brown (10YR 6/4) silty clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, fine and medium, angular and subangular blocky structure; firm; strongly acid; clear, wavy boundary.
- B22t—31 to 40 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, very coarse, subangular blocky structure; firm; strongly acid; clear, wavy boundary.
- B3—40 to 60 inches, light yellowish-brown (10YR 6/4) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure to massive; friable when moist, slightly sticky when wet; medium acid; gradual, wavy boundary.
- C—60 to 68 inches +, grayish-brown (10YR 5/2) silt; massive; friable; neutral in upper part and calcareous in lower.

In most places the loess ranges from 3 to 6 feet in thickness, but it is less than 3 feet thick in a few sloping areas. The solum, however, developed entirely in silt. Mottling occurs at a depth of 18 to 36 inches. Calcareous loam till is below the silt at a depth of 60 inches or more. In cultivated areas the plow layer is grayish brown (10YR 5/2) to light yellowish brown (10YR 6/4).

Brookston series

The Brookston series consists of Humic Gley soils that developed in silty material that is as much as 42 inches thick and is underlain by highly calcareous loam and silt loam till of Wisconsin age. These soils developed

under hardwoods and water-tolerant shrubs in depressions and on broad flats of the till plains.

The Brookston soils are the very poorly drained members of the catena that includes the well drained Miami and Russell soils, the moderately well drained Celina and Xenia soils, the somewhat poorly drained Crosby and Fincastle soils, and the poorly drained, light-colored Delmar soils. Surface runoff of the Brookston soils is very slow or ponded, and permeability is slow. The content of organic matter is high.

Profile of Brookston silty clay loam (NW. corner of NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 19 N., R. 8 W.):

- Ap—0 to 7 inches, black (10YR 2/1) silty clay loam; weak, fine, granular structure; cloddy when dry, friable or firm; neutral; abrupt, smooth boundary.
- A12—7 to 11 inches, very dark gray (10YR 3/1) silty clay loam; medium and coarse, subangular blocky structure; firm; neutral; clear, smooth boundary.
- B21g—11 to 27 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; thin coatings of very dark gray (10YR 3/1) on ped faces; root channels filled with a very dark gray (10YR 3/1) material; moderate, medium and coarse, prismatic structure breaking to moderate, coarse, angular blocky with some subangular blocky structure; very firm; neutral; clear, wavy boundary.
- B22g—27 to 36 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; dark-gray (10YR 4/1) organic coatings on ped surfaces; root channels filled with dark-gray (10YR 4/1) material; moderate, medium and coarse, subangular blocky structure; firm; neutral; clear, smooth boundary.
- IIB3g—36 to 52 inches, gray (N 5/0) loam; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; friable; neutral; abrupt, wavy boundary.
- IICg—52 inches +, gray (N 5/0) and strong-brown (7.5YR 5/6) loam till; massive; friable; calcareous.

The A horizon ranges from 8 to 15 inches in thickness. Brookston soils are more silty in areas near Russell soils than in areas near Miami soils. Some of the silty material is local alluvium washed from higher surrounding soils. The B horizon is dominantly gray and has many mottles. Depth to the IICg horizon ranges from 42 to 70 inches or more. A few inches of water-sorted sand and gravelly material commonly occur just above the calcareous till.

Camden series

The Camden series consists of Gray-Brown Podzolic soils that developed in moderately calcareous stratified sand and silt, and some gravel and clay, of Wisconsin age. These soils developed under hickory, oak, walnut, and other deciduous hardwoods on gentle slopes of the flood plains and terraces along small streams.

Camden soils are the well-drained members of the catena that includes the somewhat poorly drained Whitaker soils. Surface runoff is slow or medium, and permeability is medium. The content of organic matter is low.

Camden soils are underlain by sand, silt, and some gravel and clay, but the Ockley soils are underlain by only sand and gravel. Camden soils have a thicker solum than Fox soils and are leached to a greater depth. They are leached to a depth of 42 to 70 inches or more, but Fox soils are leached only to 24 to 42 inches. Also, Camden soils lack the coarse gravel and sand that occur in the Fox soils.

Profile of Camden loam in a cultivated field (NW¼ SW¼ sec. 11, T. 18 N., R. 8 W.):

- Ap—0 to 7 inches, brown (10YR 5/3) loam; weak, fine and medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A2—7 to 9 inches, dark-brown (10YR 4/3) loam; weak, medium, granular structure; friable; slightly acid or medium acid; clear, smooth boundary.
- B1—9 to 13 inches, dark-brown (7.5YR 4/4) sandy clay loam; weak, fine and medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- B21t—13 to 24 inches, dark-brown (7.5YR 4/4) clay loam; moderate, fine and medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- B22t—24 to 30 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium and coarse, subangular blocky structure; firm; strongly acid; gradual, smooth boundary.
- B23t—30 to 36 inches, dark-brown (7.5YR 4/4) fine sandy loam; weak, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.
- B3—36 to 52 inches, dark-brown (7.5YR 4/4) and light brownish-gray (10YR 6/2) coarse sandy loam containing pockets of silt; weak, medium and coarse, subangular blocky structure; friable; medium acid; clear, smooth boundary.
- IIC1—52 to 68 inches, brown to dark-brown (7.5YR 4/2) and gray (10YR 5/1) loamy sand containing bands and pockets of silt; structureless; loose; slightly acid or neutral; abrupt, smooth boundary.
- IIC2—68 inches +, very dark grayish-brown (10YR 3/2) and gray (10YR 5/1) stratified sand and silt; structureless; loose; calcareous.

In areas where the Camden soils grade toward the Ockley soils, the silt bands decrease but there are small amounts of gravel. Silt is more common in pockets than in bands. The depth of leaching of the Camden soils ranges from 42 to 100 inches. Only loam is mapped in this county, but in mapped areas a few small areas of silt loam or fine sandy loam are included. In a few small areas only 2 or 3 inches of stratified material is between the solum and the underlying till.

Celina series

The Celina series consists of moderately well drained Gray-Brown Podzolic soils that developed in 0 to 18 inches of loess and in the underlying loam till of Wisconsin age. These soils are on gentle slopes of the till plains and low moraines. They developed under deciduous forest.

The Celina soils are the moderately well drained members of the catena that includes the well drained Miami soils, the somewhat poorly drained Crosby soils, and the dark-colored, very poorly drained Brookston soils. Surface runoff of the Celina soils is slow to medium, and permeability is moderate.

Celina soils have a silt cap less than 18 inches thick, but that of the Xenia soils is 18 to 40 inches thick. Unlike the Birkbeck soils, the Celina soils did not develop entirely in loess and do not have a C horizon of neutral or calcareous loess.

Profile of Celina silt loam in a cultivated field (NW¼ SE¼ sec. 5, T. 18 N., R. 7 W.):

- Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; weak, moderate and coarse, granular structure; friable; slightly acid or neutral; abrupt, smooth boundary.
- B1—7 to 12 inches, yellowish-brown (10YR 5/4) to dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine and medium, subangular blocky structure; friable; grayish-brown (2.5Y 5/2) silt coatings on ped faces; very strongly acid; clear, smooth boundary.

- B21t—12 to 19 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; friable or slightly firm; medium to thin grayish-brown (2.5Y 5/2) silt coatings on ped faces; very strongly acid; clear, smooth boundary.
- IIB22t—19 to 26 inches, yellowish-brown (10YR 5/8) clay loam; common, medium, distinct, brown (7.5YR 5/4) mottles; moderate, coarse, subangular blocky structure; firm; many dark-brown (7.5YR 4/2) clay films; medium acid; clear, smooth boundary.
- IIB3—26 to 36 inches, olive-gray (5Y 5/2) to olive (5Y 5/3) clay loam; common, medium, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; many very dark grayish-brown (10YR 3/2) organic stains on ped faces; slightly acid or neutral; abrupt, wavy boundary.
- IIC—36 inches +, olive (5Y 5/3) loam; common, medium, distinct, dark grayish-brown (10YR 4/2) mottles; massive; friable; calcareous.

The silt mantle varies considerably in thickness within short distances. The depth to mottling ranges from 16 to 28 inches, and the depth to the calcareous loam till ranges from 24 to 42 inches. Silt loam is the only type mapped in this county.

Chelsea series

The Chelsea series consist of Gray-Brown Podzolic soils that intergrade toward Regosols. Chelsea soils developed in fine sand, sand, or loamy sand glacial drift of Wisconsin age. They are on gentle to strong slopes of terraces and of dunelike areas of bottom lands. The native vegetation was oak, elm, and other deciduous hardwoods.

These soils have low content of organic matter. The surface runoff is slow or medium, and permeability is very rapid.

The subsoil of Chelsea soils occurs in bands and contains less clay than the continuous subsoil of Princeton soils.

Profile of Chelsea loamy fine sand (NW. corner of SE¼SE¼ sec. 22, T. 20 N., R. 9 W.):

- Ap—0 to 8 inches, dark-brown (10YR 4/3) loamy fine sand; single grain to weak, coarse, granular structure; loose or very friable; slightly acid; abrupt, smooth boundary.
- A21—8 to 34 inches, brownish-yellow (10YR 6/6 to 6/8) loamy fine sand; single grain; loose; slightly acid; gradual, smooth boundary.
- A22—34 to 45 inches, yellowish-brown (10YR 5/6 to 5/8) loamy fine sand; single grain; loose; strongly acid; gradual, smooth boundary.
- A23—45 to 48 inches, yellow (10YR 7/6) loamy fine sand; single grain; loose; medium acid; clear, smooth boundary.
- A&Bt—48 to 93 inches, bands of material of the A2 and B2 horizons; bands of the A2 horizon are yellow, loose, single-grain fine sand separated from the B2 bands by an abrupt, wavy boundary; bands of the B2 horizon are reddish-brown (5YR 4/4) and yellowish-red (5YR 4/6), massive, friable sandy loam to heavy loamy sand that are generally ¼ to ¾ inch thick but are discontinuous in some places; horizon is medium acid; gradual, smooth boundary.
- C—93 inches +, yellow (10YR 8/6) fine sand; single grain; loose; neutral.

The thin bands range from sandy loam to loamy sand. These bands occur at a depth of 36 to 60 inches and range from ¼ inch to 3 inches in thickness. They are 3 to 6 inches apart and are nearly horizontal or wavy. Strata of fine sand and silt occur in some places at a depth below 6 feet. Loamy fine sand is the only type mapped in this county.

Crane series

The Crane series consists of Brunizems that intergrade toward Humic Gley soils. Crane soils developed on nearly level outwash plains in 0 to 36 inches of silty material that is underlain by loam or gravelly clay loam outwash. Calcareous stratified gravel and sand of Wisconsin age occur at a depth of 42 to 70 inches or more. Tall prairie grasses make up the native vegetation.

The Crane soils are the somewhat poorly drained members of the catena that includes the well drained Wea soils, the moderately well drained Tippecanoe soils, and the very poorly drained, dark-colored Westland soils. Surface runoff of Crane soils is slow, and permeability is moderately slow. The content of organic matter is high.

The Crane soils have a darker colored, deeper A horizon than have the Sleeth soils.

Profile of Crane silt loam (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 19, T. 21 N., R. 6 W.):

- Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A12—8 to 13 inches, very dark gray (10YR 3/1) to black (10YR 2/1) silt loam; moderate, fine and medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A3—13 to 18 inches, dark-gray (10YR 4/1) to very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure that breaks to weak, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.
- B1—18 to 23 inches, dark-brown (10YR 3/3) heavy silt loam; few, fine, distinct, yellowish-brown (10YR 5/4 to 5/6) mottles; moderate, fine, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- B21—23 to 28 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6 to 5/8) mottles; moderate, fine and medium, subangular blocky structure; firm; few faint, gray (10YR 6/1) clay films on ped faces; medium acid; gradual, smooth boundary.
- IIB22t—28 to 41 inches, gray (10YR 5/1) silty clay loam in upper part and coarse light silty clay loam in lower part; many, medium and coarse, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium and coarse, subangular blocky structure; firm; few faint, light-gray (10YR 6/1) clay films on ped faces; medium acid; clear, smooth boundary.
- IIB31—41 to 48 inches, dark-gray (10YR 4/1) sandy clay loam; common, medium, distinct, brown (10YR 5/3) and yellowish-brown (10YR 5/8) mottles; weak, medium and coarse, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- IIB32—48 to 70 inches, gray (10YR 5/1) and dark yellowish-brown (10YR 3/4) loamy fine sand to sandy loam; single grain; nonsticky and nonplastic when wet; medium acid in upper part and neutral in lower; abrupt, smooth boundary.
- IIC—70 inches +, brown (10YR 4/3) and gray (10YR 5/1) stratified loose gravel and sand; single grain; calcareous.

In most areas the silty material is 30 to 36 inches thick. Instead of an A3 or B1 horizon, a gray subsurface layer, 2 to 4 inches thick, occurs in some areas.

Crosby series

The Crosby series consists of somewhat poorly drained Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Crosby soils developed in 0 to 18

inches of loess underlain by highly calcareous loam till of Wisconsin age. These soils occur on nearly level till plains and developed under a deciduous forest.

The Crosby soils are the somewhat poorly drained members of the catena that includes the well drained Miami soils, the moderately well drained Celina soils, and the dark-colored, very poorly drained Brookston soils. Surface runoff of Crosby soils is slow or very slow, and permeability is slow.

The silt cap of the Crosby soils is less than 18 inches thick, but that of the Fincastle soils is 18 to 40 inches thick. Crosby soils did not develop entirely in loess as did the Reesville soils, which have a C horizon of neutral or calcareous loess.

Table 13 lists analytical data for a profile of Crosby silt loam.

Profile of Crosby silt loam in a forest (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 11, T. 18 N., R. 7 W.):

- A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
- A2—4 to 11 inches, brown (10YR 5/3) silt loam; weak, fine and medium, granular structure; friable; slightly acid or neutral; clear, wavy boundary.
- B21t—11 to 18 inches, brown (10YR 5/3) silty clay; common, medium, distinct, light grayish-brown (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.
- IIB22t—18 to 27 inches, brown (7.5YR 5/3) light silty clay; common, medium, distinct, gray (10YR 5/1) mottles; very firm; strongly acid; clear, smooth boundary.
- IIB23—27 to 31 inches, yellowish-brown (10YR 5/8) clay loam; few, medium, distinct, gray (10YR 5/1) to dark-gray (10YR 4/1) mottles; moderate, coarse, subangular blocky structure; very firm; neutral; clear, smooth boundary.
- IIC—31 inches +, grayish-brown (10YR 5/2) to yellowish-gray (10YR 5/6) coarse clay loam glacial till; calcareous.

The depth to the calcareous till ranges from 24 to 42 inches. In cultivated areas the A horizon is lighter colored than that described and has a weak, platy structure. In some places the B21t and IIB22t horizons are grayer than those described. These horizons are generally silty clay loam, but they are light silty clay in some areas and silty clay in a few. Silt loam is the only soil type mapped in this county.

Dana series

The Dana series consists of Brunizems that developed in 18 to 40 inches of loess underlain by loam till of Wisconsin age. These soils developed under tall prairie grasses on the nearly level to gently sloping upland till plains.

The Dana soils are the moderately well drained members of the catena that includes the well drained Sidell soils, the somewhat poorly drained Raub soils, and the very poorly drained, very dark colored Romney soils. Surface runoff of Dana soils is slow or medium. Permeability is moderate in the upper part of the solum and moderately slow in the lower part. The organic-matter content is high.

Dana soils have a darker colored, thicker A horizon than Xenia soils. In most places Dana soils are darker colored than Wingate soils and lack the A2 horizon that occurs in those soils.

TABLE 13.—Analytical data for Crosby silt loam sampled 4 miles east of Yeddo (NW¼NW¼ sec. 14, T. 18 N., R. 7 W.)

MECHANICAL ANALYSIS

Horizon	Depth	Particle-size distribution (in millimeters)								Texture
		Very coarse sand (2.0-1.0)	Coarse sand (1.0-0.5)	Medium sand (0.5-0.25)	Fine sand (0.25-0.10)	Very fine sand (0.10-0.25)	Silt (0.05-0.002)	Clay (<0.002)	>2	
Ap-----	Inches 0-7	Percent 1 0.5	Percent 1 1.5	Percent 2 1.6	Percent 2 2.3	Percent 2 1.4	Percent 72.1	Percent 20.6	Percent	Silt loam. Silty clay loam. Silty clay. Loam. Loam. Loam.
B1-----	7-11	1.2	1.6	2.9	2 1.4	2.8	58.3	37.8	(³)	
B2-----	11-19	.7	1.2	1.8	3.1	1.9	50.0	41.3	(³)	
B3-----	19-27	4.0	7.0	9.4	15.6	6.2	31.7	26.1	5	
C11-----	27-37	4 5.1	4 6.8	4 8.0	4 14.8	4 7.3	38.7	19.3	8	
C12-----	37-52	4 6.3	4 6.7	4 8.1	4 14.5	4 7.3	38.2	18.9	12	

CHEMICAL ANALYSIS

Horizon	Depth	pH (1:1)	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxides (Fe ₂ O ₃)	Cation exchange capacity (NH ₄ OAc)	Extractable cations (meq. per 100 gm.)					Base saturation (NH ₄ OAc)	Base saturation on sum of cations	Calcium-magnesium ratio	
								Ca	Mg	H	Na	K				Sum of cations
Ap-----	Inches 0-7	5.3	Percent 1.66	Percent 0.162	10	Percent 2.0	Meg./100 gm. 13.7	7.0	2.4	9.0	<0.1	0.4	18.8	Percent 72	Percent 52	2.9
B1-----	7-11	4.9	.65	.077	8	2.5	22.2	10.8	6.4	10.1	.1	.4	27.8	80	64	1.7
B2-----	11-19	5.5	.44	.049	9	2.7	27.5	15.8	10.0	7.7	.2	.6	34.3	97	78	1.6
B3-----	19-27	⁵ 7.7	.23	.031	7	1.8	13.8	12.0	6.7	2.0	.1	.3	21.1	138	90	1.8
C11-----	27-37	⁶ 8.1	.13	-----	-----	1.2	6.5	21.8	4.1	<.1	.1	.2	26.2	403	100	5.3
C12-----	37-52	⁷ 8.2	.12	-----	-----	1.0	5.8	20.9	3.7	<.1	.1	.1	24.8	428	100	5.6

¹ Many concretions, probably of iron and manganese.² Few concretions, probably of iron and manganese.³ Trace.⁴ Few carbonates and some limestone fragments.⁵ Calcium carbonate equivalent amounts to 3 percent of horizon.⁶ Calcium carbonate equivalent amounts to 21 percent of horizon.⁷ Calcium carbonate equivalent amounts to 22 percent of horizon.

Profile of Dana silt loam (SW¼SE¼ sec. 2, T. 20 N., R. 8 W.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) or very dark brown (10YR 2/2) silt loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A12—8 to 16 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 4/3) heavy silt loam; moderate, medium and coarse, granular structure; friable; slightly acid; clear, smooth boundary.

B21t—16 to 28 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, fine, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; medium acid; gradual, smooth boundary.

IIB22t—28 to 32 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.

IIB23t—32 to 70 inches, dark yellowish-brown (10YR 4/4) heavy clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; slightly acid; clear, smooth boundary.

IIC—70 inches +, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) loam till; massive; friable; calcareous.

In this county the silt mantle of Dana soils is almost 40 inches thick in most places, but in a few scattered areas

this mantle is thicker. The A horizon ranges from 8 to 16 inches in thickness, and an A3 horizon has developed in some nearly level areas. The color of the surface layer ranges from very dark grayish brown (10YR 3/2) to black (10YR 2/1). Mottling occurs at a depth of 16 to 30 inches.

Delmar series

The Delmar series consists of poorly drained Low-Humic Gley soils that intergrade toward Planosols. Delmar soils developed in 18 to 40 inches of loess underlain by calcareous loam till of Wisconsin age. These soils occupy nearly level and slightly depressional areas of the upland till plains. They developed under deciduous forest.

The Delmar soils are the poorly drained members of the catena that includes the well drained Russell soils, the moderately well drained Xenia soils, the somewhat poorly drained Fincastle soils, and the dark-colored, very poorly drained Brookston soils. Surface runoff of Delmar soils is very slow or ponded, and permeability is very slow.

Profile of Delmar silt loam in a forest (SW¼NW¼ sec. 8, T. 18 N., R. 6 W.):

- A1—0 to 2 inches, gray (10YR 5/1) silt loam; weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.
- A2—2 to 11 inches, light-gray (10YR 7/2) silt loam; common, medium, faint, pale-brown (10YR 6/3) mottles; weak, medium, granular structure; friable; many, rounded, very dark brown (10YR 2/2) concretions; very strongly acid; abrupt, smooth boundary.
- B1g—11 to 14 inches, light brownish-gray (10YR 6/2) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; firm; many, small, rounded, very dark brown (10YR 2/2) concretions; few, fine, grayish-brown (10YR 5/2) clay coatings on ped surfaces; very strongly acid; clear, wavy boundary.
- B21gt—14 to 20 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/1) mottles; moderate, medium, prismatic structure that breaks to moderate, fine and medium, subangular structure; firm; thin to medium, gray (10YR 5/1) clay coatings on ped surfaces; many, small, rounded, very dark brown (10YR 2/2) concretions; extremely acid; clear, smooth boundary.
- B22gt—20 to 28 inches, gray (10YR 5/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) and brownish-yellow (10YR 6/6) mottles; moderate, medium, prismatic structure that breaks to moderate, medium and coarse, subangular and angular blocky structure; firm; many, small, rounded, very dark brown (10YR 2/2) concretions; common, gray (10YR 6/1) clay coatings on ped surfaces; very strongly acid; clear, wavy boundary.
- IIB3—28 to 44 inches, light olive-brown (2.5Y 5/4) clay loam; common, medium, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; friable; thin, gray (10YR 5/1) coatings and dark-gray (10YR 4/1) to very dark gray (10YR 3/1) organic coatings on ped surfaces; strongly acid to medium acid; abrupt, wavy boundary.
- IICg—44 to 55 inches +, light olive-brown (2.5Y 5/4) loam till; friable; calcareous.

Depth to calcareous loam till ranges from 42 to 66 inches. In some cultivated areas where the Delmar soils grade toward the Fincastle soils, the surface layer is almost dark grayish brown. Silt loam is the only type mapped in this county.

Eel series

In the Eel series are Alluvial soils consisting of medium-textured and moderately fine textured sediments from neutral or calcareous drift of Wisconsin age. These soils occur in nearly level or depressional areas of the flood plains along rivers and creeks. Their native vegetation was elm, ash, maple, sycamore, and other deciduous hardwoods.

The Eel soils are the moderately well drained members of the catena that includes the well drained Genesee soils, the somewhat poorly drained Shoals soils, and the very poorly drained, dark-colored Sloan soils. Surface runoff of Eel soils is slow or very slow, and permeability is moderate or moderately slow. The content of organic matter is moderately low.

Profile of Eel silt loam (NE. corner of NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 32, T. 20 N., R. 7 W.):

- A—0 to 15 inches, dark-brown (10YR 3/3) silt loam; weak, coarse, granular structure; friable; neutral; clear, wavy boundary.
- C1—15 to 19 inches, dark-brown (10YR 3/3) silt loam; weak, coarse, subangular blocky structure to weak, medium, platy structure; friable; many very dark brown (10YR 2/2) iron concretions; neutral; clear, broken boundary.

C2g—19 to 26 inches, dark-brown (10YR 4/3) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure; friable; many iron concretions; neutral; gradual, wavy boundary.

IIC3g—26 inches +, gray (10YR 5/1) and reddish-brown (5YR 4/4) layers of sandy loam, sand, and silt; many, coarse, distinct, gray (10YR 5/1) mottles; massive; neutral.

The soil types mapped in this county are loam, silt loam, and silty clay loam. The surface layer ranges from brown (10YR 5/3) to dark brown (10YR 3/3) and is calcareous in some areas. Depth to mottling ranges from 15 to 26 inches. The C horizon is either uniform in texture or has strata of loam, silt loam, and silty clay loam.

Elston series

The Elston series consists of Brunizems that developed in loamy material underlain by slightly acid or calcareous strata of fine and medium sand that contain a small amount of fine gravel. These soils developed under prairie grasses on nearly level to gentle slopes of outwash plains, terraces, and valley trains.

Elston soils are well drained and occur with the dark-colored, well-drained Warsaw soils and the dark-colored, very poorly drained Westland soils. Surface runoff of Elston soils is very slow or slow, and permeability is moderate to rapid.

Elston soils have a thicker solum than Wea soils and are underlain by finer textured parent material. They are coarser textured and deeper than Warsaw soils.

Table 14 lists analytical data for a profile of Elston loam.

Profile of Elston loam observed in a Bureau of Public Roads pit in a hayfield (SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 20 W., R. 9 W.):

- Ap—0 to 6 inches, black (10YR 2/1) loam; structure is weak, coarse, and granular in upper 2 inches and massive in lower part; friable; few or common fine roots; neutral; abrupt, smooth boundary.
- A12—6 to 11 inches, black (5YR 2/1) sandy loam; moderate, coarse, granular structure; friable; few or common fine roots; neutral; gradual, smooth boundary.
- A13—11 to 20 inches, black (5YR 2/1) to dark reddish-brown (5YR 2/2) sandy loam; weak, medium, subangular blocky structure; friable when moist, slightly sticky when wet; few or common roots; insignificant amount of gravel; few grains of clean sand scattered throughout; slightly acid; gradual boundary.
- A3—20 to 26 inches, dark-brown (7.5YR 3/2) light sandy loam; moderate, coarse, granular structure; very friable when moist, slightly sticky or sticky when wet; few or common roots; less than 5 percent of horizon is gravel; medium acid; gradual, wavy boundary.
- B1—26 to 32 inches, reddish-brown (5YR 4/3) gravelly sandy loam; weak, fine, subangular blocky structure; slightly sticky or nonplastic when wet; common roots; approximately 2 percent of horizon is pebbles more than $\frac{3}{4}$ inch across; medium acid; gradual boundary.
- B21t—32 to 42 inches, dark reddish-brown (5YR 3/3) gravelly sandy loam; weak to moderate, medium, subangular blocky structure; slightly sticky and slightly plastic when wet; medium acid; gradual boundary.
- B22—42 to 50 inches, reddish-brown (5YR 4/4 to 4/3) sandy clay loam to loamy sand; moderate, coarse, subangular blocky structure; very friable, slightly sticky and slightly plastic when wet; few roots; approximately 20 percent of horizon is gravel; strongly acid; wavy boundary.

TABLE 14.—Analytical data for Elston loam sampled near the cemetery 2½ miles north of Covington (SE¼NW¼ sec. 14, T. 20 N., R. 9 W.)

MECHANICAL ANALYSIS

Horizon	Depth	Particle-size distribution (in millimeters)								Texture
		Very coarse sand (2.0-1.0)	Coarse sand (1.0-0.5)	Medium sand (0.5-0.25)	Fine sand (0.25-0.10)	Very fine sand (0.10-0.05)	Silt (0.05-0.002)	Clay (<0.002)	>2	
	<i>Inches</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	
A1p	0-6	4.4	32.1	19.0	5.4	1.3	23.6	14.2		Coarse sandy loam.
A11	6-11	4.1	29.0	17.2	5.1	1.2	27.0	16.4		Coarse sandy loam.
A12	11-20	5.1	30.5	17.4	4.8	1.2	24.4	16.6	2	Coarse sandy loam.
A3	20-26	15.6	34.3	14.6	4.2	1.1	18.0	12.2	8	Coarse sandy loam.
B1	26-32	20.5	33.2	17.2	5.4	1.3	10.7	11.7	22	Coarse sandy loam.
B21	32-42	23.0	29.5	14.6	4.8	1.6	7.1	19.4	24	Coarse sandy loam and sandy clay loam.
B22	42-50	34.0	36.1	11.6	2.8	.9	5.5	9.1	24	Loamy coarse sand.
B3	50-64	17.1	53.7	11.5	5.7	1.6	5.3	5.1	3	Coarse sand.
C1	64-76	12.7	60.8	11.6	4.3	1.7	7.1	1.8	3	Coarse sand.

CHEMICAL ANALYSIS

Horizon	Depth	pH (1:1)	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxides (Fe ₂ O ₃)	Cation exchange capacity (NH ₄ OAc)	Extractable cations (meq. per 100 gm.)						Base saturation (NH ₄ OAc)	Base saturation on sum of cations	Calcium-magnesium ratio
								Ca	Mg	H	Na	K	Sum of cations			
	<i>Inches</i>		<i>Percent</i>	<i>Percent</i>		<i>Percent</i>	<i>Meq./100 gm.</i>						<i>Percent</i>	<i>Percent</i>		
A1p	0-6	6.6	1.72	0.125	14	1.3	12.1	10.2	1.3	4.9	0.1	0.2	16.6	70	7.8	
A11	6-11	6.2	1.66	.129	13	1.4	13.0	9.2	1.3	6.3	<.1	.2	17.0	80	7.1	
A12	11-20	5.3	1.14	.085	13	1.4	10.3	5.2	.8	8.8	<.1	.1	14.9	59	6.5	
A3	20-26	5.1	.71	.060	12	1.4	7.2	3.2	.7	6.3	<.1	.1	10.3	56	4.6	
B1	26-32	5.0	.40			1.4	6.2	2.7	.4	4.6	<.1	.1	7.8	52	6.8	
B21	32-42	4.9	.30			1.8	10.2	5.0	1.6	6.4	<.1	.2	13.2	67	3.1	
B22	42-50	5.1	.22			1.3	5.6	2.7	.9	3.9	<.1	.1	7.6	66	3.0	
B3	50-64	5.4	.13			1.0	3.2	1.5	.6	<.1	<.1	.1	4.6	69	2.5	
C1	64-76	8.5	.13			.7	1.4	13.8	.5	.1	<.1	<.1	14.3	1,021	27.6	

¹ Few carbonates and some fragments of limestone.

² Calcium carbonate amounts to 20 percent of horizon.

B3—50 to 64 inches, dark-brown (10YR 4/3) coarse sand; single grain; loose; few roots; less than 2 percent of horizon is gravel; coatings visible on 75 percent of sand grains; medium to slightly acid; irregular boundary.

C1—64 to 76 inches, yellowish-brown (10YR 5/4) medium and coarse sand; loose; less than 2 percent of horizon is gravel; about 25 percent of horizon is dark-colored iron and manganese minerals and shell fragments; several opaque sand grains; slightly acid or neutral.

C2—76 inches +, yellowish-brown (10YR 5/4), light yellow-brown (10YR 6/4), and pale-brown (10YR 6/3) medium and coarse sand; calcareous.

The depth to the C horizon ranges from 55 to 70 inches. The A horizon ranges from 14 to 30 inches in thickness and, in fields where row crops have been cultivated intensively, is lighter colored than that described. In areas that grade toward Warsaw soils, the underlying material is at a depth of less than 64 inches and contains more than the normal amount of gravel.

Fincastle series

The Fincastle series consists of somewhat poorly drained Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Fincastle soils developed in 18 to 40 inches of loess and material weathered from loam till of Wisconsin age. Calcareous loam till occurs at a depth of 42 to 72 inches. These soils occupy nearly level to gentle slopes of the upland till plains. Their native vegetation was deciduous forest.

The Fincastle soils are the somewhat poorly drained members of the catena that includes the well drained Russell soils, the moderately well drained Xenia soils, the poorly drained Delmar soils, and the dark-colored, very poorly drained Brookston soils. Surface runoff of Fincastle soils is slow or very slow, and permeability is slow.

Fincastle soils have a thicker silt cap than Crosby soils and a thinner one than Reesville. The A1 horizon of

Fincastle soils is not so dark or so deep as that of the Raub soils, which are Brunizems.

Profile of Fincastle silt loam in a cultivated field (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, R. 8 W., T. 19 W.):

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine and medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- B1g—8 to 13 inches, dark grayish-brown (10YR 4/2) heavy silt loam; many, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; moderate, fine, angular blocky structure; firm; medium acid; gradual, smooth boundary.
- B2gt—13 to 38 inches, dark-brown to brown (7.5YR 4/4) silty clay loam; many, coarse, prominent, gray (10YR 5/1) mottles and many, coarse, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular and angular blocky structure; firm; medium acid in the upper part and strongly acid in lower; gradual, smooth boundary.
- IIB3g—38 to 54 inches, brown (7.5YR 5/4) clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and grayish-brown (10YR 5/2) mottles; moderate, coarse, subangular blocky structure; firm; very strongly acid in upper part and neutral in lower; gradual, smooth boundary.
- IIC1—54 to 60 inches, grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/4) clay loam; massive; firm; neutral; clear, smooth boundary.
- IIC2—60 inches +, grayish-brown (2.5Y 5/2) loam; massive; firm; calcareous till.

In most places the silt cap extends to a depth of about 30 inches, but in areas of Fincastle soils that grade toward Crosby soils this depth is as little as 18 inches. The A horizon ranges from 8 to 13 inches in thickness and in forests is slightly darker colored than normal. Depth to mottling ranges from 8 to 18 inches. A thin stratum of sandy or gravelly material is generally between the loess and the till, especially in areas where Fincastle soils grade toward Sleeth soils.

Fox series

The Fox series consists of Gray-Brown Podzolic soils developed in silty and loamy outwash that, at a depth of 24 to about 42 inches, is overlain by stratified gravel and sand of Wisconsin age. Fox soils are in nearly level to strongly sloping areas of terraces, moraines, valley trains, and outwash plains. They developed under oak, walnut, beech, hickory, and other deciduous hardwoods.

Fox soils are the well-drained members of the catena that includes the very poorly drained, dark-colored Westland soils. The organic-matter content of Fox soils is low. Surface runoff is slow in nearly level areas and rapid in steeper areas. Permeability is moderate or moderately rapid.

The subsoil and entire solum of Fox soils are thinner than those of the Ockley soils. The solum of Fox soils ranges from 24 to 42 inches, but that of Ockley soils is more than 42 inches thick. The Fox soils have a lighter colored surface layer than Warsaw soils and generally a lighter colored subsoil.

Profile of Fox silt loam (SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 15, T. 18 N., R. 8 W.):

- Ap—0 to 6 inches, dark-brown to brown (10YR 4/3) silt loam; weak, fine and medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A2—6 to 9 inches, brown (10YR 5/3) silt loam; moderate, medium, platy structure that breaks to moderate, medium, granular structure; friable; slightly acid; clear, smooth boundary.

- B1t—9 to 13 inches, dark-brown (10YR 3/3) light silty clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.
- IIB21t—13 to 32 inches, dark yellowish-brown (10YR 3/4) gravelly clay loam; moderate, coarse, subangular blocky structure; firm; medium acid to strongly acid; clear, smooth boundary.
- IIB22t—32 to 37 inches, dark-brown (10YR 3/3) gravelly clay loam; weak, moderate, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.
- IIC—37 inches +, light brownish-gray (10YR 6/2) and brown (10YR 5/3) stratified gravel and sand; single grain; loose; calcareous; tongues of gravelly clay loam from IIB22t horizon extend into this horizon generally for 10 to 13 inches.

The thickness of the silty material ranges from 0 to 18 inches. The tongues that extend from the B22t horizon into the loose gravel and sand are 5 to 15 inches long. More gravel is in the subsoil in areas that have a coarser textured surface layer. On eroded slopes coarse gravel is commonly on the surface. The soil types mapped in the county are silt loam, loam, and fine sandy loam.

Genesee series

The Genesee series consists of well-drained Alluvial soils in which the sediments washed from highly calcareous drift of Wisconsin age. These soils are nearly level and occur on the bottom lands of rivers and creeks. They developed under elm, ash, sycamore, maple, and other hardwoods.

The Genesee soils are the well drained members of the catena that includes the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, and the very poorly drained, dark-colored Sloan soils. Surface runoff of Genesee soils is slow or very slow, and permeability is moderate. The content of organic matter is low.

Genesee soils have a lighter colored profile than Huntsville soils and are finer textured than Landes soils. The Huntsville soils occur in the Brunizem region, but they are Alluvial soils.

Profile of Genesee silt loam (SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T. 19 N., R. 9 W.):

- Ap—0 to 7 inches, dark-brown (10YR 3/3) silt loam; moderate, medium and coarse, granular structure; friable; calcareous; abrupt, smooth boundary.
- C1—7 to 16 inches, dark-brown (10YR 3/3) silt loam; weak, medium, subangular blocky structure; friable; calcareous; clear, smooth boundary.
- C2—16 to 45 inches, brown (10YR 4/3) silt loam; alternating layers of very fine sandy loam and silt loam; weak, fine, granular structure to massive; friable; calcareous; clear, smooth boundary.
- C3—45 to 51 inches +, brown (10YR 4/3) very fine sandy loam; very faint, yellowish-brown (10YR 5/4) mottles; single grain; very friable; calcareous.

The layers of Genesee soils are of more uniform texture in large areas than in small ones. Reaction is neutral or calcareous. Those soils on high bottoms have a weakly developed B horizon in some areas.

Hennepin series

The Hennepin series consists of well-drained Regosols that intergrade toward Gray-Brown Podzolic soils. Hennepin soils developed under deciduous forest on steep slopes of the glacial till plains where geologic erosion has limited soil development.

Hennepin soils occur with the catena that includes the Miami and Crosby soils and in the one that includes the

Russell and Fincastle soils. Surface runoff of Hennepin soils is medium or rapid, and permeability is moderate to moderately slow.

The kind of parent material is the main difference between the Hennepin soils and the Rodman and Muskingum soils. The Hennepin soils formed in weathered glacial till, whereas the Rodman soils formed in stratified sand and gravel and the Muskingum soils formed in weathered interbedded sandstone and shale.

Profile of Hennepin loam in a forest (NE $\frac{1}{4}$ NE sec. 23, T. 18 N., R. 9 W.):

- O2—1 inch to 0, partly decomposed leaf and organic matter.
- A1—0 to 4 inches, very dark gray (10YR 3/1) to very dark brown (10YR 2/2) loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
- C1—4 to 17 inches, dark grayish-brown (10YR 4/2) to dark-brown (10YR 4/3) loam; common, medium, distinct, very dark gray (10YR 3/1) organic stains; massive; firm; neutral or mildly alkaline; clear, smooth boundary.
- C2—17 inches +, light olive-brown (2.5Y 5/4) loam till; massive; firm; calcareous.

The A horizon varies in thickness. In areas where it is thickest, Hennepin soils are leached to the greatest depth. In some places the A horizon is slightly finer or coarser textured than that described. Variable amounts of fine gravel underlie the A horizon. In the deeper Hennepin soils a faint B horizon has developed. In this county Hennepin soils are mapped only as soil complexes.

High Gap series

The High Gap series consists of Gray-Brown Podzolic soils that developed in 15 to 36 inches of Wisconsin drift underlain by sandstone, siltstone, and shale. These soils occur on uplands and terraces in nearly level to moderately sloping areas where they developed under oak, hickory, and elm.

The High Gap soils are the well-drained members of the catena that includes the somewhat poorly drained Shadeland soils. Surface runoff of High Gap soils is slow to rapid, and permeability is moderate. The content of organic matter is low.

High Gap soils have a thinner, more strongly acid solum than Miami soils, which are underlain by calcareous till instead of bedrock. The moderately fine textured B horizon that developed in High Gap soils has not developed in the Muskingum soils, for they are shallow to bedrock and are generally on steep slopes.

Profile of High Gap silt loam (SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 32, T. 19 N., R. 8 W.):

- A1—0 to 3 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; very strongly acid; abrupt, smooth boundary.
- A2—3 to 7 inches, dark-brown (10YR 4/3) to brown (7.5YR 4/4) silt loam; moderate, medium and coarse, granular structure; friable; strongly acid; clear, smooth boundary.
- IIB2t—7 to 30 inches, brown (7.5YR 5/4) to dark-brown (7.5YR 4/4) light clay loam; moderate, coarse, subangular blocky structure; firm; very strongly acid; clear, smooth boundary.
- IIC—30 to 34 inches, brown (7.5YR 5/4) sandy loam; massive; very friable; very strongly acid; abrupt, smooth boundary.
- IIIR—34 inches +, partly weathered sandstone grading to solid sandstone bedrock.

The depth to bedrock ranges from 15 to 40 inches. The IIB2t horizon ranges from coarse sandy clay loam

to clay loam in texture and from 10 to 25 inches in thickness. Pebbles, probably from outwash or till, are common in the subsoil. The lower part of the IIB2t horizon is slightly mottled in some places where the High Gap soils grade toward the Shadeland soils.

Huntsville series

The Huntsville series consists of dark-colored Alluvial soils that occur in the Brunizem soil region. Huntsville soils formed from sediments washed mainly from Brunizems that developed in loess and drift of Wisconsin age. They occur on nearly level flood plains that border the larger meandering streams.

Surface runoff is very slow, and permeability is moderate.

Huntsville soils are darker colored than the Genesee soils and have a higher organic-matter content.

Profile of Huntsville silt loam in a cultivated field (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 12, T. 20 N., R. 8 W.):

- Ap—0 to 11 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.
- A12—11 to 31 inches, very dark gray (10YR 3/1) silt loam; weak, coarse, subangular blocky structure; friable; neutral; clear, smooth boundary.
- A13—31 to 37 inches, very dark gray (10YR 3/1) silt loam; many, prominent, dark reddish-brown (2.5YR 3/4) mottles; weak, coarse and very coarse, subangular blocky structure; friable; alkaline; abrupt, smooth boundary.
- A14—37 to 43 inches, very dark gray (10YR 3/1) silt loam; massive; friable; very thin strata of sand between layers of silt loam; calcareous; clear, smooth boundary.
- IIC1—43 inches +, reddish-yellow (7.5YR 6/6) sand; single grain; loose; calcareous.

The Ap horizon ranges from about 6 to 12 inches in thickness. Between the layers of silt are strata of sand only $\frac{1}{16}$ to $\frac{3}{4}$ inch thick. In a few areas mottling is above a depth of 30 inches.

Landes series

In the Landes series are well-drained Alluvial soils that consist of sandy sediments washed from highly calcareous drift of Wisconsin age. These sediments were deposited recently on natural levees and in areas along rivers and smaller streams that receive material from washouts. Although elm, ash, maple, and other hardwoods add to the organic matter in these soils, the native vegetation has not greatly affected their development.

Surface runoff is slow or very slow, and permeability is moderate.

Landes soils are coarser textured throughout their profile than Genesee soils and do not contain so much organic matter as the Huntsville soils.

Profile of Landes fine sandy loam (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 23, T. 22 N., R. 7 W.):

- Ap—0 to 9 inches, dark-brown (10YR 3/3 to 3/4) fine sandy loam; weak, fine and medium, granular structure; very friable; few fine roots; calcareous; abrupt, smooth boundary.
- C1—9 to 13 inches, yellowish-brown (10YR 5/4) loamy sand; single grain; loose; few fine roots; calcareous; abrupt, smooth boundary.
- C2—13 to 32 inches, dark grayish-brown (10YR 4/2) loamy fine sand; single grain to weak, fine, granular structure; very friable; calcareous; gradual, smooth boundary.

C3—32 to 50 inches +, yellowish-brown (10YR 5/4) sandy loam; weak, fine, granular structure; very friable; calcareous.

The texture of the surface layer ranges from fine sandy loam to fine sand within short horizontal distances. In a few places thin strata of clean coarse sand is between the thicker, finer textured layers. The subsoil ranges from loamy fine sand to fine sandy loam.

Miami series

The Miami series consists of Gray-Brown Podzolic soils that developed in 0 to 18 inches of loess underlain by material weathered from calcareous loam till of Wisconsin age. These soils occur on gentle or moderate slopes of the upland till plains. In most places they occur with Russell soils. The native vegetation was white and red oaks, maple, ash, hickory, and other deciduous hardwoods.

Miami soils are the well drained members of the catena that includes the moderately well drained Celina soils, the somewhat poorly drained Crosby soils, and the very poorly drained, dark-colored Brookston soils. Surface runoff of Miami soils is medium to very rapid, and permeability is moderate. The organic-matter content is low.

Miami soils are leached to a depth of 24 to 42 inches, but leaching in the Russell soils is to a depth of 42 to 70 inches. The upper subsoil of the Miami soils developed mainly in weathered till, but that of the Russell soils developed mainly in loess.

Profile of Miami silt loam (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 16, T. 19 N., R. 7 W.):

- A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, granular structure; friable; neutral; clear, smooth boundary.
- A2—4 to 10 inches, brown to dark-brown (10YR 4/3) silt loam; weak, medium and coarse, granular structure; friable; slightly acid; clear, smooth boundary.
- B1—10 to 13 inches, dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) heavy silt loam; moderate, fine and medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- B21t—13 to 16 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; very strongly acid; clear, smooth boundary.
- IIB22t—16 to 26 inches, dark-brown (7.5YR 4/4) light clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- IIB3—26 to 31 inches, brown (10YR 5/3) and brown to dark-brown (10YR 4/3) clay loam to heavy loam; weak, medium, subangular blocky structure; firm; neutral; clear, smooth boundary.
- IIC—31 inches +, brown to dark-brown (10YR 4/3) and olive-brown (2.5Y 4/4) loam till; massive; firm; calcareous.

The windblown silt ranges from 0 to 18 inches in thickness, and the depth of leaching increases as the thickness of the silt increases. In cultivated areas the surface layer to a depth of 6 to 8 inches is grayish brown (10YR 5/2) to dark yellowish brown (10YR 4/4).

Muskingum series

The Muskingum series consists of well-drained Sols Bruns Acides that developed in thin deposits of silt and residuum of interbedded sandstone, siltstone, and shale. These soils occur on gentle to steep slopes between ter-

aces and uplands. They developed under deciduous forest.

The Muskingum soils occur with the somewhat poorly drained Shadeland soils and the well-drained High Gap soils. Surface runoff of the Muskingum soils is medium to very rapid, and permeability is moderate to rapid.

Muskingum soils are underlain by weathered sandstone rather than by calcareous loose sand and gravel as are the Rodman soils or by calcareous glacial till as are the Hennepin soils.

Profile of Muskingum stony loam in a forest (NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 24, T. 21 N., R. 8 W.):

- O1—1 inch to 0, thin, loose forest litter from deciduous trees.
- A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) to very dark brown (10YR 2/2) stony loam; high content of organic matter; weak, very fine, granular structure; friable; extremely acid; clear, smooth boundary.
- A2—2 to 6 inches, yellowish-brown (10YR 5/4) loam; weak, medium, granular structure; friable; many irregular-shaped small stones; very strongly acid; clear, smooth boundary.
- B2—6 to 18 inches, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/6) heavy loam; weak to moderate, fine, subangular blocky structure; friable; medium sandstone fragments; very strongly acid; clear, smooth boundary.
- IIR—18 inches +, weathered sandstone bedrock; strongly acid.

Profile characteristics, including the depth to bedrock, vary within short horizontal distances. The A horizon is loam or silt loam, and the B2 horizon ranges from heavy loam to loamy sand. Small flagstone are on the gentle slopes, and outcrops or large boulders are on the steep slopes. Weak podzolic development has occurred in one small area. In this county Muskingum soils are mapped only in stony complexes.

Ockley series

The Ockley series consists of Gray-Brown Podzolic soils that developed in silty and loamy material as much as 3 feet thick. This material is either outwash or is loess underlain by gravelly clay loam outwash. At a depth of 42 to about 72 inches are calcareous gravel and sand of Wisconsin age. These soils occur in nearly level to steep areas of the high terraces, moraines, kames, and outwash plains. The native vegetation was oak, hickory, poplar, beech, and other hardwoods.

Ockley soils are the well-drained members of the catena that includes the somewhat poorly drained Sleeth soils and the very poorly drained, dark-colored Westland soils. The organic-matter content of Ockley soils is low. The surface runoff is slow to very rapid, and permeability is moderate.

Ockley soils have a solum at least 42 inches thick that contrast with the 24- to 42-inch solum of the Fox soils. The upper subsoil of the Ockley soils is more silty and contains less gravel and sand than that of the Fox soils.

Profile of Ockley silt loam (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 17, T. 19 N., R. 7 W.):

- A1—0 to 4 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.
- A2—4 to 10 inches, dark yellowish-brown (10YR 3/4) silt loam; moderate, fine and medium, granular structure; friable; medium acid; clear, smooth boundary.

- B1—10 to 13 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, fine, subangular blocky structure; slightly firm; medium acid to strongly acid; clear, smooth boundary.
- B21t—13 to 24 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; strongly acid or very strongly acid; clear, smooth boundary.
- B22t—24 to 31 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, angular and subangular blocky structure; firm; strong-brown (7.5YR 5/8) coatings on ped faces; strongly acid; clear, smooth boundary.
- IIB23t—31 to 39 inches, yellowish-brown (10YR 5/4 to 5/6) gritty silty clay loam; strong, medium and coarse, angular and subangular blocky structure; firm; dark-brown (10YR 3/3) clay films on ped faces; strongly acid; clear, smooth boundary.
- IIB3—39 to 45 inches, dark-brown (10YR 4/3) sandy clay loam; weak, medium, subangular blocky structure; firm; medium acid; abrupt, smooth boundary.
- IIIC1—45 to 64 inches, dark yellowish-brown (10YR 4/4) coarse sand and fine gravel; single grain; loose; medium acid or slightly calcareous; abrupt, smooth boundary.
- IIIC2—64 inches +, dark grayish-brown (10YR 4/2) stratified gravel and coarse sand; single grain; loose; calcareous.

Silt loam and loam types are mapped in this county. In cultivated areas the Ap horizon ranges from brown (10YR 4/3) to grayish brown (10YR 5/2). The silt mantle is thickest in areas where Ockley soils grade toward Alford soils. As the thickness of the silt mantle increases, so does the depth of leaching. In areas of moraines and kame terraces in the northeastern part of the county, the silt is 30 to 35 inches thick. Ockley soils are leached of carbonates to a depth of 42 to 72 inches. In some places tongues of material from the IIB3 horizon extend 6 to 10 inches into the IIIC1 horizon.

Parr series

The Parr series consists of well-drained Brunizems that developed in 0 to 18 inches of loess underlain by loam till of Wisconsin age. Calcareous loam till occurs at a depth of 24 to 42 inches. These soils occur on gentle to moderate slopes of the till plains. They developed under prairie grasses.

The Parr soils are the well-drained members of the catena that includes the very dark colored, very poorly drained Romney soils. Surface runoff of the Parr soils is slow or medium, and permeability is moderate.

The A horizon of Parr soils is thicker and darker colored than that of the Miami soils, but the loess mantle of Parr soils is not so thick as that of Sidell soils. Parr soils developed in loess over loam till, whereas Warsaw soils developed in calcareous stratified gravel and sand.

Profile of Parr silt loam in a cultivated field (NW¼ NW¼ sec. 29, T. 21 N., R. 6 W.):

- Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; cloddy; friable; roots plentiful; medium acid; abrupt, smooth boundary.
- B21t—6 to 12 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine, angular blocky structure; firm; roots plentiful; medium acid; clear, smooth boundary.
- IIB22t—12 to 26 inches, dark-brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; few roots; thin, very dark grayish-brown (10YR 3/2) clay and organic films on ped faces; many small pebbles; medium acid; clear, smooth boundary.
- IIB23t—26 to 31 inches, yellowish-brown (10YR 5/4) light clay loam; weak, coarse, subangular blocky structure; firm; thin, very dark grayish-brown (10YR 3/2)

- clay and organic films on ped faces; many small pebbles; neutral; clear, smooth boundary.
- IIC—31 to 36 inches +, light yellowish-brown (10YR 6/4) loam till; massive; friable; many small pebbles; calcareous.

The surface layer in pasture is darker colored than that described. It is lighter colored in areas where the Parr soils grade toward the Miami soils. Also, in uneroded areas the A horizon is thicker than that described. In some places glacial till is underlain by beds of sand and gravel at a depth of 5 to 8 feet.

Princeton series

The Princeton series consists of well-drained Gray-Brown Podzolic soils that developed in thick deposits of windblown coarse silt and fine sand. In the Princeton soils the depth to calcareous material ranges from 36 to 75 inches. These soils occur on nearly level to steep slopes of the uplands. Their native vegetation was deciduous forest.

The Princeton soils are the well-drained members of the catena that includes the somewhat poorly drained Ayrshire soils and the dark-colored, very poorly drained Ragsdale soils. Surface runoff of Princeton soils is very slow to very rapid, and permeability is moderate to rapid.

Princeton soils developed in coarse silt and sand rather than in silt only as did the Alford soils or in leached silt 18 to 40 inches thick over loam till as did the Russell soils.

Profile of Princeton fine sandy loam in a cultivated field (NW¼SW¼ sec. 36, T. 20 N., R. 9 W.):

- Ap—0 to 7 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, medium, granular structure; friable; medium acid; abrupt, smooth boundary.
- A2—7 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.
- B21t—11 to 20 inches, yellowish-brown (10YR 5/8) silty clay loam; moderate, medium, subangular blocky structure that breaks to moderate, fine, subangular blocky structure; firm; medium acid; gradual, smooth boundary.
- B22t—20 to 56 inches, strong-brown (7.5YR 5/8) clay loam; moderate, coarse, angular blocky structure that breaks to moderate, medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.
- B3—56 to 62 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak to moderate, coarse, subangular blocky structure; firm; medium to strongly acid; clear, smooth boundary.
- IIC1—62 to 79 inches, yellowish-brown (10YR 5/6) fine loamy sand; weak, medium, subangular blocky structure; very friable; neutral; clear, smooth boundary.
- IIC2—79 to 91 inches, yellowish-brown (10YR 5/8) sandy loam; massive; calcareous.
- IIC3—91 inches +, coarse silt and fine sand; calcareous.

The windblown deposits range from 5 to 9 feet in thickness. The underlying material is calcareous gravel and sand, sand and silt, or glacial till. Depth to carbonates varies greatly; in a few small areas carbonates are at a depth of 90 inches or more. Generally, areas having a coarser textured A horizon have a coarser textured B horizon. In areas where Princeton soils grade toward Alford soils, the profile contains more silt than normal. The B horizon is continuous in some areas, but in others it is continuous in the upper part and discontinuous in the lower. Loam and fine sandy loam are mapped in this county.

Ragsdale series

The Ragsdale series consists of very poorly drained Humic Gley soils that developed in neutral to calcareous loess underlain by loam till. These soils are on uplands in nearly level and slightly depressional areas. They developed under deciduous swamp forest and marsh grasses.

The Ragsdale soils are associated with the moderately well drained Birkbeck soils and the somewhat poorly drained Reesville soils. They are also associated with the well-drained Princeton soils and the somewhat poorly drained Ayrshire soils. Surface runoff of Ragsdale soils is very slow, and permeability is slow.

The B horizon of the Ragsdale soils is siltier than that of the Brookston, and the C horizon is predominantly loess rather than loam till. Ragsdale soils developed in loess rather than stratified silt, fine sand, sand, and gravel as did the Westland soils.

Profile of Ragsdale silty clay loam in a cultivated field (NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 18 N., R. 7 W.):

- Ap—0 to 7 inches, black (10YR 2/1) silty clay loam; moderate, coarse, subangular blocky structure; friable; neutral; abrupt, smooth boundary.
- A12—7 to 12 inches, black (10YR 2/1) silty clay loam; moderate, medium and coarse, angular blocky structure; friable; neutral; clear, smooth boundary.
- B21g—12 to 18 inches, mottled very dark gray (10YR 3/1) and light olive-brown (2.5Y 5/4) heavy silty clay loam; moderate, fine and medium, angular blocky structure; firm; neutral; clear, smooth boundary.
- B22g—18 to 25 inches, mottled grayish-brown (2.5Y 5/2), black (10YR 2/1), and yellowish-brown (10YR 5/4) heavy silty clay loam; moderate, medium, angular blocky structure; firm; slightly acid; clear, smooth boundary.
- B23g—25 to 31 inches, grayish-brown (2.5Y 5/2) silty clay loam; moderate, coarse, columnar structure breaking to moderate, medium and coarse, angular blocky structure; firm; very dark gray (10YR 3/1) organic coatings on ped faces; neutral; gradual, smooth boundary.
- B24g—31 to 49 inches, mottled yellowish-brown (10YR 5/6) and olive (5Y 5/6) silty clay loam; moderate, medium, subangular blocky structure; neutral; abrupt, smooth boundary.
- C1—49 inches +, pale-brown (10YR 6/3) to light yellowish-brown (10YR 6/4) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; friable; calcareous.

The amount of organic matter in the A horizon varies and depends on past cropping. The thickness of the dark-colored Ap and A12 horizons combined ranges from 9 to 18 inches. The depth to the underlying C horizon ranges from about 45 to 60 inches. In areas where Ragsdale soils occur with Princeton soils, the profile is coarser textured than it is in areas where Ragsdale soils occur with Alford soils. Silty clay loam is the only type mapped in this county.

Raub series

The Raub series consists of Brunizems that intergrade toward Humic Gley soils. Raub soils developed in 18 to 40 inches of loess underlain by material weathered from loam till. Calcareous loam till occurs at a depth of 42 to 70 inches. These nearly level soils are on upland till plains and moraines. They developed under tall prairie grasses.

The Raub soils are the somewhat poorly drained members of the catena that includes the well drained Sidell soils, the moderately well drained Dana soils, and the very poorly drained, very dark colored Romney soils. The surface runoff of Raub soils is slow or very slow, and permeability is slow. The content of organic matter is high.

The Raub soils have a darker colored, thicker A horizon than the Fincastle soils.

Profile of Raub silt loam (SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 21 N., R. 7 W.):

- Ap—0 to 8 inches, black (10YR 2/1) to very dark gray (10YR 3/1) silt loam; weak, fine and medium, granular structure; friable; medium acid; abrupt, smooth boundary.
- A12—8 to 10 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.
- A3—10 to 14 inches, dark grayish-brown (10YR 4/2) to dark-gray (10YR 4/1) silt loam; few, very dark gray (10YR 3/1) mottles; weak, fine, subangular blocky structure; firm; strongly acid; clear, smooth boundary.
- B21—14 to 24 inches, dark grayish-brown (10YR 4/2) to grayish-brown (10YR 5/2) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure that breaks to moderate, fine, subangular blocky structure; firm; very dark gray (10YR 3/1) organic matter in root channels and on ped faces; strongly acid; clear, smooth boundary.
- B22—24 to 38 inches, yellowish-brown (10YR 5/6 to 5/8) silty clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; firm; dark-gray (10YR 4/1) clay films on ped faces; strongly acid to slightly acid; clear, smooth boundary.
- IIB23—38 to 46 inches, gray (10YR 5/1) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; dark-gray (10YR 4/1) clay films in root channels and on ped faces; firm; neutral; abrupt, smooth boundary.
- IIC—46 inches +, mottled gray to light-gray (10YR 6/1) and brownish-yellow (10YR 6/6) loam till; massive; friable; calcareous.

The A horizon ranges from 12 to 16 inches in thickness. Mottling is at a depth of 10 to 15 inches, and leaching is to a depth of 42 to 70 inches. Silt loam is the only type mapped in the county.

Reesville series

The Reesville series consists of Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Reesville soils developed in 3 to 7 feet of neutral or calcareous loess that is underlain by calcareous glacial till of Wisconsin age. These nearly level and gently sloping soils of the till plains developed under deciduous forest.

The Reesville soils are the somewhat poorly drained members of the catena that includes the moderately well drained Birkbeck soils and the very poorly drained Ragsdale soils. Surface runoff of Reesville soils is very slow, and permeability is slow.

The A and B horizons of Reesville soils developed in loess, but the lower B horizon of Fincastle soils developed in weathered till. Instead of loess, the Ayrshire soils developed in coarse silt and fine sand.

Table 15 lists analytical data for a profile of Reesville silt loam.

TABLE 15.—Analytical data for Reesville silt loam sampled 5 miles northeast of Covington (NE¼SW¼ sec. 9, T. 20 N., R. 8 W.)

MECHANICAL ANALYSIS

Horizon	Depth	Particle-size distribution (in millimeters)								Texture
		Very coarse sand (2.0-1.0)	Coarse sand (1.0-0.5)	Medium sand (0.5-0.25)	Fine sand (0.25-0.10)	Very fine sand (0.10-0.05)	Silt (0.05-0.002)	Clay (<0.002)	>2	
Ap	0-7	0.8	1.9	2.8	4.9	7.4	70.8	11.4	(2)	Silt loam.
A2	7-10	1.3	1.2	1.6	2.7	6.0	68.5	19.7	-----	Silt loam.
B1	10-13	1.2	1.6	1.0	1.8	4.9	65.1	26.4	-----	Silt loam.
B21	13-19	<.1	1.3	.6	1.2	4.3	61.7	31.9	-----	Silty clay loam.
B22	19-24	1.1	1.5	.8	1.3	6.1	64.4	26.8	(2)	Silt loam bordering silty clay loam.
B3	24-29	3.3	1.2	1.3	1.9	7.1	68.0	20.2	(2)	Silt loam.
C1	29-37	3.8	1.8	1.9	2.5	8.6	70.6	13.8	(2)	Silt loam.
C2	37-49	3.8	5.5	8.2	11.2	5.2	54.8	11.3	5	Silt loam.
IIC3	49-62	3.9	9.1	15.0	21.1	5.0	31.6	14.3	13	Fine sandy loam.

CHEMICAL ANALYSIS

Horizon	Depth	pH (1:1)	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxides (Fe ₂ O ₃)	Cation exchange capacity (NH ₄ OAc)	Extractable cations (meq. per 100 gm.)					Base saturation (NH ₄ OAc)	Base saturation on sum of cations	Calcium-magnesium ratio	
								Ca	Mg	H	Na	K				Sum of cations
Ap	0-7	6.3	0.88	0.081	11	0.9	8.1	5.8	1.1	3.4	0.1	0.2	10.6	89	68	5.3
A2	7-10	5.9	.30	.039	8	1.0	12.0	7.6	2.7	4.2	.1	.2	14.8	88	72	2.8
B1	10-13	5.8	.35	.044	8	1.3	17.0	10.6	4.4	4.7	.1	.3	20.1	90	77	2.4
B21	13-19	6.1	.34	.046	7	1.7	21.9	13.5	7.1	5.0	.1	.4	26.1	96	81	1.9
B22	19-24	6.7	.32	.40	8	1.9	19.8	12.8	6.7	3.2	.1	.4	23.2	101	86	1.9
B3	24-29	7.7	.21	-----	-----	1.9	15.7	14.3	5.8	1.2	.1	.3	21.7	130	94	2.5
C1	29-37	4 7.9	.16	-----	-----	1.7	10.5	12.9	4.9	.5	<.1	.2	18.5	171	97	2.6
C2	37-49	6 8.0	.13	-----	-----	1.5	7.7	16.2	3.2	<.1	<.1	.1	19.5	253	100	5.1
IIC3	49-62	6 8.1	.12	-----	-----	1.6	5.8	16.5	2.5	<.1	<.1	.1	19.1	329	100	6.6

¹ Few concretions, probably iron and manganese.
² Trace.
³ Few carbonates; calcareous aggregates and limestone fragments.

⁴ Calcium carbonate equivalent amounts to 25 percent of horizon.
⁵ Calcium carbonate equivalent amounts to 20 percent of horizon.
⁶ Calcium carbonate equivalent amounts to 15 percent of horizon.

Profile of Reesville silt loam in a cultivated field (SE¼SW¼ sec. 25, T. 18 N., R. 7 W.):

- Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
- B1—7 to 13 inches, grayish-brown (10YR 5/2) heavy silt loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; slightly acid; clear, smooth boundary.
- B2—13 to 39 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; many, coarse, distinct, yellowish-brown (10YR 5/8) and brown (10YR 5/3) mottles; moderate, medium, prismatic to subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- C1—39 to 48 inches, yellowish-brown (10YR 5/6) silt loam; light brownish-gray (10YR 6/2) mottles; massive; neutral; gradual, smooth boundary.
- C2—48 to 64 inches, yellowish-brown (10YR 5/6) silt; light brownish-gray (10YR 6/2) mottles; massive; calcareous.
- IIC3—64 inches +, yellowish-brown (10YR 5/4) loam to coarse clay loam till; calcareous.

The depth to the underlying till ranges from 36 to 84 inches. In some areas there are several inches of interbedded fine sand and silt in the C horizon. In areas of Reesville soils that grade toward the Birkbeck soils, the depth to mottling is more than 7 inches. The A horizon ranges from 7 to 10 inches in thickness, and in some places an A2 horizon is visible. Silt loam is the only type mapped in this county.

Rodman series

The Rodman series consists of Brown Forest soils that intergrade toward weakly developed Gray-Brown Podzolic soils. Rodman soils developed in highly calcareous stratified gravel and sand of Wisconsin age. These soils are on strong to very steep terrace escarpments. They generally occur between the Ockley soils on the higher terraces and the Fox soils on the lower terraces. The native vegetation was oak, hickory, poplar, and other hardwoods.

The organic-matter content of Rodman soils is low. Surface runoff is rapid or very rapid, and permeability is rapid.

The Rodman soils are shallower than the Hennepin soils and are underlain by gravel and sand rather than by loam till. They are less acid than the Muskingum soils and lack the sandstone, siltstone, and shale that occur in those soils.

Profile of Rodman gravelly loam (SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 20 N., R. 9 W.):

- A1—0 to 8 inches, very dark gray (10YR 3/1) gravelly loam; weak, fine, granular structure; very friable; neutral; clear, smooth boundary.
- A2—8 to 13 inches, dark yellowish-brown (10YR 3/4) gravelly loam; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.
- IIC—13 inches +, dark yellowish-brown (10YR 4/4) and gray (10YR 6/1) gravel and sand; single grain; loose; calcareous.

Calcareous material is commonly at the surface, and many boulders and large stones are on the surface. The calcareous gravel and sand are normally at a depth of 10 to 15 inches. In some places a faint B horizon of loam occurs where the thickness of the solum approaches 19 inches. In this county Rodman soils are mapped only in gravelly complexes.

Romney series

The Romney series consists of Humic Gley soils that developed in 18 to 40 inches of loess underlain by material weathered from calcareous loam till of Wisconsin age. The calcareous loam till occurs at a depth of 42 inches or more. These soils are on flats and depressions of the upland till plains, generally in the prairie grass region. They developed under marsh grasses.

Romney soils are the very poorly drained, very dark colored members of the catena that includes the well drained Sidell and Parr soils, the moderately well drained Dana soils, and the somewhat poorly drained Raub soils. Surface runoff of Romney soils is very slow or ponded, and permeability is slow or very slow. The content of organic matter is high.

Profile of Romney silty clay loam (SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 21 N., R. 7 W.):

- Ap—0 to 6 inches, black (10YR 2/1) to very dark brown (10YR 2/2) light silty clay loam; moderate, fine and medium, granular structure; firm; slightly acid; clear, smooth boundary.
- A12—6 to 11 inches, black (10YR 2/1) or very dark gray (10YR 3/1) light silty clay loam; moderate, medium, subangular blocky structure; firm; slightly acid or neutral; clear, smooth boundary.
- A13—11 to 19 inches, black (10YR 2/1) silty clay loam; moderate, fine, angular and subangular blocky structure; firm; neutral; clear, smooth boundary.
- B21g—19 to 27 inches, black (10YR 2/1) to very dark gray (10YR 3/1) silty clay loam to silty clay; moderate, medium, prismatic structure that breaks to strong, fine and medium, angular blocky structure; firm; neutral; clear, smooth boundary.
- B22g—27 to 36 inches, dark-gray (5Y 4/1) to gray (5Y 5/1) silty clay loam; few, fine, prominent, yellowish-brown (10YR 5/6) mottles; strong, coarse, prismatic structure that breaks to strong, medium and coarse, angular blocky structure; very firm; black (10YR 2/1) clay films on peds and in root channels; neutral; clear, smooth boundary.
- IIB23g—36 to 46 inches, dark-gray (5Y 4/1) and gray (5Y 5/1) clay loam; common, fine, prominent, yellowish-brown (10YR 5/8) mottles; strong, coarse, angular blocky

structure; very firm; black (10YR 2/1) clay films on ped faces and in cracks; neutral; clear, smooth boundary.

- IIB24g—46 to 53 inches, gray (5Y 5/1) and light-gray (5Y 6/1) clay loam; common, medium, prominent, yellowish-brown (10YR 5/8) mottles; moderate, medium and coarse, subangular blocky structure; firm; black (10YR 2/1) clay films on ped faces; neutral; clear, smooth boundary.
- IIC1g—53 to 60 inches, gray (5Y 5/1) and yellowish-brown (10YR 5/8) loam; massive; friable; very dark gray (5Y 3/1) clay films in root channels; neutral; abrupt, smooth boundary.
- IIC2g—60 inches +, gray (5Y 5/1) and yellowish-brown (10YR 5/8) loam till; massive; friable; calcareous.

The A horizon ranges from 10 to 22 inches in thickness. Leaching is to a depth of 42 to 70 inches. In many places 2 to 4 inches of assorted sandy and gravelly material separate the loess and the till. Silty clay loam is the only type mapped in this county.

Russell series

The Russell series consists of Gray-Brown Podzolic soils that developed in 18 to 40 inches of loess underlain by material weathered from calcareous loam till of Wisconsin age. These soils are on gentle to steep slopes of the upland till plains. They developed under oak, poplar, hickory, and other hardwoods.

The Russell soils are the well drained members of the catena that includes the moderately well drained Xenia soils; the somewhat poorly drained Fincastle soils; the poorly drained, light-colored Delmar soils; and the very poorly drained, dark-colored Brookston soils. Surface runoff of Russell soils is slow to very rapid, and permeability is moderate. The content of organic matter is low.

The Russell soils have a lighter colored, generally thinner A horizon than Sidell soils. The loess of the Russell soils is 18 to 40 inches thick, but that of the Miami soils is only 0 to 18 inches thick. The lower subsoil of Russell soils developed in loam till, but Alford soils developed entirely in loess.

Profile of Russell silt loam (SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 19 N., R. 8 W.):

- Ap—0 to 7 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; friable; slightly acid; clear, smooth boundary.
- A2—7 to 10 inches, brown (10YR 5/3) silt loam; weak, thin, platy structure; friable; slightly acid; clear, smooth boundary.
- B1t—10 to 13 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- B21t—13 to 26 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.
- IIB22t—26 to 42 inches, dark yellowish-brown (10YR 4/4) heavy clay loam; moderate, medium and coarse, subangular blocky structure; dark grayish-brown (10YR 4/2) silt coatings on ped faces; firm; slightly acid; clear, smooth boundary.
- IIC1—42 to 47 inches, yellowish-brown (10YR 5/8) loam; massive; friable; neutral; abrupt, irregular boundary.
- IIC2—47 inches +, yellowish-brown (10YR 5/4 to 5/6) loam till; massive; friable; calcareous.

In most places the loess is almost 40 inches thick. It is thickest in areas where the Russell soils grade toward the Alford soils, and in these areas the subsoil is less gritty than it is elsewhere. Depth to carbonates range from 42 to 70 inches. In many places gray coatings of silt

are on the ped faces. Silt loam is the only type mapped in the county.

Shadeland series

The Shadeland series consists of somewhat poorly drained Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Shadeland soils developed in 15 to 36 inches of weathered glacial drift of Wisconsin age that is underlain by interbedded acid sandstone, shale, and siltstone. They occur on nearly level areas of terraces and the tops of ridges, where they developed under deciduous forest.

The Shadeland soils are the somewhat poorly drained members of the catena that includes the well-drained High Gap soils. Surface runoff and permeability are slow.

The Shadeland soils have a thinner solum and are more strongly acid than Crosby and Fincastle soils and are underlain by sandstone, shale, and siltstone rather than by calcareous till.

Profile of Shadeland silt loam in a pasture (NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 24, T. 20 N., R. 9 W.):

- A1—0 to 3 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; slightly acid; clear, smooth boundary.
- A2—3 to 10 inches, gray (10YR 6/1) silt loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; medium acid; gradual, smooth boundary.
- B21tg—10 to 20 inches, yellowish-brown (10YR 5/8) silty clay loam; many, coarse, distinct, pale-brown (10YR 6/2) mottles; moderate, fine and medium, subangular blocky structure; firm; strongly acid; gradual, smooth boundary.
- B22tg—20 to 24 inches, gray (N 5/0) silty clay loam; many, medium and coarse, prominent, strong-brown (7.5YR 5/8) mottles; moderate, medium, angular and subangular blocky structure; firm; dark-gray (N 4/0) organic stains on ped surfaces; strongly acid; clear, smooth boundary.
- IIB3—24 to 33 inches, yellowish-red (5YR 5/8) silty clay loam; common, medium, distinct, gray (N 5/0) mottles; massive; firm; many sandstone fragments $\frac{1}{2}$ to 1 inch thick and 4 to 15 inches long; strongly acid; abrupt, wavy boundary.
- IIR—33 inches +, partly weathered, thinly bedded sandstone that grades to unweathered sandstone.

The depth to bedrock generally ranges from 18 to 30 inches, but it is about 40 inches in areas where Shadeland soils grade toward Crosby and Fincastle soils. The A and B horizons developed in till in some areas and in outwash material in others. In some places loess 10 inches thick caps the till or outwash material. Silt loam is the only type mapped in the county.

Shoals series

The Shoals series consists of medium-textured and moderately fine textured Alluvial soils that developed in material washed from neutral or calcareous drift of Wisconsin age. Shoals soils are on flats and in depressions of the bottom lands of rivers and creeks. Their native vegetation was maple, cottonwood, sycamore, and other hardwoods.

Shoals soils are the somewhat poorly drained members of the catena that includes the well drained Genesee soils, the moderately well drained Eel soils, and the very poorly drained, dark-colored Sloan soils. Surface runoff

of Shoals soils is very slow or slow, and permeability is moderately slow or slow.

The Shoals soils are mottled at a depth below 6 inches, but the Eel soils are mottled below 18 inches. Shoals soils are lighter colored than Sloan soils.

Profile of Shoals silt loam (NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 19 N., R. 9 W.):

- Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.
- C1—6 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; neutral; clear, smooth boundary.
- C2—12 to 20 inches, dark-gray (10YR 4/1) silt loam; many, medium, prominent, dark reddish-brown (2.5YR 3/4) mottles; weak, coarse, subangular blocky structure; friable; neutral; abrupt, smooth boundary.
- C3—20 to 40 inches +, dark-gray (10YR 4/1) silt loam; massive; friable; calcareous.

The A horizon ranges from 4 to 10 inches in thickness and from grayish brown (10YR 5/2) to a very dark gray (10YR 3/1) in color. The layers in the C horizon vary in thickness and range from sandy loam to silty clay loam. They are silty clay loam in only a few places. In places thin smears of sand separate the layers in the C horizon. These soils are slightly acid or calcareous. Silt loam and silty clay loam are the only types mapped in this county.

Sidell series

The Sidell series consists of Brunizems that developed in thin deposits of loess underlain by material weathered from loam till of Wisconsin age. Calcareous loam till is at a depth of 42 to 70 inches. These soils occur on nearly level and gently sloping uplands of the till plains. Their native vegetation was tall prairie grasses.

Sidell soils are the well drained members of the catena that includes the moderately well drained Dana soils, the somewhat poorly drained Raub soils, and the very poorly drained, very dark colored Romney soils. Surface runoff of Sidell soils is slow or medium, and permeability is moderate. The content of organic matter is high.

The A horizon of Sidell soils is darker colored and thicker than that of the Russell soils, and the subsoil is generally darker colored. Carbonates in the Sidell soils are at a greater depth than those in the Parr soils, which are at a depth of only 24 to 42 inches. The entire subsoil of Sidell soils is less gritty and contains less sand and fewer pebbles than that of the Parr soils.

Profile of Sidell silt loam (NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 20 N., R. 6 W.):

- Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.
- A12—7 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, coarse, granular structure; friable; neutral or slightly acid; clear, smooth boundary.
- B21t—11 to 15 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine, subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- B22t—15 to 29 inches, dark yellowish-brown (10YR 4/4) silty clay loam; strong, fine and medium, subangular blocky structure; friable when moist, sticky when wet; medium acid; clear, smooth boundary.
- IIB23t—29 to 38 inches, yellowish-brown (10YR 5/4) clay loam; weak, coarse, subangular blocky structure; friable; medium acid; clear, smooth boundary.

IIB3—38 to 55 inches, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) clay loam; massive; friable; medium acid; abrupt, smooth boundary.

IIC—55 inches +, brown (10YR 5/3) and grayish-brown (10YR 5/2) loam till; massive; friable; calcareous.

The A horizon ranges from 10 to 14 inches in thickness. In most places the Sidell soils developed in about 40 inches of loess. They are leached to a depth of 42 to 70 inches.

Sleeth series

The Sleeth series consists of Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Sleeth soils developed in 0 to 36 inches or more of silty material underlain by loamy or gravelly outwash. Stratified gravel and sand of Wisconsin age occur at a depth of 42 to about 72 inches. These soils are on nearly level areas of high terraces and outwash plains. They developed under oak, hickory, beech, elm, and other hardwoods.

Sleeth soils are the somewhat poorly drained members of the catena that includes the well-drained Ockley soils and the very poorly drained, dark-colored Westland soils. Surface runoff of Sleeth soils is slow or very slow, and permeability is moderately slow. The content of organic matter is low.

Sleeth soils have a thinner, lighter colored A horizon than Crane soils. Gravel and sand underlie the Sleeth soils, but Whitaker soils are underlain by stratified sand, silt, and some gravel.

Table 16 lists analytical data for a profile of Sleeth silt loam.

Profile of Sleeth silt loam (SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 20 N., R. 6 W.):

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

A2—7 to 10 inches, grayish-brown (2.5YR 5/2) silt loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, thin, platy structure; friable; medium acid; clear, smooth boundary.

B1—10 to 14 inches, mottled yellowish-brown (10YR 5/4) and gray (10YR 5/1) light silty clay loam; moderate, fine and medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.

B21t—14 to 21 inches, gray (10YR 5/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate and strong, medium, angular blocky structure; firm; strongly acid; clear, smooth boundary.

B22t—21 to 29 inches, mottled gray (10YR 5/1) and yellowish-brown (10YR 5/8) silty clay loam; moderate, medium, prismatic structure that breaks to moderate, medium, angular blocky structure; firm; strongly acid; gradual, smooth boundary.

B23t—29 to 37 inches, gray (10YR 5/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, prismatic structure that breaks to weak, coarse, angular blocky structure; firm; medium acid; clear, smooth boundary.

IIB31—37 to 50 inches, gray (10YR 5/1) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

IIB32—50 to 60 inches, dark-gray (10YR 4/1) and yellowish-brown (10YR 5/6) gravelly sandy clay loam; weak, coarse, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIC—60 inches +, light olive-brown (2.5Y 5/4) and yellowish-brown (10YR 5/8) stratified fine sand and gravel; single grain; loose; calcareous.

The loess ranges from 20 to 36 inches or more in thickness but is generally 30 inches thick. Calcareous sand and gravel are at a depth of 42 to 70 inches. Depth to mottling ranges from 7 to 12 inches. The underlying IIC horizon ranges from 6 to 12 feet in thickness and consists of fine or medium gravel and sand.

Sloan series

The Sloan series consists of Humic Gley soils that developed in recent alluvium that washed from areas of highly calcareous glacial drift of Wisconsin age. These soils are in nearly level or depressional areas of the bottom lands along rivers. They developed under deciduous swamp trees and water-tolerant grasses and shrubs.

The Sloan soils are the dark-colored, very poorly drained members of the catena that includes the well drained Genesee and Landes soils, the moderately well drained Eel soils, and the somewhat poorly drained Shoals soils. Surface runoff of Sloan soils is ponded, and internal drainage is very slow.

The Sloan soils are deeper than the Westland soils, which are underlain by calcareous sand and gravel.

Profile of Sloan silty clay loam in a cultivated field (NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T. 19 N., R. 9 W.):

Ap—0 to 6 inches, very dark brown (10YR 2/2) light silty clay loam; moderate, weak, granular structure; firm; neutral; abrupt, smooth boundary.

A12—6 to 17 inches, very dark gray (N 3/0) silty clay loam; common, medium, prominent, dark reddish-brown (5YR 3/4) mottles; weak, medium, prismatic structure that breaks to moderate, medium and fine, angular blocky structure; firm; neutral; gradual, smooth boundary.

B21g—17 to 30 inches, dark-gray (N 4/0) silty clay loam; many, medium, prominent, dark reddish-brown (5YR 3/4) mottles; weak, prismatic structure that breaks to weak, medium and coarse, subangular blocky structure; firm; neutral; gradual, smooth boundary.

B3g—30 to 55 inches, dark-gray (N 4/0) silty clay loam; common, medium, prominent, dark reddish-brown (5YR 3/4) mottles; weak, coarse, subangular blocky structure; firm; few soft black manganese and iron concretions; neutral.

IICg—55 to 75 inches +, gray (10YR 5/1 to 6/1) sandy clay loam; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; massive; friable; many soft black manganese and iron concretions; neutral.

Recent accumulations that are 2 to 7 inches thick and range from silt loam to silty clay loam are scattered through areas of Sloan soils. The layers beneath the A horizon range from sandy clay loam to silty clay loam. In a few places lenses of silt or sand occur in these layers. Near the center of areas of Sloan soils, the profile is thickest and the organic-matter content is greatest. In this county the types mapped are silt loam and silty clay loam.

Sunbury series

The Sunbury series consists of somewhat poorly drained Gray-Brown Podzolic soils that intergrade toward Brunizems. Sunbury soils developed in loess that is 4 to 7 feet thick and is underlain by calcareous loam till of Wisconsin age. These soils are nearly level and formed under prairie grasses and scattered deciduous trees.

Sunbury soils are the somewhat poorly drained members of the catena that includes the very poorly drained,

TABLE 16.—Analytical data for Sleeth silt loam (SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T. 20 N., R. 6 W.)

MECHANICAL ANALYSIS

Horizon	Depth	Particle-size distribution (in millimeters)								Texture
		Very coarse sand (2.0-1.0)	Coarse sand (1.0-0.5)	Medium sand (0.5-0.25)	Fine sand (0.05-0.10)	Very fine sand (0.10-0.05)	Silt (0.05-0.002)	Clay (<0.002)	>2	
Ap-----	Inches 0-7	Percent 2.0	Percent 3.7	Percent 3.6	Percent 4.1	Percent 1.9	Percent 70.1	Percent 14.6	Percent (4)	Silt loam.
A2-----	7-10	1.5	2.0	2.1	2.3	1.3	70.2	21.6	(4)	Silt loam.
B1-----	10-14	1.5	1.0	2.9	1.0	1.0	63.3	32.3	-----	Silty clay loam.
B21t-----	14-21	<.1	2.2	2.3	2.4	1.2	59.9	38.0	(4)	Silty clay loam.
B22t-----	21-29	1.1	2.4	2.4	2.5	1.8	62.3	34.5	-----	Silty clay loam.
B23t-----	29-37	1.3	1.8	2.2	3.2	3.1	58.5	30.9	-----	Silty clay loam.
IIB31-----	37-50	5.8	11.0	12.8	17.9	5.1	26.0	21.4	12	Sandy clay loam.
IIIB32-----	50-63	9.8	22.2	27.1	19.3	2.2	8.0	11.4	21	Coarse sandy loam.
IIIC-----	63-73	5 13.9	5 15.0	5 14.5	5 37.2	5 5.5	9.7	4.2	21	Loamy coarse sand.

CHEMICAL ANALYSIS

Horizon	Depth	pH (1:1)	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxides (Fe ₂ O ₃)	Cation exchange capacity (NH ₄ OAc)	Extractable cations (meq. per 100 gm.)					Base saturation (NH ₄ OAc)	Base saturation on sum of cations	Calcium-magnesium ratio	
								Ca	Mg	H	Na	K				Sum of cations
Ap-----	Inches 0-7	5.9	Percent 1.08	Percent 0.107	10	1.6	Meq./100 gm. 10.1	6.2	1.4	6.1	<.1	0.3	14.0	Percent 78	Percent 56	4.4
A3-----	7-10	4.6	.32	.045	7	1.6	10.7	3.9	1.2	9.3	<.1	.2	14.6	50	36	3.2
B1-----	10-14	4.5	.27	.041	7	1.7	16.7	6.0	2.9	13.2	.1	.3	22.5	56	41	2.1
B21-----	14-21	4.5	.26	.037	7	1.8	23.1	8.7	5.5	15.4	.1	.5	30.2	64	49	1.6
B22-----	21-29	4.6	.24	.033	7	2.2	21.2	9.1	6.3	12.6	.1	.4	28.5	75	56	1.4
B23-----	29-37	5.3	.20	-----	-----	2.0	20.6	11.6	7.4	6.2	.1	.5	25.8	95	76	1.6
IIB24-----	37-50	6.3	.10	-----	-----	1.5	14.8	9.3	5.5	3.2	.1	.3	18.4	103	83	1.7
IIIB3-----	50-63	6.9	.16	-----	-----	1.4	7.2	4.7	2.3	1.2	.1	.2	8.5	101	86	2.0
IIIC-----	63-73	8.3	.21	-----	-----	1.0	1.7	18.7	.9	<.1	<.1	<.1	19.6	1, 153	100	20.8

¹ Many concretions, probably iron and manganese.
² Common concretions, probably iron and manganese.
³ Few concretions, probably iron and manganese.

⁴ Trace.
⁵ Few carbonates and some limestone fragments.

dark-colored Ragsdale soils. Surface runoff of Sunbury soils is very slow, and permeability is slow.

Sunbury soils have a thicker, darker colored A horizon than the Reesville soils.

Profile of Sunbury silt loam in a cultivated field (SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 26, T. 20 N., R. 8 W.):

- Ap—0 to 7 inches, very dark gray (10YR 3/1) to very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.
- A2—7 to 11 inches, dark-gray (10YR 4/1) silt loam; weak, medium and thick, platy structure; friable; neutral; abrupt, smooth boundary.
- Bit—11 to 15 inches, grayish-brown (10YR 5/2) light silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/4 to 5/6) mottles; moderate, medium, subangular blocky structure; friable; many small rounded iron and manganese concretions; slightly acid; clear, wavy boundary.
- B2t—15 to 37 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6 to 5/8) mottles; moderate and strong, medium, subangular blocky structure; firm; many small rounded iron and manganese concretions; slightly acid; clear, wavy boundary.

B3—37 to 43 inches, pale-brown (10YR 6/3) heavy silt loam; many, fine and medium, distinct, brownish-yellow (10YR 6/6 to 6/8) mottles; weak, medium, subangular blocky structure; friable; many small rounded iron and manganese concretions and stains; slightly acid.

C1—43 to 47 inches, mottled light brownish-gray (10YR 6/2), light yellowish-brown (10YR 6/4), and brownish-yellow (10YR 6/6) silt loam or silt; massive; many iron and manganese concretions and stains; friable; neutral; clear, wavy boundary.

C2—47 to 83 inches, light yellowish-brown (10YR 6/4) silt; massive; friable; calcareous; clear, wavy boundary.

IIIC3—83 inches +, calcareous loam till.

The silt ranges from about 48 to approximately 84 inches in thickness. In undisturbed areas, the A1 horizon ranges from 6 to 10 inches in thickness. The A2 horizon ranges from 2 to 6 inches. Leaching is to a depth of about 35 to 55 inches. In some places the silt is underlain by calcareous loam till and in others by stratified calcareous sand, silt, and gravel.

Tawas series

The Tawas series consists of Bog soils developed in woody and fibrous organic material that is 12 to 42

inches thick and is underlain by neutral or calcareous sand of Wisconsin age. The organic material in these soils is from deciduous trees and reeds, sedges, and grasses. These soils occur in nearly level or depressional areas on bottom lands near the breaks between bottoms and terraces.

Surface runoff of Tawas soils is very slow or ponded, and permeability is moderate or moderately rapid.

The Tawas soils consists of organic material underlain by sand and gravelly material at a depth of 12 to 42 inches, in contrast to the Wallkill soils, which have 10 to 40 inches of mineral material underlain by muck and peat. Tawas soils lack the marl that underlies Marl beds.

Profile of Tawas muck (NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 20 N., R. 9 W.):

- 1—0 to 4 inches, very dark brown (10YR 2/2) muck that contains variable amounts of undecomposed organic matter and some remains of woody material; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
- 2—4 to 14 inches, very dark gray (10YR 3/1) muck; weak, coarse, granular structure; friable; neutral or slightly acid; clear, smooth boundary.
- 3—14 to 32 inches, very dark gray (N 3/0) muck and a small amount of partly decomposed peat; weak, very coarse, granular structure; root channels filled with sand to loamy sand; friable; neutral or slightly alkaline; abrupt, wavy boundary.
- IIC—32 inches +, pale-olive (5Y 6/4) sandy loam to loamy sand; single grain; loose; calcareous.

The surface layer consists of well-decomposed muck, partly decomposed wood and fibrous fragments, and peat. The surface layer ranges from very dark brown (10YR 2/2) to black (10YR 2/1). In some areas the sand and loamy sand have been mixed considerably with the organic matter in the top horizons. The mineral material ranges from highly calcareous sandy loam to loose sand and gravel. Muck is the only type mapped in this county.

Tippecanoe series

The Tippecanoe series consists of Brunizems that developed in 0 to 36 inches of silty material underlain by loamy or gravelly outwash. Stratified calcareous sand and gravel of Wisconsin age occur at a depth of 42 to 70 inches. These soils are on nearly level outwash plains. Their native vegetation was prairie grasses.

Tippecanoe soils are the moderately well drained members of the catena that includes the well drained Wea soils, the somewhat poorly drained Crane soils, and the very poorly drained, dark-colored Westland soils. Surface runoff of Tippecanoe soils is slow, and permeability is moderate in the upper subsoil and moderately slow in the lower subsoil. The content of organic matter is high.

The upper subsoil of Tippecanoe soils is uniformly brown and free of mottling, but the entire subsoil of Wea soils is unmottled brown and the entire subsoil of Crane soils is mottled.

Profile of Tippecanoe silt loam (NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 21 N., R. 6 W.):

- Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; weak, coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A12—8 to 12 inches, black (10YR 2/1) to very dark gray (10YR 3/1) silt loam; weak, coarse, granular structure; friable; medium acid; clear, smooth boundary.

A3—12 to 16 inches, dark gray (10YR 4/1) to very dark gray (10YR 3/1) silt loam; weak, fine and medium, subangular blocky structure; friable; very dark brown (10YR 2/2) organic stains on ped faces; medium acid; gradual, smooth boundary.

B1—16 to 19 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, fine and medium, subangular blocky structure; friable; dark-gray (10YR 4/1) stains on ped faces; medium acid; gradual, smooth boundary.

B21t—19 to 29 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; strongly acid; gradual, smooth boundary.

IIB22t—29 to 38 inches, grayish-brown (10YR 5/2) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; medium acid; clear, smooth boundary.

IIB31—38 to 49 inches, dark-brown (10YR 3/3 and 4/3) sandy clay loam to heavy sandy loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; many shale fragments and coarse gravel; medium acid; gradual, smooth boundary.

IIB32—49 to 66 inches, dark grayish-brown (10YR 4/2) and dark-brown (10YR 3/3) sandy loam; massive; very friable; medium acid; abrupt, smooth boundary.

IIIC—66 inches +, dark-brown (10YR 3/3) and gray (10YR 5/1) stratified gravel and sand; single grain; loose; calcareous.

The surface layer ranges from very dark brown (10YR 2/2) to black (10YR 2/1) or very dark grayish brown (10YR 3/2). The A horizon is 10 to 17 inches thick. Mottling is at a depth of 15 to 30 inches, and leaching is to a depth of 42 to 70 inches. Silt loam is the only type mapped in this county.

Wallkill series

The Wallkill series consists of Alluvial soils that developed in moderately fine textured and medium-textured alluvium underlain by woody or fibrous muck of Wisconsin age. These soils are flat or depressional and occur in abandoned river channels and in pockets of smaller stream bottoms. Surface runoff is very slow or ponded, and permeability is moderate.

Wallkill soils consist of mineral material underlain by muck and peat at a depth of 10 to 40 inches, but the Tawas soils consists of organic material underlain by sandy and gravelly material at a depth of 12 to 42 inches.

Profile of Wallkill silty clay loam (NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 12, T. 20 N., R. 9 W.):

Ap—0 to 8 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

C—8 to 14 inches, very dark gray (10YR 3/1) fine silt loam; common, fine, distinct, dark grayish-brown (10YR 4/2) mottles; moderate, medium and coarse, subangular blocky structure; firm; neutral; abrupt, smooth boundary.

III—14 to 22 inches, very dark brown (10YR 2/2) muck with partly decomposed roots; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

II2—22 to 34 inches, black (10YR 2/1) muck with partly decomposed roots and grass fibers; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

II3—34 to 42 inches, black (10YR 2/1) and very dark gray (10YR 3/1) muck with coarse fibrous roots and partly decomposed grass; weak, thick, platy structure; friable; neutral; abrupt, smooth boundary.

II4—42 inches +, grayish-brown (2.5Y 5/2) decomposed organic material with partly decomposed roots and fibers; weak, thick, platy structure; friable; slightly alkaline.

In some places the muck in these soils is less than 1 foot thick. The platy structure is very noticeable in the II3 and II4 layers, and gray (10YR 6/1) silt and clay films are on some surfaces of the plates. Silty clay loam is the only type mapped in this county.

Warsaw series

The Warsaw series consists of Brunizems developed in loamy or silty material and are underlain by loamy and gravelly outwash. Stratified coarse gravel and sand of Wisconsin age occur at a depth of 24 to about 42 inches. These soils are in nearly level to sloping areas of terraces and outwash plains. Their native vegetation was prairie grasses.

The Warsaw soils occur with the Westland soils, which are in the Humic Gley great soil group. Warsaw soils have slow or medium surface runoff and moderate permeability.

Carbonates are at a depth of 24 to 42 inches in the Warsaw soils and at a depth of 42 to 70 inches in the Wea soils. Warsaw soils have a coarser textured B horizon than the Wea soils and a thicker, darker colored A horizon than the Fox soils. Warsaw soils are not so deep as the Elston soils and contain less sand but more gravel.

Profile of Warsaw loam (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 13, T. 20 N., R. 9 W.):

- Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; neutral; clear, smooth boundary.
- A12—8 to 14 inches, very dark brown (10YR 2/2) loam; weak, thin, platy structure that breaks to weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.
- IIB1—14 to 17 inches, very dark grayish-brown (10YR 3/2) to dark-brown (10YR 3/3) light gravelly loam; weak, fine and medium, subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- IIB21—17 to 24 inches, dark-brown (10YR 3/3) to dark yellowish-brown (10YR 3/4) gravelly loam; weak, medium and coarse, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- IIB22t—24 to 32 inches, very dark grayish-brown (10YR 3/2) gravelly clay loam; moderate, medium and coarse, subangular blocky structure; firm; slightly acid; clear, wavy boundary.
- IIB23t—32 to 38 inches, dark yellowish-brown (10YR 3/4) gravelly clay loam; moderate, medium, subangular blocky structure; firm; slightly acid or neutral; abrupt, irregular boundary.
- IIIC—38 inches +, light brownish-gray (10YR 6/2) stratified coarse gravel and sand; single grain; loose; calcareous.

The A horizon ranges from 10 to 16 inches in thickness and from very dark brown (10YR 2/2) to black (10YR 2/1) in color. The B horizon ranges from fine gravelly clay loam to very coarse gravelly clay loam. Tongues of material from the IIB23t horizon extend into the IIIC horizon for 8 to 12 inches. The IIB horizon is nearly neutral in some areas, but generally it is medium acid or slightly acid. Silt loam and loam types are mapped in the county. The silt loam occurs in low areas and in some places has an upper subsoil of silty clay loam.

Washtenaw series

In the Washtenaw series are very poorly drained Alluvial soils consisting of 10 to 40 inches of moderately dark colored to light-colored alluvium or colluvium that was recently deposited on dark colored, very poorly drained mineral soils. Washtenaw soils occupy nearly level and depressional areas of till plains and outwash plains.

Surface runoff and permeability are very slow.

Washtenaw soils formed in material that differs from that of Brookston and Westland soils. Washtenaw soils formed in recent alluvium or colluvium underlain by older mineral soils, but Brookston soils developed in silty material underlain by loam and silt loam till, and Westland soils developed in outwash material underlain by sand and gravel. In the Washtenaw soils the washed-in material was deposited on mineral soils, but in the Walkkill soils it was deposited on organic material.

Profile of Washtenaw silt loam in a meadow of clover and timothy (NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 22 N., R. 7 W.):

- Ap—0 to 6 inches, mixed dark grayish-brown (10YR 4/2) and light brownish-gray (10YR 6/2) silt loam; weak, medium, granular structure; friable; many fine roots; neutral; clear, smooth boundary.
- C1—6 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; common, medium, distinct, brown (10YR 5/3) mottles; weak, thin, platy structure; friable; many fine roots; neutral; gradual, smooth boundary.
- C2—9 to 16 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, distinct, brown (10YR 5/3) mottles; massive; friable; many fine roots; neutral; gradual, smooth boundary.
- C3—16 to 22 inches, very dark gray (10YR 3/1) silt loam; few, medium, faint, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure to massive; friable; neutral; abrupt, smooth boundary.
- IIA1b—22 to 34 inches, black (10YR 2/1) silty clay loam; strong, medium and coarse, angular blocky structure that breaks to weak, medium, prismatic structure; firm; neutral; gradual, smooth boundary.
- IIB21gb—34 to 45 inches, gray (10YR 6/1) silty clay loam; common, medium, distinct, light yellowish-brown (10YR 6/4) mottles; moderate, medium, angular blocky structure; very sticky when wet; neutral; gradual, smooth boundary.
- IIB22gb—45 to 75 inches, gray (10YR 6/1) light silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; very sticky when wet; neutral; abrupt, smooth boundary.
- IIIC—75 inches +, gray (10YR 6/1) and yellow (10YR 7/6) fine sand and silt; stratified; calcareous.

The thickness of the A and C horizons combined ranges from 12 to 30 inches. The A horizon ranges from light brownish gray (10YR 6/2) to brown (10YR 5/3). The subsurface layers range from dark grayish brown (10YR 4/2) to brown (10YR 5/3) mottled with gray. The IIA1b horizon ranges from black (10YR 2/1) to very dark brown (10YR 3/2). The underlying calcareous material is at a depth of 50 to 80 inches or more. In some areas the underlying material is loam till. Ground water is at a depth of about 34 inches. Silt loam is the only type mapped in this county.

Wea series

The Wea series consists of Brunizems that developed in 0 to 36 inches of silty material underlain by loamy and gravelly outwash. Calcareous stratified gravel

and sand of Wisconsin age occur at a depth of 42 to about 70 inches. These soils are in nearly level to moderately sloping areas of the outwash plains. Their native vegetation was tall prairie grasses.

Wea soils are the well drained members of the catena that includes the moderately well drained Tippecanoe soils, the somewhat poorly drained Crane soils, and the very poorly drained, dark-colored Westland soils. Surface runoff of Wea soils is slow to rapid, and permeability is moderate. The content of organic matter is high.

The Wea soils have less gravel throughout the profile, a finer textured B horizon, and a thicker solum than the Warsaw soils and are leached to a greater depth. Leaching in the Warsaw soils is to a depth of 24 to 42 inches. The A horizon of Wea soils is deeper and darker colored than that of the Ockley soils. Wea soils have a finer textured surface layer than the Elston soils and are less sandy throughout the profile.

Profile of Wea silt loam (NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 32, T. 21 N., R. 7 W.):

- Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.
- A12—7 to 11 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, granular structure; friable; neutral; clear, smooth boundary.
- A3—11 to 16 inches, dark-brown (10YR 3/3) to black (10YR 2/1) heavy silt loam; weak, fine, subangular blocky structure; friable; neutral; clear, smooth boundary.
- B21t—16 to 21 inches, dark-brown (10YR 3/3 to 4/3) silty clay loam; moderate, fine, subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- B22t—21 to 33 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; thin dark grayish-brown (10YR 4/2) clay films on ped faces; medium acid; clear, smooth boundary.
- IIB23t—33 to 42 inches, yellowish-brown (10YR 5/4) or dark yellowish-brown (10YR 4/4) light silty clay loam; moderate, medium, subangular blocky structure; firm; medium dark grayish-brown (10YR 4/2) clay films on ped faces; medium acid; abrupt, smooth boundary.
- IIB24—42 to 51 inches, dark-brown (7.5YR 4/4) sandy clay loam; weak, coarse, subangular blocky structure; firm; medium or slightly acid; abrupt, smooth boundary.
- IIIB3—51 to 60 inches, dark-brown (7.5YR 4/4) sandy loam to loamy sand; single grain; friable or very friable; medium or slightly acid; abrupt, smooth boundary.
- IVC—60 inches +, gray (10YR 5/1) and brown (10YR 4/3) stratified coarse sand and fine gravel; single grain; loose; calcareous.

The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). Depth to carbonates ranges from 42 to 70 inches. In most areas the silty material is almost 36 inches thick. Leaching is generally deepest where the silt is thickest. The IIIB3 horizon ranges from 7 to about 18 inches in thickness but generally is less than 12 inches thick. Silt loam is the only type mapped in this county.

Westland series

The Westland series consists of very poorly drained Humic Gley soils. Westland soils developed in silty and loamy material that is generally underlain by stratified calcareous sand and gravel. These soils are nearly level or depressional and occur on broad flats of outwash plains and terraces. They developed under swamp grasses, sedges, and deciduous swamp trees.

The Westland soils are the dark-colored, very poorly drained members of the catena that includes the well-drained Ockley soils and the somewhat poorly drained Sleeth soils. They also occur with the Fox, Warsaw, and Wea soils. Surface runoff of Westland soils is very slow or ponded, and permeability is very slow.

Westland soils are underlain by stratified sand and gravel, but the Brookston soils are underlain by loam till.

Profile of Westland silty clay loam in a pasture (SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T. 21 N., R. 7 W.):

- A1—0 to 11 inches, black (10YR 2/1) silty clay loam; moderate, fine and medium, granular structure; friable or firm; slightly acid; clear, smooth boundary.
- B21g—11 to 18 inches, dark-gray (N 4/0) silty clay loam; common, medium, distinct, olive (5Y 3/3) and yellowish-brown (10YR 5/6) mottles; moderate, medium and fine, subangular blocky structure; firm; gray (N 5/0) clay films on ped faces in upper part of horizon; slightly acid; clear, smooth boundary.
- IIB22g—18 to 29 inches, grayish-brown (2.5Y 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) and brownish-yellow (10YR 6/6) mottles; moderate, medium and coarse, prismatic structure that breaks to moderate, medium, angular blocky structure; firm; thin gray (N 5/0) clay films on ped faces; slightly acid; gradual, smooth boundary.
- IIB23g—29 to 42 inches, olive (5Y 5/6) clay loam; many, medium, prominent, yellowish-brown (10YR 5/8) mottles; weak, coarse, prismatic structure that breaks to coarse, subangular and angular blocky structure; firm; slightly acid; gradual, wavy boundary.
- IIB3g—42 to 51 inches, gray (5Y 5/1) gravelly loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, coarse, prismatic structure; friable; neutral; clear, wavy boundary.
- IIICg—51 inches +, gray (10YR 6/1) poorly sorted sand and gravel; single grain; loose; calcareous.

The A horizon ranges from 8 to 16 inches in thickness. In areas where Westland soils grade toward Romney soils with a gravelly substratum, the A horizon is thickest and its content of organic matter is higher than normal. The organic-matter content is somewhat lower than normal in areas where Westland soils are near Fox and Ockley soils. In some areas these soils are underlain by fine sand and silt instead of by sand and gravel. Sand and gravel or bedrock is at a depth of 25 to 45 inches in small areas. In this county the types mapped are silt loam and silty clay loam.

Whitaker series

The Whitaker series consists of Gray-Brown Podzolic soils that intergrade toward Low-Humic Gley soils. Whitaker soils developed in material of Wisconsin age consisting of calcareous stratified sand and silt that contain some gravel and clay. These soils occur on nearly level terraces along small streams and in outlets of old drainageways. They developed under deciduous trees.

The Whitaker soils are somewhat poorly drained and occur with the well-drained Camden soils. Surface runoff of the Whitaker soils is very slow, and permeability is slow.

The Whitaker soils developed in stratified sand and gravel, but the Sleeth soils developed in 36 inches of loess underlain by silty loam outwash and that, in turn, by stratified sand and gravel at a depth of 42 to 70 inches. Instead of stratified sand and gravel, the Ayrshire soils developed in windblown sand and coarse silt.

Profile of Whitaker loam in a cultivated field (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 9, T. 18 N., R. 8 W.):

- Ap—0 to 8 inches, grayish-brown (2.5Y 5/2) loam; very fine and fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
- B21gt—8 to 16 inches, light-gray (10YR 7/1) to gray (10YR 6/1) light silty clay loam to clay loam; moderate, medium, subangular blocky structure; firm; very strongly acid; abrupt, wavy boundary.
- B22gt—16 to 29 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam; many, medium, prominent, yellowish-brown (10YR 5/6 to 5/8) mottles; moderate, medium, prismatic structure that breaks to moderate, fine and medium, angular blocky structure; firm; distinct clay films on ped surfaces; very strongly acid; abrupt, smooth boundary.
- IIB23gt—29 to 44 inches, light-gray (10YR 6/1) to gray (10YR 5/1) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6 to 5/8) mottles; weak, medium and coarse, subangular blocky structure; firm; medium acid; tongues extend 4 to 6 inches into the underlying material; gradual, wavy boundary.
- IIC1—44 to 56 inches, gray (10YR 5/1) stratified sand; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; single grain; very friable or loose; pockets of silt common; neutral; abrupt, smooth boundary.
- IIC2—56 inches +, light-gray (10YR 6/1) and yellowish-brown (10YR 5/8) very fine sand and coarse silt; stratified; calcareous.

Some areas have a silt mantle as much as 30 inches thick. The B horizon ranges from sandy clay loam to fine silty clay loam. Depth to the calcareous sand and silt ranges from 33 to 60 inches. Loam and silt loam types are mapped in this county.

Wingate series

The Wingate series consists of Gray-Brown Podzolic soils that intergrade toward Brunizems. Wingate soils developed in 18 to 40 inches of windblown silt underlain by material weathered from loam till of Wisconsin age. Calcareous loam till occurs at a depth of 42 to 70 inches. These soils are in nearly level and gently sloping areas of the upland till plains. Their native vegetation was prairie grasses and hardwoods.

Wingate soils are the moderately well drained members of the catena that includes the very poorly drained, very dark colored Romney soils. Surface runoff of Wingate soils is slow or medium, and permeability is moderate in the upper subsoil and moderately slow in the lower subsoil. The content of organic matter is high.

Wingate soils have a thicker, darker colored A horizon than Xenia soils. The light-colored A₂ horizon that occurs in Wingate soils is absent in the Dana soils.

Profile of Wingate silt loam (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 19 N., R. 7 W.):

- Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
- A₁₂—7 to 10 inches, very dark gray (10YR 3/1) silt loam; weak, medium, platy structure; friable; medium acid; abrupt, smooth boundary.
- A₂—10 to 13 inches, brown (10YR 5/3) silt loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.
- B_{1t}—13 to 18 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, fine, subangular blocky structure; slightly firm; medium acid or strongly acid; clear, smooth boundary.
- B_{21t}—18 to 22 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium and coarse, subangular blocky structure; firm; strongly acid; clear, smooth boundary.

- B_{22t}—22 to 33 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, faint, light grayish-brown (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; strongly acid; clear, smooth boundary.
- IIB₃—33 to 46 inches, mottled pale-brown (10YR 6/3) and yellowish-brown (10YR 5/4) clay loam; moderate, coarse, subangular blocky structure; firm; strongly acid in upper part and neutral in lower; abrupt, smooth boundary.
- IIC—46 inches +, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) loam till; massive; friable; calcareous.

Depth to carbonates ranges from 42 to 70 inches. The thickness of the loess varies within short horizontal distances. The A horizon ranges from 10 to 14 inches in thickness. Mottling occurs at a depth of 15 to 29 inches. Silt loam is the only type mapped in this county.

Xenia series

The Xenia series consists of moderately well drained Gray-Brown Podzolic soils that developed in 18 to 40 inches of loess underlain by material weathered from loam till of Wisconsin age. These soils occupy nearly level to gentle slopes of the till plains and developed under deciduous trees.

The Xenia soils are the moderately well drained members of the catena that includes the well drained Russell soils, the somewhat poorly drained Fincastle soils, the poorly drained Delmar soils, and the dark-colored, very poorly drained Brookston soils. Surface runoff of Xenia soils is very slow or slow, and permeability is moderate.

Xenia soils have a silt mantle that is thicker than the 0- to 18-inch silt mantle of the Celina soils. The surface layer of the Xenia soils is lower in content of organic matter than that of the Dana and Wingate soils. Xenia soils developed in silt and till rather than entirely in windblown silt as did the Birkbeck soils.

Profile of Xenia silt loam in a cultivated field (NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T. 20 N., R. 7 W.):

- Ap—0 to 7 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, medium, granular structure; friable; neutral; clear, smooth boundary.
- A₂—7 to 11 inches, grayish-brown (10YR 5/2) silt loam; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
- B_{21t}—11 to 16 inches, dark yellowish-brown (10YR 4/4) and pale-brown (10YR 6/3) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; slightly acid; clear, smooth boundary.
- B_{22t}—16 to 19 inches, dark yellowish-brown (10YR 4/4) or brown (10YR 5/3) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; medium acid; clear, smooth boundary.
- B_{23t}—19 to 28 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, fine and medium, subangular blocky structure; firm; black (10YR 2/1) coatings on ped surfaces; strongly or very strongly acid; clear, smooth boundary.
- IIB_{24t}—28 to 33 inches, yellowish-brown (10YR 5/4) or dark-brown (10YR 3/3) clay loam; common, medium, distinct, gray (10YR 6/1) mottles; weak, coarse, subangular blocky structure; firm; strongly acid; abrupt, smooth boundary.
- IIB₃—33 to 57 inches, mottled yellowish-brown (10YR 5/4), dark-brown (10YR 3/3), and gray (10YR 6/1) loam; massive; firm; neutral; abrupt, irregular boundary.
- IIC—57 inches +, gray and brown loam till; massive; firm; calcareous.

The loam till is calcareous at a depth of 42 to 70 inches. Within short distances the silt mantle varies greatly in

thickness. The depth to mottling ranges from 18 to 29 inches. In undisturbed areas the A1 horizon is darker colored than the Ap horizon of the soil described. The A2 horizon in undisturbed areas is somewhat lighter colored than the A2 horizon of the soil described. Silt loam is the only type mapped in the county.

Literature Cited

- (1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 7, 2 v., 257 and 514 pp., illus.
- (2) BARGER, G. L., SHAW, R. H., AND DALE, R. F.
1959. CHANCES OF RECEIVING SELECTED AMOUNTS OF PRECIPITATION IN THE NORTH-CENTRAL REGION OF THE UNITED STATES. Agr. Expt. Sta., Iowa State University, 47 pp.
- (3) FEDERAL HOUSING ADMINISTRATION.
1961. ENGINEERING SOIL CLASSIFICATION FOR RESIDENTIAL DEVELOPMENTS. Federal Housing Administration No. 373.
- (4) SCHAAL, L. A., NEWMAN, J. E., AND EMERSON, F. H.
1961. RISKS OF FREEZING TEMPERATURES—SPRING AND FALL IN INDIANA. Purdue University Research Bul. No. 721.
- (5) SOCIETY OF AMERICAN FORESTERS.
1955. FORESTRY HANDBOOK. 23 sections, illus.
- (6) TREWARTHA, GLENN T.
1943. AN INTRODUCTION TO WEATHER AND CLIMATE. Appendix A. 517-521 pp., illus.
- (7) UNITED STATES DEPARTMENT OF AGRICULTURE.
1938. SOIL CLASSIFICATION. In Soils and Men. U.S. Dept. Agr. Ybk. 979-1001 pp.
- (8) ———
1951. MAKING LAND PRODUCE USEFUL WILDLIFE. Bul. 2035, 22 pp., illus.
- (9) ———
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. No. 18, 503 pp., illus.
- (10) WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo No. 3-357, 2 v. and appendix. 44 pp., illus.

Glossary

A horizon. See Horizon, soil.

Acidity. See Reaction.

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvial soils. A group of azonal soils that consist of transported and relatively recently deposited material (alluvium) characterized by weak or no modification of the original material by soil-forming processes.

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

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available moisture capacity. The difference between the amount of water in a soil at field capacity and the amount in the same soil at the permanent wilting point. Commonly expressed as inches of water per inch depth of soil.

Azonal soils. A class of soil order consisting of soils not having well-developed profile characteristics because of their youth, or because the nature of their parent material or relief prevents the normal development of such characteristics.

B horizon. See Horizon, soil.

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

Bog soils. An intrazonal group of soils that formed under swamp or marsh vegetation mostly in a humid or subhumid climate and consist of brown, dark-brown, or black peat or muck. The peat or muck is partly decayed remains of plants that have been preserved in places that remain saturated.

Bottom land. Low-lying land that is adjacent to a river or smaller stream and generally is rich in alluvium.

Brown Forest soils. A group of intrazonal soils having a very dark brown surface horizon that is relatively rich in humus and that grades to lighter colored material. The lighter colored material grades, in turn, to parent material. These soils are slightly acid or neutral and have a moderately high content of exchangeable calcium. They formed in temperate, humid regions under deciduous forest from parent material relatively rich in bases, especially calcium.

Brunizems. A group of zonal soils that have an acid, thick, very dark brown to black A horizon rich in organic matter; a brown B horizon that may or may not be mottled; and lighter colored parent material at a depth of 2 to 5 feet. Brunizems formed under tall grasses in a humid, temperate climate.

C horizon. See Horizon, soil.

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

Catena, soil. A sequence, or "chain," of soils on a landscape, developed from one kind of parent material but having different characteristics because of differences in relief and drainage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay loam. Soil material that contains 27 to 40 percent clay and 20 to 45 percent sand.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; soil does not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, soil is moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; soil is little affected by moistening.

Contour. An imaginary line connecting points of equal elevation on the surface of the soils.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop that is grown primarily to improve the soil and to protect it between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Cropland. Land regularly used for crops, except forest crops. It includes rotation pasture, cultivated summer fallow, and land that is temporarily idle.

Crop residues. Parts of plants—leaves, stubble, roots, and straw—that are left in the field after harvest.

Deciduous forest. A forest consisting of trees that shed their leaves at the end of each growing season.

Deep soil. Generally, a soil that is more than 42 inches deep to rock or other contrasting material.

Diversion. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from such runoff.

Drainage, soil. The relative rapidity and extent of removal of water, under natural conditions, from on and within the soil. Terms commonly used to describe drainage are as follows:

Very poorly drained.—Water is removed so slowly that the soil remains wet most of the time, and water ponds on the surface frequently. The water table is at the surface most of the time.

- Poorly drained.**—Water is removed so slowly that the soil remains wet for much of the time. The water table is at or near the surface during a considerable part of the year.
- Somewhat poorly drained.**—Water is removed so slowly that the soil is wet for significant periods but not all the time.
- Moderately well drained.**—Water is removed somewhat slowly and the soil is wet for a small but significant part of the time.
- Well drained.**—Water is removed readily but not rapidly. A well-drained soil has good drainage.
- Somewhat excessively drained.**—Water is removed so rapidly that only a small part is available to plants. Only a narrow range of crops can be grown, and yields are usually low unless the soil is irrigated.
- Excessively drained.**—Water is removed very rapidly. Enough precipitation commonly is lost to make the soil unsuitable for ordinary crops.
- Drift (or glacial drift).** Rock and earth material transported by ice sheets. Unsorted drift—sand, clay, silt, and boulders left in place as the ice melted—is called glacial fill.
- Erosion, soil.** The wearing away of the land surface by detachment and transport of soils and rock materials through the action of moving water, wind, and other geological agents.
- Escarpment.** A long, steep ridge of land or rock that resembles a cliff. It faces in one general direction and separates two areas of more nearly level land.
- Fertility.** The quality that enables a soil to provide the proper compounds, in proper quantities and balance, for the growth of specified plants when light, temperature, moisture, physical condition of the soil, and other factors are favorable.
- First bottom (or flood plain).** The normal flood plain of a stream, flooding may be frequent or occasional.
- Gleization.** The reduction, translocation, and segregation of soil compounds, notable of iron, generally in the subsoil or substratum, as a result of poor aeration and drainage; indicated in the soil by mottles of dominantly gray. The soil-forming processes leading to the development of a gley soil.
- Gray-Brown Podzolic soils.** A group of zonal soils having a thin organic covering and a thin organic-mineral layer over a grayish-brown leached layer that is underlain by a brown B horizon richer in clay than the horizon above. These soils formed under deciduous forest in a moist, temperate climate.
- Great soil group.** Any one of several broad groups of soils having fundamental characteristics in common.
- Green-manure crop.** Any crop grown and plowed under for the purpose of improving the soil, especially by the addition of organic matter.
- Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes and that differs in one or more ways from adjacent horizons in the same profile. These are the major soil horizons:
- O horizon.**—Organic horizon of mineral soils.
- A horizon.**—The mineral horizon at the surface. It contains an accumulation of organic matter, has been leached of soluble minerals and clay, or shows the effects of both.
- B horizon.**—The horizon in which clay minerals or other materials have accumulated, that has developed a characteristic blocky or prismatic structure, or that shows the characteristics of both processes.
- C horizon.**—The unconsolidated material immediately under the true soil. In chemical, physical, and mineral composition it is presumed to be similar to the material from which at least part of the overlying solum has developed, unless the C designation is preceded by a Roman numeral.
- R horizon.**—Rock underlying the C horizon, or the B horizon if no C horizon is present.
- Roman numerals** are prefixed to the master horizon or layer designations (O, A, B, C, R) to indicate lithologic discontinuities either within or below the solum. The first, or uppermost, material is not numbered, for the Roman numeral I is understood; the second, or contrasting, material is numbered II, and others are numbered III, IV, and so on, consecutively downward. Thus for example, a sequence from the surface downward might be A2, B1, IIB2, IIB3, IIC1, IIC2.
- Following are the symbols used in this report with the letters designating the master horizons, and the meaning of these symbols:
- g—strong gleying.
 - p—plow layer.
 - t—illuvial clay.
- Humic Gley soils.** An intrazonal group of soils having a dark-brown or black surface layer that grades, at a depth of 6 to 30 inches, to a grayish layer. Humic Gley soils developed under grasses and sedges, mostly in a humid or subhumid climate.
- Immature soil.** A soil lacking clearly defined horizons because the soil-forming forces have acted on the parent material for only a relatively short time after it was deposited or exposed.
- Intercrop.** A grass-legume or other crop that is seeded in small grain and plowed under the following spring before the succeeding crops are planted.
- Internal drainage.** The movement of water through the soil profile. The rate of movement is affected by the texture, structure, and other characteristics of the surface soil and subsoil, and by the height of the water table, either permanent or perched. Terms for expressing internal drainage are as follows:
- None.**—No free water passes through the soil mass.
- Very slow.**—Water moves through the soil much too slowly for good growth of most important crops.
- Slow.**—Water moves through the soil faster than in very slow drainage but not so fast as in medium drainage.
- Medium.**—Water moves through the soil at a rate that is about right for good growth of most of the important crops.
- Rapid.**—Water moves through the soil somewhat faster than is best for the growth of most important crops.
- Very rapid.**—Water moves through the soil too rapidly for good growth of most of the important crops.
- Intrazonal soils.** A class of soil order consisting of soils that have more or less well-developed soil characteristics that reflect a dominating influence of some local factor of relief or of parent material over the normal influence of the climate and vegetation. Such groups of soils may be geographically associated with two or more of the zonal soils having characteristics dominated by the influence of climate and vegetation.
- Leaching, soil.** The removal of materials in solution by percolating water.
- Lime.** Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.
- Loam.** Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.
- Loess.** A fine-grained windblown deposit consisting dominantly of silt-sized particles.
- Low-Humic Gley soils.** A group of intrazonal soils that are imperfectly to poorly drained and have a very thin surface horizon that is moderately high in organic matter and is underlain by mottled gray and brown, gleylike mineral horizons with little textural differentiation.
- Mapping unit.** Any soil, miscellaneous land type, soil complex, or undifferentiated soil group shown on the detailed soil map and identified by a letter symbol.
- Marl.** An earthy, unconsolidated deposit formed in fresh-water lakes that consists chiefly of calcium carbonate mixed with various amounts of clay or other impurities.
- Mature soil.** Any soil that is in near equilibrium with its environment and has well-developed soil horizons produced by the natural processes of soil formation.
- Maximum dry density.** The highest density obtained in the compaction test.
- Mechanical analysis, soils.** A laboratory method of determining soil texture by determining the percentage of the various sizes of individual mineral particles, or separates, in the soil.
- Mineral soil.** Soil consisting mainly of inorganic (mineral) material and containing only a small amount of organic material. Its bulk density is greater than that of organic soil.
- Moraine (geology).** An accumulation of earth, stones, and other debris deposited by a glacier.
- Moisture density.** The density to which a soil can be compacted with various moisture contents and forces of compaction. The greatest density obtained in the test is termed "maximum density," and the corresponding moisture content is termed "optimum moisture."
- Morphology, soil.** The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: *Abundance*—few, common, and many; *size*—fine, medium, and coarse; and *contrast*—faint, distinct, and prominent. The size measurements are these: *Fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Nutrient, plant. Any element that is taken in by a plant, is essential to its growth, and is used by the plant in producing food and tissue. Important plant nutrients obtained from the soil are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps others. Those obtained from the air are carbon, hydrogen, and oxygen.

O horizon. See Horizon, soil.

Order, soil. The highest category in soil classification. The three classes of soil orders are zonal soils, intrazonal soils, and azonal soils.

Outwash. Crossbedded gravel, sand, and silt deposited by melt water as it flowed from the ice.

Parent material, soil. The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.

pH. See Reaction.

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification by the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Planosols. A group of intrazonal soils having an eluviated surface horizon underlain by a B horizon that is more strongly illuviated, cemented, or compacted than the B horizon of associated normal soils. These soils formed in nearly level upland areas under grass or forest vegetation in a humid or subhumid climate.

Plastic (soil consistence). Capable of being deformed without being broken.

Plastic limit (soil engineering). The moisture content at which a soil changes from a semisolid to a plastic state.

Plasticity index (soil engineering). The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

R horizon. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words the degree of acidity or alkalinity is expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Regosols. A group of azonal soils that are developing from deep unconsolidated or soft, rocky deposits and have no definite genetic horizons.

Relative humidity. The ratio of the mass of moisture actually present in any volume of air of a given temperature to the maximum amount possible at that temperature and pressure, usually expressed in percentage.

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill erosion. The removal of soil through the cutting of many small but conspicuous water channels or by tiny rivulets that are minor concentrations of runoff.

Runoff (or surface runoff). The rate at which water is removed by flow over the surface of the soil. The rapidity of runoff and the amount of water removed is closely related to slope and is also affected by factors such as texture, structure, and porosity of the surface soil; the vegetative covering; and the prevailing climate.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Second bottom. The first terrace above the normal flood plain of a stream.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

Shrink-swell potential (engineering). Amount that a soil expands when wet or contracts when dry. Indicates kinds of clay in soil.

Silt. Settling of waterborne sediments, chiefly silt, in lakes, reservoirs, stream channels, or overflow areas.

Silt loam. Soil material that contains 50 percent or more silt and 12 to 27 percent clay; or soil material that contains 50 to 80 percent silt and less than 12 percent clay.

Silty clay. Soil material that contains 40 percent or more clay and 40 percent or more silt.

Silty clay loam. Soil material that contains 27 to 40 percent clay and less than 20 percent sand.

Slope classes. As used in this report, slopes, in percent, are designated as follows:

Nearly level	0 to 2
Gently sloping	2 to 6
Sloping	6 to 12
Moderately steep	12 to 18
Steep	18 to 25
Very steep	25 to 60

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effects of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Sols Bruns Acides. A group of zonal soils that have a thin A1 horizon, an A2 horizon that is poorly differentiated from the A1, and a B2 horizon that shows uniform color, weak, blocky structure, and little evidence, or only traces, of silicate clay accumulation. Many of these soils have a fragipan, which may have a distinct accumulation of clay and a higher percentage of base saturation than the horizons above. Soils of this group formed under forest in a humid, temperate climate.

Solum, soil. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, that serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. In many soils, the B horizon; roughly, the part of the profile below plow depth.

- Substratum.** Any layer beneath the solum, or true soil; the C or R horizon.
- Subsurface layer.** The part of the soil between the surface soil and the subsoil.
- Surface layer.** A term used in nontechnical soil descriptions for one or more upper layers of soil. It may include all or only part of the A horizon, and it has no depth limit.
- Terrace, agricultural.** An embankment or ridge constructed across sloping soils, on or approximately on contour lines, at specified intervals. The terrace intercepts runoff and holds it so that it soaks into the soil or it conducts the excess water to an outlet.
- Terrace, geological.** An old alluvial plain, often called a second bottom, that now lies above the present first bottom as a result of entrenchment of the stream; seldom subject to flooding.
- Texture, soil.** The relative proportion of the various size groups of individual soil grains in a mass of soil. A coarse-textured soil is high in content of sand; a fine-textured soil has a large proportion of clay. The textural names of the soils in this county are listed in this Glossary in alphabetic order and defined.
- Till (or glacial till).** An unstratified deposit of earth, sand, gravel, and boulders transported by glaciers.
- Till plain.** A level or undulating land surface that was formed when glaciers deposited their till.
- Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.
- Topography.** The lay of the land or the elevations or inequalities of the land surface as shown on a topographic map.
- Topsoil.** A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.
- Type, soil.** A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.
- Upland (geology).** Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.
- Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.
- Weathering.** All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.
- Zonal soils.** A class of soil order consisting of soils that have well-developed characteristics that reflect the influence of the active factors of soil formation: climate and living organisms, chiefly vegetation.



Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at <http://offices.sc.egov.usda.gov/locator/app>.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (<http://directives.sc.egov.usda.gov/33081.wba>) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (<http://directives.sc.egov.usda.gov/33085.wba>).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (<http://directives.sc.egov.usda.gov/33086.wba>).