Series 1958, No. 16

Issued January 1962

SOIL SURVEY

Van Buren County Iowa

OUR SOIL ★ OUR STRENGTH

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

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Van Buren County will serve various groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields, and it will add to the knowledge of soil scientists.

In making this survey, soil scientists walked over the fields and woodlands. They examined surface soils and subsoils; measured slopes with a hand level; noticed differences in growth of crops, weeds, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming, trees, wildlife, and related uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, woods, roads, streams, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has the symbol Ha. The legend for the detailed map shows that this symbol identifies Haig silty clay loam. This soil and all others mapped in the county are described in the section "Descriptions of the Soils."

The "Guide to Mapping Units and Management Groups" at the end of the report will simplify the use of the map and the report. This guide gives the name of each soil and its map symbol, the page on which the soil is described, the management group in which the soil has been placed, and the page where the management group is described.

Finding information

Special sections of the report will interest different groups of readers. The section "General Soil Areas" and the one entitled "General Information About Van Buren County" will be of interest mainly to those not familiar with the county.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils," and then turn to the section "Use and Management of the Soils." In this way they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability classes and subclasses and management groups; that is, groups of soils that need similar management and respond in about the same way. For instance, in the section "Descriptions of the Soils," Haig silty clay loam, is shown to be in capability subclass IIw, management group 6. The management this soil needs will be stated in the section "Use and Management of the Soils."

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

Engineers and others who use soil as a material in construction will find helpful information in the section "Engineering Interpretations of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending upon their particular interest. A subsection has been included on "Woodland Use of the Soils."

Technical assistance

The soil survey is not intended to be a source of all information needed for the successful operation of a farm in Van Buren County. Information on crop varieties, fertilizer, soil conserving practices, and livestock management can be obtained from the Van Buren County extension director.

Farmers in Van Buren County have organized the Van Buren County Soil Conservation District. The district, through its district commissioners, arranges for farmers to receive technical help from the Soil Conservation Service in planning good use and conservation of the soils on their farms. The survey is part of the technical assistance furnished to the Van Buren County Soil Conservation District.

Specific conservation plans should be made for each farm. Assistance in the use or interpretation of information in this report is available from either the Soil Conservation Service or the Extension Service.

* * * * *

Fieldwork on the soil survey was completed in 1958. Unless noted otherwise, all statements refer to conditions at the time of the survey.

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SOIL SURVEY OF VAN BUREN COUNTY, IOWA

BY W. P. DIETZ AND A. R. HIDLEBAUGH, SOIL CONSERVATION SERVICE

FIELDWORK BY W. P. DIETZ,[1] L. H. GRANT,[1] R. C. KRONENBERGER,[1] A. R. HIDLEBAUGH, M. P. KOPPEN, L. D. LOCKRIDGE, AND L. E. TYLER, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, AND R. C. PRILL AND J. F. CORLISS, IOWA AGRICULTURAL EXPERIMENT STATION

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

VAN BUREN COUNTY is in the southeastern part of Iowa (fig. 1). It has an area of about 487 square miles, or 311,680 acres. Keosauqua, the county seat, is on the Des Moines River.

The county is almost entirely agricultural. Most of the acreage is in farms About one-fifth is in timber, and the rest is used for pasture, grain, and hay. The acreage of pasture is more than that used for grain and hay. Corn, soybeans, and oats are the principal grain crops. The agriculture consists mainly of grain and livestock production. Most of the grain is fed to livestock.

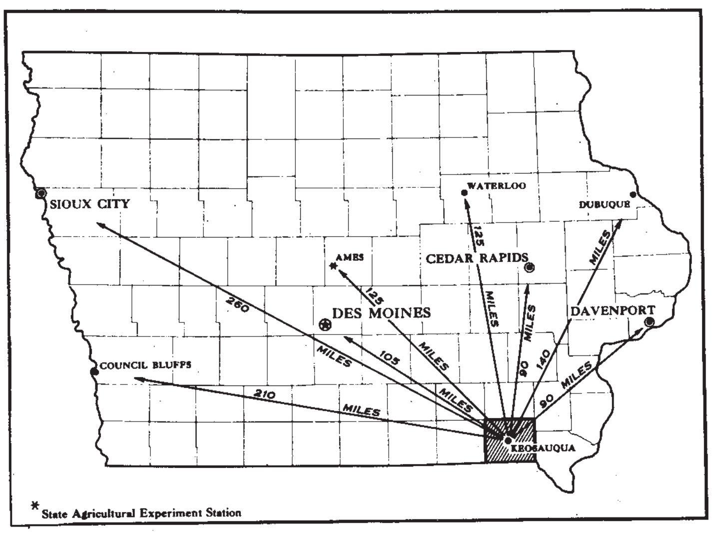

Figure 1.—Location of Van Buren County in Iowa.

General Soil Areas

In traveling over Van Buren County it is easy to see differences in the steepness and length of the slopes, the kind of natural vegetation, size of streams and stream valleys, and in the methods of farming. Other differences, not so obvious, are in the kinds of soils and the soil patterns or relationships.

The general soil map in the back of the report, shows seven general soil areas, each of which contains a characteristic pattern of soils. The general soil map is useful to those who want a broad picture of the soils. It can be used to compare different parts of a county or to locate large areas for some specific type of farming or for some other land use.

The general soil areas are named for the major soils in them, but they also contain other soils. The major soil series in one area may also occur in other areas. A description of each general soil area in Van Buren County follows.

1. Haig and Grundy Soils

This general soil area is level to sloping, and the Haig silty clay loam and Grundy silty clay loam are the dominant soils. Both of these soils have developed from loess. This area comprises about 15 percent of the county. Most of the soils in it are well suited to cultivation. This is the most important area in the county for grain production. Most farms have a high percentage of good cropland and follow a crop-livestock or a cash-grain program. The level soils are used intensively for row crops. They are wet part of the time and fieldwork is often delayed. Artificial drainage is generally needed for best yields. The sloping soils are used for row crops and meadow.

Haig silty clay loam is on the level, upland flats and has poor natural drainage. The moderately well drained to imperfectly drained Grundy soils occupy the gentle to moderate slopes adjacent to Haig silty clay loam.

The Adair and Clarinda soils, which have developed from till, are minor soils. They are on the moderate slopes adjacent to or below the Grundy soils. Other minor soils are the Edina, Pershing, and Belinda, which have developed from loess.

Most of the soils in this area have dark-colored surface layers. The native vegetation was mainly prairie.

2. Haig Silty Clay Loam, Fine Textured

This general soil area is made up of several small upland flats in the northeastern one-fourth of the county. It covers less than 2 percent of the county. The soils are used intensively for corn and soybeans, and yields are moderately high. These soils are often wet, need surface drainage, and are more difficult to manage in spring and in wet seasons than those in general soil area 1. Most

[1] In charge, part time.

operators follow an intensive crop or crop-livestock farming program.

The main soil in this area is the nearly level, poorly drained Haig silty clay loam, fine textured. A few areas of the Grundy soils on gentle slopes and small areas of Haig silty clay loam are included. All soils in the area have a dark-colored surface layer and have developed under prairie vegetation from loess. They are underlain by glacial till at depths of 7 to 9 feet.

3. Lindley, Weller, and Gosport Soils

This general soil area consists mainly of soils formed under forest on steep slopes and narrow divides along the rivers, creeks, and large drainageways. It covers more than half the county. Most of the farms in the area follow a grain-livestock farming program. There is a considerable amount of part-time farming. Soils of the Lindley, Weller, Gosport, Adair, and Clarinda series are dominant.

The loess-derived Weller, Clinton, Pershing, Belinda, and Beckwith soils are generally the only ones suitable for row crops. Yields are generally low. This general soil area is best suited to pasture and hay and a livestock type of farming.

About 40 percent of the area is still in timber, particularly the steeper slopes. Some trees are harvested and milled into barrel staves, and some are sawed into lumber for local use. Evergreen and deciduous trees have been planted to provide marketable timber. Several limestone quarries and gravel pits are in the area.

The Weller soils are most extensive on the sloping, loess-capped, narrow divides. Beckwith soils occur in places on nearly level, loess-covered divides, and the Clinton soils may occur on loess-covered slopes adjacent to the larger stream bottoms. The nearly level Belinda and the sloping Pershing soils grade toward soils that have developed under prairie conditions, and they occur where this area joins areas 1 and 5.

The Lindley soils are extensive throughout the area on steep, low side slopes composed of glacial till. They are normally below the Adair and Clarinda soils, which occur on upper slopes. The shale-derived Gosport soils are on steep slopes below the Lindley or the Adair and Clarinda soils. These soils are along both sides of the Des Moines River and along streams entering the Des Moines River from the north. The Sogn, Gosport, and Lindley soils are along the Des Moines River where limestone outcroppings occur above the bottom lands and bench terraces. A few areas of Steep sandy land are north of Farmington and near Selma, along the Des Moines River.

4. Shelby, Adair, and Clarinda Soils

This general soil area is made up of several smaller areas of sloping divides and steep side slopes. These areas are mainly in the southern half of the county adjacent to the Edina and the Seymour soils in general soil area 5. A few are adjacent to the Haig and the Grundy soils in general soil area 1. The soils in general soil area 4 are used mainly for hay and pasture, but row crops are grown to some extent on the lesser slopes. Most of the farms are operated as grain-livestock farms.

Most of the soils in general soil area 4 have developed from glacial till. The Shelby, Adair, and Clarinda soils are dominant. Minor areas of soils developed from loess, such as the Grundy and Seymour, occur on the higher, more gently sloping divides.

The Shelby soils are naturally well drained and have a dark surface soil and a yellowish-brown clay loam subsoil. They occupy steep, lower slopes. The Adair and Clarinda soils are moderately well drained to poorly drained and have a moderately dark surface soil over a gray or mottled brown, clay or silty clay subsoil that contains a few pebbles. They occupy positions downslope from the upland loess soils and upslope from the Shelby soils. They are extensive in this general soil area but also occur in general soil areas 1, 3, and 5.

5. Edina and Seymour Soils

This general soil area is made up of several smaller areas that occur south of the Des Moines River on loess-covered, level, upland flats and gentle to moderate slopes of 2 to 9 percent.

Most soils in the area are used intensively for row crops and hay, the yields of which are moderate to high. Farms in this area generally occur partly within general soil area 1 or 4 and contain some of the steeper Shelby, Adair, and Clarinda soils. Grain-livestock farms are predominant.

The Edina and Seymour soils are dominant in this general soil area. The Edina soils are level, are poorly drained, and have a gray subsurface soil and a silty clay subsoil. Wetness is a problem, and surface drains are generally needed. The Seymour soils occur on gentle to moderate slopes, are imperfectly to moderately well drained, and have a silty clay subsoil. Edina and Seymour soils have developed from loess but are underlain by glacial till at depths ranging from 9 feet on level areas to about 3 feet on slopes.

The Adair and Clarinda soils occur throughout general soil area 5. They are adjacent to and below the Seymour soils. The Belinda (fig. 2) and Pershing soils are also in this area but are adjacent to the timbered soils in soil area 3.

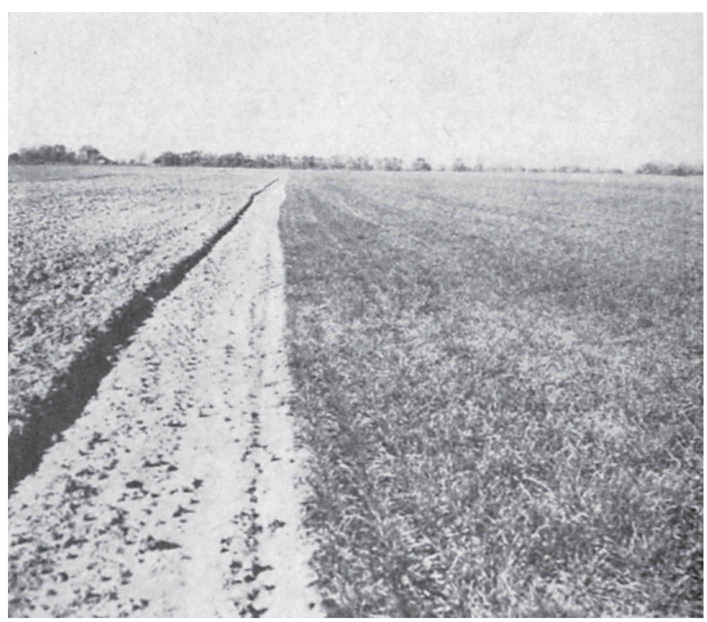

Figure 2.—**Belinda silt loam. The crop is winter wheat.**

6. Alluvial Soils on Stream Bottoms

These soils occur along the level to gently sloping stream bottoms and have developed in water-deposited sediment. The Nodaway and Coppock soils are dominant, and there are lesser amounts of Wabash, Colo, and other minor soils.

Most of the soils in this area have been cleared and are used intensively for cultivated crops. Some farms on bottom land along the Des Moines River are entirely in general soil area 6, but most farms also extend into the more sloping, forested soils in general soil area 3 or to the bench soils in general soil area 7. Farms are generally of the grain-livestock type. Two nursery farms in general soil area 6 are irrigated.

The soils vary widely in physical properties and productivity. The Nodaway and deep Waukegan soils are highly productive, but the Perks and Hagener soils are low in productivity. The Wabash soils are wet and poorly to very poorly drained, and the Perks and Hagener soils are droughty. Some of the soils are subject to flooding.

7. Soils on Benches

This general soil area is chiefly along the Des Moines River and Chequest Creek, but small areas are along the other streams in the county. The area consists of loess-covered bench terraces, which have level to gentle upper slopes, steep side slopes, and escarpments. Most benches are strongly dissected by deep drainageways. However, some extensive, level or nearly level benches occur on the north side of the river in the "Big Bend" area around Keosauqua.

The level and sloping soils in general soil area 7 are used for grain, hay, and forage crops; the steep side slopes are used for pasture. Most of the farms in this area also contain sizable acreages of the bottom-land soils in general soil area 6. Crop-livestock types of farming predominate.

The poorly drained Beckwith silt loam, bench position; Belinda silt loam, bench position; Rubio silt loam, bench position; and Rushville silt loam, bench position, all occupy the level, loess-covered areas. The better drained Weller, Clinton, Pershing, Givin, Keomah, Downs, and Lamont soils occupy the loess-covered side slopes. The Downs, Lamont, and the Douds soils and Terrace escarpments are on the steep, lower side slopes. On these slopes there are outcroppings of limestone, shale, or glacial till. Except for a few small areas of Grundy soils on benches near Selma, the soils in general soil area 7 were forested.

Descriptions of the Soils

The soil scientists who prepared this survey went over each farm at appropriate intervals and examined the soils by digging with a spade or soil auger. They examined the different layers, or horizons, in each boring, and they compared the different borings. By such comparison, they determined the different kinds of soils in the area.

Then, they described the various soils and drew boundaries on aerial photographs to separate them. The soils are described in the following pages. Their acreage and proportionate extent are shown in table 1, and their location can be seen on the detailed map at the back of this report.

The soil series (groups of soils) and the single soils (mapping units) are described in alphabetic order. A soil series is a group of soils that are much alike except for possible differences in texture of surface soil.

When two or more soils are so intricately mixed in small areas that they cannot be shown separately on a soil map, they are mapped together and called a soil complex. An example of this is the Nodaway-Coppock complex which is Nodaway silt loam and Coppock silt loam.

Two or more closely related soils that are not regularly associated geographically may be mapped in an undifferentiated group—a single unit. In Van Buren County the Downs silt loam and Lamont sandy loam are mapped as Downs and Lamont soils.

An important part of each series description is a discussion of the soil profile, a record of what the soil scientist saw and learned when he dug into the ground. All soils of one series have essentially the same kind of profile. The differences, if any, are explained in the description of the soil or are indicated in the soil name. To illustrate, a profile is described in detail for the Adair series, and the reader is to conclude that all soils in the Adair series have essentially this kind of profile.

Following the name of each soil, there is a set of symbols in parentheses. These identify the soil on the detailed map. The capability classification is also given for each mapping unit. This classification is discussed in the section "Use and Management of the Soils."

In describing the soils, the scientist frequently assigns a letter symbol, for example, "A_1", to the various layers. These letter symbols have special meanings that concern scientists and others who desire to make a special study of soils. Most readers will need to remember only that all letter symbols beginning with "A" are surface soil or subsurface soil; those beginning with "B" are usually subsoil; and those beginning with "C" are substratum, or parent material.

The boundaries between horizons are described so as to indicate their thickness. The terms for thickness are (1) *abrupt*, if less than 1 inch thick; (2) *clear*, if about 1 to 2½ inches thick; (3) *gradual*, if 2½ to 5 inches thick; and (4) *diffuse*, if more than 5 inches thick.

The color of a soil can be described in words, such as "yellowish brown," or can be indicated by symbols for the hue, value, and chroma, such as "10YR 5/4." These symbols, called Munsell color notations, are used by soil scientists to evaluate soil colors precisely.

The texture of the soil refers to the content of sand, silt, and clay. It is determined by the way the soil feels when rubbed between the fingers, and it is checked by laboratory analyses. Most mapping units are identified by a textural name, such as "fine sandy loam." This refers to the texture of the surface layer.

Structure is indicated by the way the individual soil particles are arranged in larger grains, or aggregates, and the amount of pore space between the grains. The structure of the soil is determined by the strength or grade, the size, and the shape of the aggregates. For example, a horizon may have "weak, fine, granular structure."

Consistence is the tendency of a soil to crumble or stick together. Terms used to describe consistence in moist soils are loose, very friable, friable, firm, very firm, extremely firm.

For definitions of other terms used in describing soils, refer to the Glossary in the back part of the report.

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

Soil	Area	Extent
	Acres	*Percent*
Adair and Clarinda soils, 5 to 9 percent slopes	5,124	1.6
Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded	23,521	7.5
Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded	1,752	.6
Adair and Clarinda soils, 9 to 14 percent slopes	5,270	1.7
Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded	27,971	9.0
Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded	5,166	1.7
Beckwith silt loam	2,747	.9
Beckwith silt loam, bench position	2,496	.8
Belinda silt loam	7,458	2.4
Belinda silt loam, bench position	869	.3
Carlow silty clay loam	576	.2
Carlow silty clay loam, overwashed	45	(1)
Chariton silt loam	442	.1
Chequest silty clay loam	831	.3
Clinton silt loam, bench position, 2 to 5 percent slopes	283	.1
Clinton silt loam, bench position, 5 to 9 percent slopes	999	.3
Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded	1,563	.5
Clinton silt loam, bench position, 9 to 14 percent slopes	126	(1)
Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded	631	.2
Clinton silt loam, 5 to 9 percent slopes	1,114	.4
Clinton silt loam, 5 to 9 percent slopes, moderately eroded	2,384	.8
Clinton silt loam, 9 to 14 percent slopes	533	.2
Clinton silt loam, 9 to 14 percent slopes, moderately eroded	1,273	.4
Colo silty clay loam	1,623	.5
Colo-Gravity-Olmitz complex	2,652	.9
Coppock silt loam, 0 to 2 percent slopes	6,219	2.0
Coppock silt loam, 2 to 5 percent slopes	1,609	.5
Coppock soils, sandy overwash, 0 to 2 percent slopes	590	.2
Coppock soils, sandy overwash, 2 to 5 percent slopes	263	.1
Dickinson sandy loam, bench position, 0 to 2 percent slopes	970	.3
Dickinson sandy loam, bench position, 2 to 5 percent slopes	878	.3
Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded	240	.1
Downs silt loam, bench position, 2 to 5 percent slopes	620	.2
Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded	274	.1
Downs and Lamont soils, bench position, 9 to 14 percent slopes	190	.1
Douds soils and Terrace escarpments	7,469	2.4
Edina silt loam	11,271	3.6
Givin silt loam, bench position, 2 to 6 percent slopes	446	.1
Givin silt loam, 2 to 6 percent slopes	173	.1
Gosport silt loam, 9 to 14 percent slopes, moderately eroded	463	.1
Gosport silt loam, 14 to 18 percent slopes, moderately eroded	1,572	.5
Gosport silt loam, 18 to 40 percent slopes, moderately eroded	2,713	.9
Gosport soils, 9 to 14 percent slopes, severely eroded	134	(1)
Gosport soils, 14 to 18 percent slopes, severely eroded	207	.1
Gravity silty clay loam, 2 to 5 percent slopes	566	.2
Grundy silty clay loam, 2 to 5 percent slopes	9,328	3.0
Grundy silty clay loam, 5 to 9 percent slopes	1,941	.6
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded	1,261	.4
Grundy silt loam, bench position, 2 to 5 percent slopes	94	(1)
Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded	76	(1)
Haig silty clay loam	16,751	5.4
Haig silty clay loam, fine textured	3,176	1.0
Keomah silt loam, 2 to 5 percent slopes	342	.1
Keomah silt loam, bench position, 2 to 5 percent slopes	1,618	.5
Landes soils	2,685	.9
Lindley loam, 14 to 18 percent slopes, moderately eroded	26,306	8.4
Lindley loam, 18 to 25 percent slopes, moderately eroded	16,489	5.3
Lindley loam, 25 to 40 percent slopes, moderately eroded	1,281	.4
Lindley soils, 14 to 18 percent slopes, severely eroded	1,666	.5
Lindley soils, 18 to 25 percent slopes, severely eroded	544	.2
Nodaway-Coppock complex	9,612	3.1
Nodaway-Coppock complex, flaggy	1,950	.6
Nodaway silt loam	5,265	1.7
Nodaway silt loam, silty clay substratum	168	.1
Olmitz loam, 2 to 5 percent slopes	740	.2
Olmitz and Gravity soils, 2 to 5 percent slopes	1,121	.4
Perks and Hagener soils, 0 to 2 percent slopes	144	(1)
Perks and Hagener soils, 2 to 5 percent slopes	397	.1
Pershing silt loam, 2 to 5 percent slopes	9,716	3.1
Pershing silt loam, 5 to 9 percent slopes	1,069	.3
Pershing silt loam, 5 to 9 percent slopes, moderately eroded	2,493	.8
Pershing soils, 5 to 9 percent slopes, severely eroded	72	(1)
Pershing silt loam, bench position, 2 to 5 percent slopes	511	.2
Pershing silt loam, bench position, 5 to 9 percent slopes	149	(1)
Rubio silt loam, bench position	414	.1
Rushville silt loam, bench position	1,061	.3
Seymour silt loam, 2 to 5 percent slopes	7,645	2.5
Seymour silt loam, 5 to 9 percent slopes, moderately eroded	413	.1
Seymour soils, 5 to 9 percent slopes, severely eroded	7	(1)
Shelby loam, 14 to 18 percent slopes, moderately eroded	2,614	.8
Shelby loam, 18 to 25 percent slopes, moderately eroded	405	.1
Shelby soils, 14 to 18 percent slopes, severely eroded	280	.1
Shelby soils, 18 to 25 percent slopes, severely eroded	13	(1)
Steep sandy land	211	.1
Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes	3,420	1.1
Wabash silty clay loam	1,353	.4
Wabash silty clay loam, overwashed	281	.1
Waukegan loam, deep, 0 to 2 percent slopes	823	.3
Waukegan loam, deep, 2 to 5 percent slopes	251	.1
Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded	57	(1)
Waukegan loam, moderately deep, 0 to 3 percent slopes	40	(1)
Waukegan loam, moderately deep, 3 to 6 percent slopes	22	(1)
Weller silt loam, 2 to 5 percent slopes	10,144	3.3
Weller silt loam, 2 to 5 percent slopes, moderately eroded	1,484	.5
Weller silt loam, 5 to 9 percent slopes	5,181	1.7
Weller silt loam, 5 to 9 percent slopes, moderately eroded	15,550	5.0
Weller soils, 5 to 9 percent slopes, severely eroded	480	.2

See footnote at end of table.

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

Soil	Area	Extent
	Acres	*Percent*
Weller silt loam, bench position, 2 to 5 percent slopes	2, 273	0. 7
Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded	357	. 1
Weller silt loam, bench position, 5 to 9 percent slopes	406	. 1
Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded	1, 722	. 6
Weller soils, bench position, 5 to 9 percent slopes, severely eroded	76	[1]
Quarries and gravel pits	156	0. 1
Strip mines	104	[1]
Water	3, 156	1. 0
Total	311, 680	100. 0

[1] Less than 0.1 percent.

Adair Series

The Adair series consists of slowly to very slowly permeable, moderately well drained to imperfectly drained soils. They have a moderately dark, silt loam to clay loam surface layer when not eroded. The subsoil (B horizon) is normally a strong-brown silty clay mottled with shades of red or gray. A layer of small stones and pebbles is generally in the upper part of the profile. Fine gravel, pebbles, and coarse sand are generally throughout the profile.

The Adair soils were formed on the sloping surface of the Kansan till plain during the Late Sangamon interglacial age and were then buried by a deposit of Wisconsin loess. Many thousands of years later, the cover of loess was removed, and the Adair soils were reexposed on the side slopes. Because these soils were once buried, they are called paleosols. These paleosols are often seen beneath the loess in deep roadcuts.

The Adair soils are believed to have developed under forest vegetation, but since their reexposure by erosion, the native vegetation has been prairie or mixed forest and prairie.

The Adair soils are associated with the Clarinda, Pershing, Weller, and Lindley soils. They are downslope from the Weller, Pershing, and Clarinda soils and upslope from the Lindley soils in areas where the Adair and Lindley soils are adjacent. They differ from the Clarinda soils in having browner subsoil that normally contains more pebbles and less clay. Adair soils have subsoil that is more clayey than that of the Shelby soils, and they are not so well drained.

In Van Buren County, soils of the Adair and of the Clarinda series were mapped as undifferentiated groups. In some places, the mapping units consist only of Clarinda soils, and in other places, they consist only of the Adair soils. In many places, the mapping units consist of both soils.

Two profiles that represent the Adair series are described. The first profile is that of Adair loam on a slope of 4 percent (30 feet north of the southeast corner of SW¼SW¼ sec. 32, T. 68 N., R. 11 W.):

A_{1p} 0 to 4 inches, very dark gray (10YR 3/1, moist), friable loam; weak, fine, subangular blocky structure; iron and manganese concretions; pH 4.7; abrupt boundary.

A_{12} 4 to 8 inches, very dark grayish-brown (10YR 3/2, moist), friable loam; common, fine, faint mottles of dark brown to brown (10YR 4/3, moist); weak, fine, subangular blocky structure; iron and manganese concretions; clear boundary.

B_{11} 8 to 12 inches, strong-brown (7.5YR 5/6, moist), friable to firm, light clay loam or silty clay loam; when crushed, dark brown to brown (10YR 4/3, moist); few, fine, prominent mottles of yellowish red (5YR 5/7, moist); moderate, fine, subangular blocky structure; thin, continuous clay skins; iron and manganese concretions; root channels coated with black (10YR 2/1, moist); pH 4.7; clear boundary.

B_{21} 12 to 17 inches, yellowish-brown (10YR 5/6, moist), very firm, gritty silty clay; when crushed, strong brown (7.5YR 5/6, moist); common, fine, distinct mottles of brown (10YR 5/3, moist) and common, fine, prominent mottles of red (10R 4/6, moist); strong, very fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; root channels coated black (10YR 2/1, moist); worm casts; gradual boundary.

B_{22} 17 to 21 inches, olive-gray (5Y 5/2, moist), very firm, gritty silty clay; when crushed, yellowish brown (10YR 5/5, moist); many, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and red (10R 4/6, moist); strong, very fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; root channels coated black (10YR 2/1, moist); pH 5.4; gradual boundary.

B_{23} 21 to 27 inches, yellowish-brown (10YR 5/6, moist), very firm, gritty clay; when crushed, strong brown (7.5YR 5/8, moist); many, fine, prominent mottles of olive gray (5Y 5/2, moist) and red (10R 4/6, moist); moderate, medium, subangular blocky structure; thick, continuous clay skins; few, dark coatings; gradual boundary.

B_{31} 27 to 33 inches, olive-gray (5Y 5/2, moist) and strong-brown (7.5YR 5/8, moist), very firm, gritty clay; when crushed, yellowish brown (10YR 5/8, moist); common, fine, prominent mottles of red (10R 4/6, moist); weak, medium, subangular blocky structure to massive; thin, continuous clay skins on cleavage faces; few, dark coatings; very fine, white grit; soft, red (10R 5/6) stones; pH 5.4; gradual boundary.

B_{32} 33 to 41 inches, olive-gray (5Y 5/2, moist) and strong-brown (7.5YR 5/8, moist), very firm, gritty clay; when crushed, strong brown (7.5YR 5/8, moist); few, fine, prominent mottles of red (10R 4/6, moist); nearly massive with some vertical cleavage faces; thin, discontinuous clay skins on cleavage faces; few, dark coatings; very fine, white grit; red (10R 5/6, moist), soft stones; pH 5.5; gradual boundary.

C_1 41 to 51 inches, olive-gray (5Y 5/2, moist), very firm, gritty clay; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of red (2.5YR 5/8, moist) and many, fine, prominent mottles of strong brown (7.5YR 5/8, moist); massive with a few vertical cleavage faces; thin, discontinuous clay skins on cleavage faces; manganese concretions; few, dark coatings; very fine, white grit; soft, red (10R 5/6) stones; pH 5.9.

The second profile of the Adair series is that of Adair loam on a slope of 9 percent (100 feet north and 50 feet west of the southeast corner of the NE¼SE¼ sec. 22, T. 69 N., R. 8 W.):

A_p 0 to 5 inches, very dark gray (10YR 3/1, moist), friable loam; when crushed, very dark grayish brown (10YR 3/2, moist); common, medium, prominent mottles of brown to dark brown (7.5YR 4/4, moist); weak, thin, platy structure; abrupt boundary.

A_2 5 to 9 inches, dark yellowish-brown (10YR 4/4, moist), friable loam; ped surfaces, light gray (2.5Y 7/2, dry); weak, thin, platy structure; clear boundary.

B_1 9 to 14 inches, reddish-brown (5YR 4/4, moist), friable, gritty silty clay loam; moderate, fine, subangular blocky structure; iron and manganese concretions; clear boundary.

B_{21} 14 to 21 inches, brown to dark-brown (7.5YR 4/4, moist), firm, gritty silty clay loam; common, fine, prominent mottles of dark red (2.5YR 3/6, moist); moderate to strong, fine, subangular blocky structure; thick, continuous clay skins; iron and manganese concretions; clear boundary.

B_{22} 21 to 27 inches, brown to dark-brown (7.5YR 4/4, moist), firm, gritty silty clay; when crushed, red (2.5YR 4/6, moist); common, fine, prominent mottles of red (10R 4/6, moist); common, grayish-brown (2.5Y 5/2, moist) coating on peds; strong, very fine to fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; clear boundary.

B_{23} 27 to 39 inches, strong-brown (7.5YR 5/6, moist), very firm, gritty silty clay; common, fine, prominent mottles of red (10R 4/6, moist); weak, very fine, angular blocky structure; thin, continuous clay skins; iron and manganese concretions; clear boundary.

B_3C_1 39 to 50 inches, strong-brown (7.5YR 5/6, moist), firm, heavy clay loam to gritty silty clay loam; few, fine, prominent mottles of red (2.5YR 4/6, moist); common, light brownish-gray (2.5Y 6/2, moist) coating on peds; principally massive (structureless); thin, discontinuous clay skins on cleavage faces; iron and manganese concretions.

Range in characteristics.—In places, the A horizon and upper B horizon have formed from a thin layer of loess or gritty sediment (pedisediment), or from both. A layer of small stones ranging from ½ inch to 2 inches in diameter occurs in the gritty sediment in places. The A horizon ranges from silt loam to clay loam when uneroded or moderately eroded, but it ranges from silty clay to clay when severely eroded. A weak A_2 horizon has developed in some of the Adair soils in Van Buren County, although an A_2 horizon is not typical for the Adair series.

Because the Adair soils have been reexposed through geologic erosion, they also may have been beveled or truncated by the same process. The modern B horizon may contain the full paleo B horizon, or it may contain only the lower part, such as the B_3 layer, because the upper part was lost through erosion. For this reason, the modern B horizon may range widely in thickness, color, and texture. As a rule, the more strongly truncated Adair soils (see representative profile on slope of 9 percent) occupy the steeper slopes.

Adair soils on 5 to 9 percent slopes have B horizons that generally range from clay to silty clay and are a mottled strong brown (7.5YR 5/6, moist) to olive gray (5Y 5/2, moist). On these moderate slopes, the solum is several inches thicker than on the strong slopes.

Adair soils on 9 to 14 percent slopes normally have B horizons that are brown (7.5YR 4/4, moist), strong brown (7.5YR 5/6 moist), or reddish brown (5YR 4/4, moist) and that range from heavy clay loam or heavy silty clay loam to clay or silty clay. The solum of Adair soils on 9 to 14 percent slopes is thinner and better drained than that of Adair soils on moderate slopes.

Adair and Clarinda soils, 5 to 9 percent slopes (AcC).—The Clarinda soil is dominant in this mapping unit in areas adjacent to the Grundy or to the Seymour soils. The Adair soil is dominant where this mapping unit is adjacent to the Weller and to the Pershing soils. A few areas having slopes of 3 and 4 percent are included with this mapping unit.

These soils are low in productivity. They are generally seepy and somewhat slow to dry out in spring. Available nitrogen is low in supply, phosphorus is very low, and potassium is medium. The surface layer is silt loam, 6 to 14 inches thick, which is easy to work under the right moisture conditions. The subsoil restricts the movement of air and water.

If protected from erosion, the soils have a potential for cultivated crops, but yields will be low, even under good management. All cultivated crops should be grown on the contour. Protection from erosion is needed because, if the dark surface layer is lost, good crops can be grown only with great difficulty. The best use of these soils is for hay or pasture. (Capability subclass IIIw, management group 16.)

Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded (AcC2).—The Clarinda soil is dominant in this mapping unit in areas adjacent to the Grundy or the Seymour soils. However, the Adair is dominant where this mapping unit is adjacent to the Weller and the Pershing soils. A few areas having slopes of 3 and 4 percent are included with this unit.

These soils are low in productivity. They are generally wet, seepy, and slow to dry out in spring. They are low in available nitrogen and phosphorus and medium in, potassium. The surface layer is only 3 to 6 inches thick, and in a few places the subsoil is exposed. The subsoil restricts the movement of air and water.

Because of low yields, these soils are poorly suited to cultivation. Additional erosion will make them almost useless for the growth of vegetation. The best use is hay or pasture. (Capability subclass IIIw, management group 16.)

Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded (AcC3).—The Clarinda soil is dominant in this mapping unit in areas adjacent to the Grundy or Seymour soils. The Adair soil is dominant where this mapping unit occurs adjacent to Weller and Pershing soils. Areas with slopes of 3 and 4 percent are included.

These soils are severely eroded and very low in productivity. They are wet, seepy, and slow to dry out in spring. Available nitrogen and phosphorus are very low in supply, and potassium is medium. The surface layer is clayey, sticky, and very difficult to work. It is less than 3 inches thick. The subsoil is exposed in most places.

These soils are poorly suited to cultivated crops. They can be used for hay and pasture, although the growth of grasses and legumes is generally poor. Good stands of pasture plants are difficult to establish. (Capability subclass IVe, management group 19.)

Adair and Clarinda soils, 9 to 14 percent slopes (AcD).—The Adair is the dominant soil in this mapping unit. Many profiles of this soil are more strongly truncated and contain more pebbles than those of Adair soils on 5 to 9 percent slopes.

Both soils are low in productivity. Available nitrogen is low in supply, phosphorus is very low, and potassium is medium. The surface layer is loam, 6 to 12 inches thick. The subsoil restricts the movement of air and water, but the soils are better drained than Adair and Clarinda soils on 5 to 9 percent slopes.

Erosion has not been serious, but all cultivated crops should be grown on the contour. Protection from erosion is needed to prevent the loss of the dark surface layer, as the subsoil is difficult to cultivate and prepare as a seedbed. The best use is hay or pasture. (Capability subclass IVe, management group 18.)

Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded (AcD2).—The Adair soil is dominant in this mapping unit. Many profiles of this soil are more strongly truncated and contain more pebbles than those of Adair soils on 5 to 9 percent slopes.

These soils are very low in available nitrogen and phosphorus and medium in potassium. The surface layer is only 3 to 6 inches thick, and the subsoil is exposed in places. The soils are drained better and are less likely to be wet and seepy than the Adair and Clarinda soils on 5 to 9 percent slopes.

Because of low yields, the soils are poorly suited to cultivation. They are suited best to hay or pasture. Yields of these crops can be improved through the use of phosphate fertilizer. (Capability subclass IVe, management group 18.)

Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded (AcD3).—The Adair soil is dominant in this mapping unit, and the profile of it is more strongly truncated and contains more pebbles than those of the Adair soils on 5 to 9 percent slopes.

The soils in this unit are severely eroded and are very low in productivity. They are very low in available nitrogen and phosphorus and medium in available potassium. The surface layer is clayey, sticky, and very difficult to work. It is less than 3 inches thick. The subsoil is exposed in most places.

These soils are poorly suited to cultivated crops and to hay and pasture plants. Grasses and legumes do not grow well and are difficult to establish. Hay and pasture are the best uses. (Capability subclass IVe, management group 19.)

Beckwith Series

The Beckwith series consists of strongly acid, light-colored, poorly drained soils. The soils have a silt loam surface layer, 4 to 8 inches thick, and a light-colored silt loam subsurface, 6 to 12 inches thick. The subsoil is very firm, very slowly permeable silty clay. The soils normally are very low in available nitrogen, low in available phosphorus, medium in available potassium, and low in organic matter.

The Beckwith soils have formed from Wisconsin loess and occupy level to nearly level, upland flats and broad, nearly level ridgetops having slopes of 0 to 3 percent. They are associated with the gently sloping and moderately sloping Weller soils, which occupy lower positions on the side slopes. Some Beckwith soils are on bench positions near large streams. Most of the Beckwith soils are in general soil area 3. Soils in strongly dissected areas near the Des Moines River or other large streams contain slightly more sand and less clay than those farther from streams. Soils in these areas grade toward those of the Rushville series.

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The Beckwith soils on uplands are normally underlain by glacial till at depths of 7 to 9 feet. On benches and along the streams, the loess is 5 to 10 feet thick. The bench position phase of Beckwith soils is underlain by alluvium.

A representative profile of the Beckwith series is that of Beckwith silt loam on a slope of 1 percent (520 feet north and 220 feet west of the southeast corner of NW¼ sec. 6, T. 69 N., R. 9 W.):

A_{11p} 0 to 3 inches, dark grayish-brown (10YR 4/2, moist), friable silt loam; weak, fine, granular structure; many, fine iron and manganese concretions; abrupt boundary.

A_{12p} 3 to 5 inches, brown to dark-brown (10YR 4/3, moist), friable silt loam; when crushed, same color; few, fine, faint mottles of brown to dark brown (7.5YR 4/4, moist); weak, thin, platy structure; many, fine iron and manganese concretions; worm casts; pH 5.6; abrupt boundary.

A_{21} 5 to 8 inches, dark grayish-brown (10YR 4/2, moist), friable silt loam; when crushed, same color; few, fine, faint mottles of brown to dark brown (7.5YR 4/4, moist); moderate, thin, platy structure; many, fine iron and manganese concretions; worm casts; pH 5.6; clear boundary.

A_{22} 8 to 13 inches, grayish-brown (2.5Y 5/2, moist), friable silt loam; when crushed, same color; few, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, thin, platy structure; ped surfaces, white (2.5Y 8/0, dry); many, fine iron and manganese concretions; pH 5.7; clear boundary.

B_1 13 to 16 inches, grayish-brown (10YR 5/2, moist), friable, light silty clay loam; when crushed, grayish brown (2.5Y 5/2, moist); few, fine, faint mottles of yellowish brown (10YR 5/6, moist); white (2.5Y 8/0, dry) coatings on peds; weak, very fine, subangular blocky structure; many, fine iron and manganese concretions; worm casts; pH 5.6; clear boundary.

B_{21} 16 to 19 inches, grayish-brown (2.5Y 5/2, moist), firm, medium silty clay; when crushed, brown to yellowish brown (10YR 5/3.5, moist); many, fine, distinct mottles of yellowish brown (10YR 5/6, moist); white (2.5Y 8/0, dry) coatings on peds; moderate, very fine, subangular blocky structure; thin, continuous clay skins; many, iron and manganese concretions; worm casts; pH 5.5; clear boundary.

B_{22} 19 to 29 inches, dark grayish-brown (2.5Y 4/2, moist), very firm, medium silty clay; when crushed, brown to yellowish brown (10YR 5/3.5, moist); many, fine, distinct mottles of strong brown (7.5YR 5/6, moist); strong, very fine to fine, angular blocky structure; thin, continuous clay skins; many, fine iron and manganese concretions; few, dark stains in root channels; pH 5.4; gradual boundary.

B_{23} 29 to 35 inches, dark grayish-brown (2.5Y 4/2, moist), firm, light silty clay; when crushed, brown to yellowish brown (10YR 5/3.5, moist); many, fine, distinct mottles of strong brown (7.5YR 5/6, moist); moderate, medium, subangular blocky structure; thin, discontinuous clay skins; many, fine iron and manganese concretions; few, dark stains in root channels; pH 5.5; gradual boundary.

B_3 35 to 46 inches, grayish-brown (2.5Y 5/2, moist), firm, heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); many, fine, prominent mottles of strong brown (7.5YR 5/6, moist); weak, medium, prismatic structure; thin, discontinuous clay skins; many, fine iron and manganese concretions; many, dark coatings in root channels; worm casts; pH 5.6; gradual boundary.

C_1 46 to 53 inches, grayish-brown (2.5Y 5/2, moist), firm, medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); many, medium, prominent mottles of strong brown (7.5YR 5/6, moist); massive; many, medium iron and manganese concretions; many organic stains and iron and manganese stains in root channels.

Range in characteristics.—The A_1 horizon ranges from very dark gray (10YR 3/1, moist) to dark grayish brown (10YR 4/2, moist) in color and from 4 to 8 inches in thickness. The A_2 horizon ranges from dark gray (10YR 4/1, moist) to grayish brown (2.5Y 5/2, moist) in color and from 4 to 8 inches in thickness. It is thinner on the narrow divides. The B horizon ranges from very dark grayish brown (10YR 3/2, moist) to grayish brown (2.5Y 5/2, moist) in color and from silty clay to clay in texture. In some cultivated areas, the A_1 horizon is mixed with the upper part of the A_2 horizon. In these places the color of the surface soil is light brownish gray (10YR 6/2, moist) to dark grayish brown (10YR 4/2, moist).

Beckwith silt loam (Ba).—This soil occurs on nearly level uplands. Fertility, organic matter, and plant nutrients are low, but the soil is generally used for cultivated crops. Heavy applications of fertilizer and lime are needed. The very firm, very slowly permeable silty clay subsoil restricts the downward movement of water. Wetness generally delays fieldwork. Tile drains will not function well. Surface drainage of depressions is generally needed to increase yields and prevent delays in fieldwork.

The soil tends to seal during rains, and it becomes hard and crusty when dry. (Capability subclass IIIw, management group 17.)

Beckwith silt loam, bench position (Bb).—This soil contains slightly more sand than the one described for the series and grades to the Rushville series. It is poorly drained and occupies the nearly level slopes of bench terraces between the uplands and bottom lands. Fertility and productivity, plant nutrients, and organic matter are low. Heavy applications of fertilizer and lime are generally needed for best yields of crops. The very firm, very slowly permeable silty clay subsoil restricts the downward movement of water. Wetness delays fieldwork in some seasons. Tile drains do not function properly because of the very slowly permeable subsoil. Surface drainage of depressions normally increases workability and crop yields. The surface soil tends to seal during rains, and it becomes hard and crusty when dry. (Capability subclass IIIw, management group 17.)

Belinda Series

The Belinda series consists of moderately light colored, very poorly drained soils that are low in fertility and moderate in production. They have a silt loam surface layer, 5 to 10 inches thick, and a light-colored silt loam subsurface layer, 6 to 12 inches thick. The subsoil is very firm, very slowly permeable silty clay, which restricts the movement of air and water. These soils tend to be low in available nitrogen and phosphorus and medium in available potassium. They are medium to low in organic matter and strongly acid.

The Belinda soils have developed from loess of Wisconsin age under prairie grasses, but the more recent vegetation has been trees.

These soils occur throughout the county on level upland flats and wide, level bench terraces. Generally, they are adjacent to the gently sloping and moderately sloping Pershing soils on lower side slopes or to the level Edina or Haig soils on upland flats. Some of them are in bench positions near the major streams, but most are in the uplands. In the strongly dissected areas near the Des Moines River or other large streams, the Belinda soils are slightly higher in sand and contain less clay than in areas farther from the streams. In these areas they grade toward the Rubio series.

The upland Belinda soils are underlain by glacial till at depths of 6 to 10 feet, but the usual thickness is 7 to 9 feet. The bench-position phase of Belinda soils is underlain by alluvium at depths of 6 to 10 feet.

A representative profile of the Belinda series is that of Belinda silt loam on a slope of 2 percent (15 feet east of north-south farm boundary, 40 feet south of road fence; or 820 feet east and 40 feet south of the northwest corner of NE¼ sec. 14, T. 68 N., R. 10 W.):

A_p 0 to 5 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable silt loam; weak, fine, subangular blocky structure breaking to weak, fine granular; pH 6.4; abrupt boundary.

A_{21} 5 to 11 inches, dark-gray (10YR 4/1, moist) or gray (10YR 6/1, dry), friable silt loam; moderate, thin, platy structure; pinholes; pH 5.4; clear boundary.

A_{22} 11 to 16 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist) or gray (10YR 6/1, dry), friable, light silty clay loam; weak, fine, subangular blocky structure; many, fine iron and manganese concretions; pinholes; clear boundary.

B_{21} 16 to 20 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), firm, heavy silty clay loam; many, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, subangular blocky structure; thick, continuous clay skins; many, fine iron and manganese concretions; pinholes; pH 5.2; clear boundary.

B_{22} 20 to 26 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), very firm silty clay; many, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, subangular blocky structure; thick, continuous clay skins; many, fine iron and manganese concretions; ped surfaces stained black (10YR 2/1, moist); clear boundary.

B_{23} 26 to 34 inches, dark-gray (10YR 4/1, moist), very firm, heavy silty clay loam; many, fine, distinct mottles of yellowish brown (10YR 5/4 and 5/6, moist); weak, medium, subangular blocky structure; thin, continuous clay skins; many, fine iron and manganese concretions; ped surfaces stained black (10YR 2/1, moist); pH 5.3; clear boundary.

B_3 34 to 40 inches, dark grayish-brown (2.5Y 4/2, moist), firm, heavy silty clay loam; many, fine, distinct and prominent mottles of yellowish brown (10YR 5/4 and 5/6, moist); weak, medium, subangular blocky structure; thin, continuous clay skins; many, fine iron and manganese concretions; ped surfaces stained black (10YR 2/1, moist); gradual boundary.

C_1 40 to 50 inches, dark grayish-brown (2.5Y 4/2, moist), firm, medium silty clay loam; many, fine, distinct and prominent mottles of yellowish brown (10YR 5/4 and 5/6, moist); nearly massive; thin, discontinuous clay skins on cleavage faces; many, fine iron and manganese concretions; cleavage faces stained black (10YR 2/1, moist); pH 6.3.

Range in characteristics.—The A_1, or A_p, horizon ranges from very dark gray (10YR 3/1, moist) to very dark grayish brown (10YR 3/2, moist) in color and from 5 to 10 inches in thickness. The A_2 horizon ranges from very dark grayish brown (10YR 3/2, moist) to dark gray (10YR 4/1, moist) in color and from 6 to 12 inches in thickness. This horizon is thinnest on the narrow divides and is thickest on wide, upland flats.

Belinda silt loam (Bd).—This is a very poorly drained soil on nearly level uplands. It is low in fertility and only moderately productive but is generally used for cultivated crops. Supplies of plant nutrients are low and those of organic matter are medium to low. Fertilizer and lime in large quantities are generally needed for best yields. The subsoil is very firm, very slowly permeable silty clay, which restricts the downward movement of air and water. Tile drainage will not function properly; consequently, surface drainage of depressions is generally needed to remove excess moisture and to increase yields. Wet soil often delays fieldwork. If worked when too wet, the surface soil tends to seal during rains and becomes hard and crusts on drying. (Capability subclass IIw, management group 8.)

Belinda silt loam, bench position (Bt).—This soil contains slightly more sand than the one described as representative of the series, and it grades toward the Rubio series. It is a poorly drained soil on bench terraces between the uplands and bottom lands. It is low in fertility but is generally used for cultivated crops. Plant nutrients are low, and organic matter is medium to low. Large amounts of fertilizer and lime are needed to produce the best yields. The subsoil is very firm, very slowly permeable silty clay, which restricts the downward movement of air and water. Tile drainage does not function satisfactorily. Surface drainage of depressed areas is needed to remove excess moisture and to increase yields. Wet soil often delays fieldwork. The surface soil tends to seal during rains and becomes hard and crusty on drying. (Capability subclass IIw, management group 8.)

Carlow Series

The Carlow series consists of moderately dark colored, very poorly drained, bottom-land soils. They normally have a silty clay loam surface layer, 8 to 14 inches thick, and a very slowly permeable, silty clay or clay subsoil. Some areas have been covered by a lighter colored loam or sandy loam overwash, as much as 16 inches thick. The soils are medium in organic matter, low in available nitrogen, and medium in available phosphorus and potassium. They are strongly acid.

The Carlow soils are in depressions or on the level parts of the first bottoms, mainly along the Fox and Little Fox Rivers. They occur in close association with the Wabash, Colo, Coppock, and Chequest soils. They are very similar to the Wabash soils in drainage and texture but are grayer and more mottled throughout the lower surface soil and subsoil.

A representative profile of the Carlow series is that of Carlow silty clay loam, level (300 feet north and 200 feet west of the southeast corner of NE¼NE¼ sec. 32, T. 68 N., R. 10 W.):

A_{1p} 0 to 6 inches, very dark grayish-brown (10YR 3/2, moist), friable, light silty clay loam; weak, fine, granular structure.

A_{12} 6 to 9 inches, black to very dark gray (10YR 2.5/1, moist), friable to firm, medium silty clay loam; when crushed, very dark gray and very dark grayish brown (10YR 3/1.5); few, fine, faint mottles of brown (10YR 4/3, moist) to dark brown (10YR 3/3, moist); weak, very fine, subangular blocky structure.

A_{13} 9 to 14 inches, black to very dark gray (10YR 2.5/1, moist), firm, medium to heavy silty clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); common, medium, prominent mottles of dark brown (7.5YR 4/4, moist) and strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure; pH 5.6.

B_2 14 to 19 inches, very dark gray (10YR 3/1, moist), firm, light silty clay; when crushed, very dark grayish brown (10YR 3/2, moist); common, fine, prominent mottles of dark brown (7.5YR 4/4, moist) and strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure.

B_3 19 to 32 inches, very dark gray (10YR 3/1, moist), firm, light to medium silty clay; when crushed, very dark grayish brown (10YR 4/2, moist); common, medium, prominent mottles of dark brown to brown (7.5YR 4/4, moist) and strong brown (7.5YR 5/6, moist); ped surfaces light brownish gray (10YR 6/2, moist); moderate, fine, prismatic structure; few iron and manganese concretions; pH 5.0.

C_1 32 to 40 inches, very dark gray (10YR 3/1, moist), very firm, medium silty clay; when crushed, dark gray (10YR 4/1, moist); few, medium, prominent mottles of dark brown to brown (7.5YR 4/4, moist) and strong brown (7.5YR 5/6, moist); peds coated with light brownish gray (10YR 6/2, moist); massive; pH 5.2.

Range in characteristics.—The surface horizon ranges from very dark grayish brown (10YR 3/2, moist) to black (10YR 2/1, moist) and from sandy loam to silty clay, depending on the amount and nature of the overwash. The very dark gray (10YR 3/1, moist) subsoil is slightly to very strongly mottled. A few areas on the upper Fox River bottoms include profiles that have gray (10YR 5/1, moist) silty clay loam A_2 horizons. These areas occur between areas of the Carlow and Coppock series and are transitional between them.

Carlow silty clay loam (Ca).—This soil generally has a silty clay loam surface layer, but it may be covered by as much as 6 inches of light-colored loam or silt loam overwash. The soil is firm, sticky, and difficult to work when wet. It is subject to frequent overflow from the adjacent streams and runoff from uplands. It needs dikes, diversion terraces, and open-ditch drainage systems to protect it. Tile drainage does not function well because the subsoil is very slowly permeable.

The soil is used for corn, soybeans, small grains, and legumes. In some wet years it is idle. Crop yields are generally low. (Capability subclass IIIw, management group 15.)

Carlow silty clay loam, overwashed (Cb).—This soil differs from the soil described for the Carlow series in having a light-colored deposit, 6 to 16 inches thick, that covers the original surface soil. The surface layer is a friable, easily tilled loam or silt loam. The soil is very poorly drained and subject to flooding by adjacent streams or to runoff from uplands. It should be protected by dikes, diversion terraces, or open-ditch drainage systems. Straightening of stream channels generally reduces the frequency of overflow. Tile drainage does not function properly because of the very slowly permeable subsoil.

Most of this soil has been cleared and is used intensively for cultivated crops. Yields are generally low. (Capability subclass IIIw, management group 15.)

Chariton Series

The Chariton series consists of dark-colored, poorly drained, moderately productive soils. They normally have a very dark gray silt loam surface layer, 6 to 16 inches thick, and a dark-gray or grayish-brown silt loam subsurface layer in which peds are coated with gray. The subsoil is slowly permeable, dark-gray to very dark gray silty clay to silty clay loam. Chariton soils are high in organic matter, low in available nitrogen, and medium in available phosphorus and potassium. They are strongly acid. They were formed under grass and from alluvium deposited by streams.

The Chariton soils occupy level or depressed positions on low second bottoms or on terraces in association with the Colo, Wabash, Gravity, and Olmitz soils. They occur mainly on the Des Moines River bottom but also along the smaller streams in general soil area 6.

A representative profile of the Chariton series is that of Chariton silt loam, on a level, low terrace (100 feet west and 540 feet north of the southeast corner of SW¼SW¼ sec. 23, T. 70 N., R. 11 W.):

A_{1p} 0 to 5 inches, very dark gray (10YR 3/1, moist), friable silt loam; when dry, gray (10YR 6/1); moderate, fine, granular structure; pH 6.2; gradual boundary.

A_{12} 5 to 11 inches, very dark gray to dark-gray (10YR 3.5/1, moist), friable silt loam, with some dark gray (10YR 4/1, moist); when dry, light gray (10YR 7/1); when crushed, dark gray (10YR 4/1, moist); moderate, fine, subangular blocky structure; pH 6.4; gradual boundary.

A_2 11 to 16 inches, dark-gray (10YR 4/1, moist), friable silt loam; when dry, light gray (10YR 7/1); when crushed, dark gray (10YR 4/1, moist); few, faint, medium mottles of dark brown (10YR 3/3, moist); weak, medium, platy, and moderate, fine, subangular blocky structure; pH 5.4; gradual boundary.

B_1 16 to 20 inches, very dark gray and dark-gray (10YR 3/1 and 4/1, moist), slightly firm, light silty clay loam; when dry, gray to light gray (10YR 6/1); when crushed, dark gray (10YR 4/1, moist); few, fine, faint mottles of dark brown (10YR 3/3, moist); peds coated gray (10YR 5/1, moist); moderate, medium, subangular blocky structure; pH 5.2; gradual boundary.

B_{21} 20 to 26 inches, very dark gray and dark-gray (10YR 3/1 and 4/1, moist), firm silty clay loam; when dry, gray (10YR 5/1); when crushed, dark gray (10YR 4/1, moist); few, fine, faint mottles of dark brown (10YR 3/3, moist); strong, fine, subangular blocky structure; clay skins on ped surfaces; few, fine iron and manganese concretions; pH 5.2; gradual boundary.

B_{22} 26 to 38 inches, very dark gray (10YR 3/1, moist), firm silty clay; when dry, gray (10YR 5/1); few, fine, faint mottles of dark brown (10YR 3/3, moist); strong, fine, subangular blocky structure; continuous clay skins on ped surfaces; a few, fine concretions of iron and manganese; pH 5.4; clear boundary.

B_3 38 to 44 inches, very dark gray and dark-gray (10YR 3/1 and 4/1, moist), firm, light silty clay; when dry, gray (10YR 5/1); when crushed, dark gray (10YR 4/1, moist); common, coarse, faint mottles of dark yellowish brown (10YR 4/4, moist); weak, medium, subangular blocky structure; some clay skins on ped surfaces and vertical cleavage faces; many, fine concretions of iron and manganese; pH 6.2; clear boundary.

C_1 44 to 60 inches, dark-gray (10YR 4/1, moist), firm, light silty clay; common, coarse, distinct mottles of dark brown (7.5YR 4/4, moist); root channels and vertical cleavage faces coated black (10YR 2/1, moist); massive; many, fine concretions of iron and manganese; pH 6.2.

Range in characteristics.—The A_1 horizon ranges from black (10YR 2/1, moist) to very dark grayish brown (10YR 3/2, moist) in color and from loam to heavy silt loam in texture. Recent deposits in a few areas are as much as 16 inches thick. The B horizon ranges from dark grayish brown (10YR 4/2, moist) to very dark gray (10YR 3/1, moist) in color and from heavy silty clay loam to silty clay (37 to 45 percent clay) in texture. The A_2 horizon ranges from very dark gray (10YR 3/1, moist) to dark grayish brown (10YR 4/2, moist) in color and from 6 to 10 inches in thickness.

Chariton silt loam (Ch).—This poorly drained soil has a slowly permeable subsoil that restricts the downward movement of water. The soil is generally wet and difficult to work in spring. Tile drainage may not function well in some areas because of the slowly permeable subsoil or because suitable outlets are hard to find. The most practical way to improve drainage is by surface drains or open ditches. Some areas of Coppock soils, too small to map separately, are included with this soil.

Chariton silt loam is generally used for row crops. Yields are moderately high. The soil is suitable for corn, soybeans, oats, and legumes. A good stand of alfalfa may be hard to establish in wet years. (Capability subclass IIw, management group 8.)

Chequest Series

The Chequest series consists of moderately dark, poorly drained, strongly acid soils on bottom lands. The surface layer is normally dark-gray silty clay loam, 12 to 20 inches thick. The subsoil is moderately mottled silty clay loam. Permeability is moderately slow. The soils tend to be medium in organic matter, low in available nitrogen, and medium in available phosphorus and potassium. They have developed in alluvial material, under trees, on the level to nearly level bottom land along the major streams south of the Des Moines River. They are in general soil area 6. The Chequest soils are closely associated with the Colo, Carlow, Coppock, Wabash, and Nodaway soils. They are somewhat better drained and occupy slightly higher topographic positions than the Carlow and Wabash soils.

A representative profile of the Chequest series is that of Chequest silty clay loam (960 feet north and 760 feet west of southeast corner of the NE¼ sec. 32, T. 68 N., R. 10 W.):

A_{1p} 0 to 6 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), firm, light silty clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); weak, fine, granular structure.

B_1 6 to 11 inches, very dark gray (10YR 3/1, moist), friable to firm, light silty clay loam; when crushed, very dark brown (10YR 2/2, moist); moderate, fine, subangular blocky structure; pH 5.4.

B_{21} 11 to 22 inches, dark-gray to very dark gray (10YR 3.5/1, moist), firm, medium silty clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); common, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist) and common, medium, prominent mottles of grayish brown (2.5Y 5/2, moist); moderate, fine, subangular blocky structure; pH 4.8.

B_{22} 22 to 34 inches, gray to dark-gray (10YR 4.5/1, moist), firm, light to medium silty clay loam; when crushed, dark gray (10YR 4/1, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); ped surfaces, very dark gray (10YR 3/1, moist) and light brownish gray (2.5Y 6/2, moist); strong, medium, subangular blocky structure; few, iron and manganese concretions; pH 4.8.

D–B_3 34 to 43 inches, light to medium silty clay; weak, medium and fine, blocky structure.

Range in characteristics.—The surface layer ranges from silt loam to medium silty clay loam in texture and from very dark gray (10YR 3/1, moist) to very dark grayish brown (10YR 3/2, moist) in color. The subsoil ranges from very dark gray (10YR 3/1, moist) to dark gray (10YR 4/1, moist) in color. Mottles range from distinct to prominent.

Chequest silty clay loam (Ck).—This poorly drained soil is subject to occasional flooding, but it is used intensively for cultivated crops. Yields of corn are moderately high in most years. In wet years many acres of this soil are idle. Tile drainage works well, but it is generally not practical because this soil is associated with heavier soils not suited to tiling. The soil can be protected from flooding by using diversion terraces and dikes and by straightening stream channels. Drainage can be improved by the use of surface drains and open ditches. This soil includes small areas of Coppock soils that were impractical to map separately. (Capability subclass IIw, management group 7.)

Clarinda Series

The Clarinda series consists of moderately sloping, poorly drained, very slowly permeable soils. Unless severely eroded, these soils normally have a moderately dark colored silt loam or light silty clay loam surface layer. The B horizon is normally gray to grayish-brown silty clay mottled with yellowish brown to yellowish red. The substratum is a heavy silty clay loam to silty clay.

The Clarinda soils formed under grassland vegetation on the nearly level surface of the Kansan till plain during the Yarmouth-Sangamon interglacial age. They were then buried by a deposit of loess, as were the Adair soils. Years later, the cover of loess was removed from the Clarinda soils through geological erosion on side slopes. Because these soils were once buried, they are called paleosols (fig. 3). This paleosol can be seen under the loess in deep roadcuts.

The Clarinda soils occur mainly on 5 to 9 percent slopes in association with the Grundy, Seymour, Shelby, and Adair soils. They are downslope from the Grundy and the Seymour soils but upslope from the Shelby and Adair soils. They have a grayer and normally finer textured B horizon than the Adair soils and contain fewer pebbles. They occupy lower positions on the landscape and have a finer textured C horizon than the Seymour soils. The Seymour soils have developed from loess and the Clarinda from till.

In Van Buren County, the Clarinda soils were mapped with the Adair soils as undifferentiated units.

A representative profile of the Clarinda series is that of Clarinda silt loam on a slope of 3 percent (30 feet south

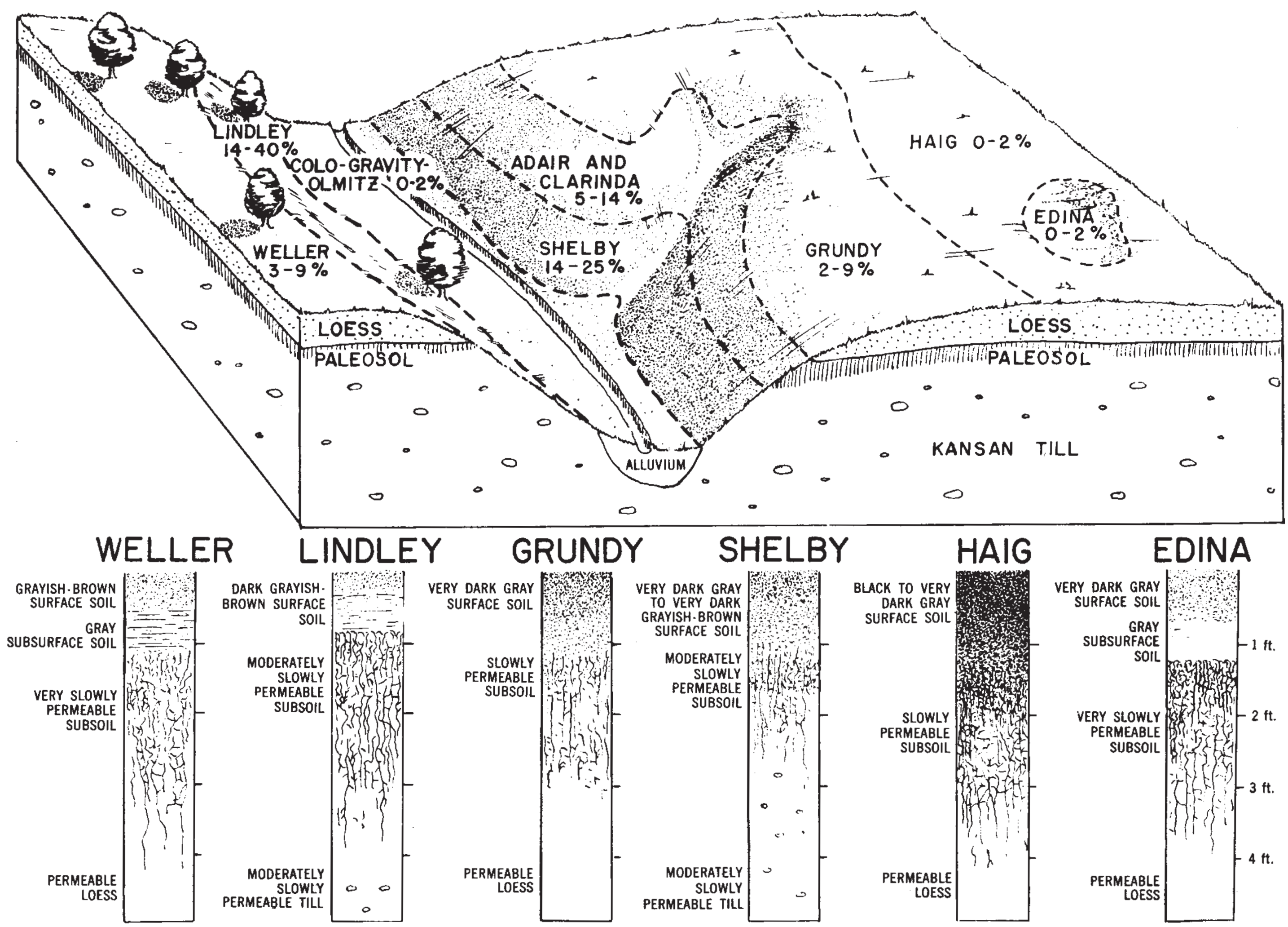

***Figure 3.*—The occurrence of some major upland soils in relation to slope, parent material, and native vegetation.**

and 250 feet east of northwest corner of NE¼ sec. 6, T. 67 N., R. 11 W.):

A_{1p} 0 to 6 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable silt loam; weak, fine, subangular blocky structure breaking to weak, fine, granular; pH 6.4; abrupt boundary.

A_{12} 6 to 9 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable, heavy silt loam; when crushed, very dark grayish brown (10YR 3/2, moist); common, fine, faint mottles of grayish brown (10YR 5/2, moist); moderate, fine, subangular blocky structure; worm casts and pinholes; clear boundary.

B_1 9 to 13 inches, very dark grayish-brown (10YR 3/2, moist), firm, heavy silty clay loam; when crushed, same color; common, fine, faint mottles of yellowish brown (10YR 5/4, moist) and few, fine, distinct mottles of strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure; worm casts and pinholes; pH 5.4; clear boundary.

B_{21} 13 to 20 inches, dark grayish-brown (2.5Y 4/2, moist), firm, heavy silty clay; when crushed, olive brown (2.5Y 4/3 to 4/4, moist); many, fine, distinct mottles of yellowish brown (10YR 5/6, moist) and many, fine, prominent mottles of strong brown (7.5YR 5/8, moist); strong, very fine, angular blocky structure; thick, continuous clay skins; root channels are coated with black (10YR 2/1, moist); worm casts and pinholes; pH 4.8; clear boundary.

B_{22} 20 to 24 inches, grayish-brown (2.5Y 5/2, moist), firm, medium silty clay; when crushed, olive brown (2.5Y 4/4, moist); many, fine, prominent mottles of strong brown (7.5YR 5/8, moist); moderate, fine, subangular blocky structure; thin, continuous clay skins; old root channels coated with black (10YR 2/1, moist); worm casts and pinholes; gradual boundary.

B_{23} 24 to 38 inches, gray (2.5YR 5/1, moist), very firm, medium silty clay; when crushed, olive brown (2.5Y 4/4, moist); common, fine, prominent mottles of yellowish brown (10YR 5/6, moist) and common, medium, prominent mottles of strong brown (7.5YR 5/8, moist); moderate, fine, subangular blocky structure; thin, discontinuous clay skins; old root channels coated with black (10YR 2/1, moist); worm casts and pinholes; pH 5.6; gradual boundary.

B_3C_1 38 to 48 inches, gray (5Y 5/1, moist), very firm, medium silty clay; when crushed, olive brown (2.5Y 4/3, moist); few, fine, prominent mottles of strong brown (7.5YR 5/8, moist) and yellowish brown (10YR 5/6, moist); principally massive; thin, discontinuous clay skins on cleavage faces; old root channels coated with black (10YR 2/1, moist); very fine, white grit; clear boundary.

C_2 48 to 55 inches, gray (5Y 5/1, moist), very firm, medium silty clay; when crushed, color same; few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); massive; thin, discontinuous clay skins on cleavage faces; old root channels coated with olive (5Y 5/4, moist); very fine, white grit; pH 6.6.

Iron and manganese concretions are present throughout profile.

Range in characteristics.—Because the Clarinda soils, like the Adair soils, have been reexposed on side slopes by geologic erosion, they also may have been beveled or truncated. Many Clarinda soils appear to have been truncated to some extent, whereas others do not. Where truncated, the soils vary in thickness of the clay or silty clay horizons and, in some places, intergrade to Adair soils. The A horizon in Clarinda soils may have developed in a thin layer of loess, or in a gritty sediment, or in both. This horizon ranges in texture from a silt loam to a silty clay loam. It ranges from 3 to 14 inches in thickness, unless severely eroded. The B horizon varies in color and texture. In color it ranges from grayish brown (2.5Y 5/2, moist) to dark grayish brown (2.5Y 4/2, moist) to gray (5Y 5/1, moist) or olive gray (5Y 5/2, moist). Mottles are yellowish brown, strong brown, or yellowish red. In texture, the B horizon ranges from silty clay to clay that contains some medium particles of sand. The C horizon ranges in texture from heavy clay loam to clay.

Clinton Series

The Clinton series consists of light-colored, moderately well drained to well drained soils. The soils are moderately acid to strongly acid and moderate to moderately high in productivity. Unless eroded, they normally have a silt loam surface layer, 6 to 10 inches thick. The subsurface layer generally is platy, weakly developed, and from 3 to 6 inches thick. Clinton soils have a firm, silty clay loam subsoil that is moderately slow in permeability.

The soils normally tend to be low to very low in available nitrogen and phosphorus, medium in available potassium, and low in organic matter. They have formed from Wisconsin loess, generally 6 to 12 feet thick, under forest vegetation.

These soils are on gently to strongly sloping uplands and on loess-mantled bench terraces adjacent to the Des Moines River and its tributaries. They occur below the gently sloping Keomah and Givin soils, above the Adair and Clarinda soils, and above the Douds soils and Terrace escarpments, which are on steeper slopes. Most of the Clinton soils are in general soil area 7.

A representative profile of the Clinton series is that of Clinton silt loam on a slope of 4 percent (50 feet north and 90 feet east of the southwest corner of sec. 6, T. 69 N., R. 9 W.):

A_p 0 to 7 inches, dark-brown (10YR 3.5/3, moist), friable silt loam; weak, fine, granular structure to weak, thin, platy; few, very fine manganese concretions; pH 6.8; clear boundary.

A_2B_1 7 to 11 inches, dark-brown (10YR 3/3, moist), friable silt loam; when crushed, dark brown to brown (10YR 4/3, moist); many, medium, faint mottles of dark yellowish brown to yellowish brown (10YR 4/4 to 5/6, moist); weak, fine, subangular blocky structure breaking to weak, fine, granular; few, fine manganese concretions; worm casts; pH 5.8; clear boundary.

B_{12} 11 to 17 inches, yellowish-brown (10YR 5/6, moist), friable, light silty clay loam; weak, fine, subangular blocky structure; thin, discontinuous clay skins; few, fine manganese concretions; worm casts; pH 5.6; clear boundary.

B_{21} 17 to 22 inches, dark yellowish-brown (10YR 4/4, moist), heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); slightly hard when dry; white coatings (2.5Y 8/2, dry) on peds; strong, fine, subangular blocky structure; thin, continuous clay skins; few, fine manganese concretions; worm casts; pH 5.4; clear boundary.

B_{22} 22 to 32 inches, dark-brown to brown (10YR 4/3, moist), medium to heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); hard when dry; few, white coatings (2.5Y 8/2, dry) on peds; weak, medium, subangular blocky structure; thin, continuous clay skins; few, fine iron and manganese concretions; pH 5.4; clear boundary.

B_{31} 32 to 38 inches, dark yellowish-brown (10YR 4/4, moist), slightly firm, light silty clay loam; when crushed, yellowish brown (10YR 5/5, moist); many, fine, distinct mottles of dark brown to brown (7.5YR 4/4, moist) and many, medium, prominent mottles of light brownish gray (2.5Y 6/2, moist); some white coatings (2.5Y 8/2, dry) on peds; weak, medium, subangular blocky structure; thin, discontinuous clay skins; common, fine iron and manganese concretions; worm casts; pH 5.2; clear boundary.

B_{32} 38 to 44 inches, light brownish-gray (2.5Y 6/2, moist), slightly firm, light silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of yellowish brown (10YR 5/4, moist) and few, fine, prominent mottles of brown (7.5YR 5/4, moist); few, white coatings (2.5Y 8/2, dry) on peds; weak, medium, subangular blocky structure; few, thin, discontinuous clay skins; common, fine iron and manganese concretions; old root channels; pH 4.8; clear boundary.

C_1 44 to 60 inches, light brownish-gray (2.5Y 6/2, moist), slightly firm, light silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of yellowish brown (10YR 5/6, moist) and strong brown (7.5YR 5/6, moist); massive; common, fine iron and manganese concretions; old root channels; pH 4.6.

Range in characteristics.—Unless eroded, the A_1 horizon ranges from very dark grayish brown (10YR 3/2, moist) to brown (10YR 5/3, moist) in color and from 6 to 10 inches in thickness. If present, the A_2 layer ranges from grayish brown (2.5Y 5/2, moist) to brown (10YR 5/3, moist) in color and from 3 to 6 inches in thickness. The B horizon usually ranges from dark yellowish brown (10YR 4/4, 4/6, moist) to yellowish brown (10YR 5/4, 5/6, moist) in color.

Clinton silt loam, bench position, 2 to 5 percent slopes (CmB).—This soil is similar to the one described as representative of the series, but in some places it has a less distinct A_2 horizon. It has a firm, moderately slowly permeable silty clay loam subsoil. The soil occurs mainly on gentle slopes of loess-mantled terraces or benches. Included with this soil are some areas (less than 10 percent of the total acreage) that occur on first bottoms at the bases of loess-covered terrace escarpments or upland slopes. The included areas have developed from loess and alluvium, and they have an A_1 horizon that is 12 to 18 inches thick.

This soil is low in fertility and moderately acid, but it responds well to fertilizers. It is moderately high in productivity and is generally used for cultivated crops. Plant nutrients tend to be low, so heavy applications of fertilizer are normally needed to obtain the best yields from crops. The soil is moderately well drained to well drained. Runoff is rapid, and all tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 3.)

Clinton silt loam, bench position, 5 to 9 percent slopes (CmC).—This well-drained soil is on moderately sloping, loess-mantled bench terraces. It is strongly acid and low in fertility but responds well to fertilizers. It is moderately high in productivity and generally is used for cultivated crops. Heavy applications of fertilizer are usually needed for best crop yields. The subsoil is firm silty clay loam that has moderately slow permeability. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded (CmC2).—This well-drained soil has a thinner surface layer (3 to 6 inches thick) than the soil described as representative of the series. It is on moderately sloping, loess-mantled bench terraces. It tends to be low in plant nutrients, is strongly acid, and responds well to fertilizer. Productivity is moderately high if management is good. The soil is generally used for cultivated crops, but heavy applications of fertilizer are needed for best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, bench position, 9 to 14 percent slopes (CmD).—This well-drained soil is on strongly sloping, loess-covered bench terraces. It tends to be low in fertility and is strongly acid but responds well to fertilizer. Productivity is high if management is good. The soil is generally used for cultivated crops, but heavy applications of fertilizer are needed for best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded (CmD2).—The profile of this well-drained soil is similar to the one described, but the surface layer is only 3 to 6 inches thick. This soil is on strongly sloping, loess-mantled bench terraces. It tends to be low in fertility and is strongly acid but responds well to fertilizer and lime. Productivity is moderate if management is good. The soil is generally used for cultivated crops, but heavy applications of fertilizer and lime are generally needed for best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, 5 to 9 percent slopes (CnC).—This is a well-drained, moderately sloping, upland soil. It is low in fertility and moderately acid but is generally used for cultivated crops. Yields are moderately high if heavy applications of fertilizer are used and other management is good. The subsoil is firm silty clay loam that is moderately slowly permeable. Runoff is rapid. All tillage should be on the contour to control erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, 5 to 9 percent slopes, moderately eroded (CnC2).—The profile of this upland soil differs from the representative series profile in having a dark surface layer that is only 3 to 6 inches thick. The soil is low in fertility, strongly acid, and responds well to heavy applications of fertilizer. It is generally used for cultivated crops. The soil produces moderately high yields if properly managed. Heavy applications of fertilizer are generally needed to produce the best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to control erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, 9 to 14 percent slopes (CnD).—This well-drained, upland soil is low in fertility and strongly acid. However, it is moderately high in productivity and generally is used for cultivated crops. Heavy applications of fertilizer are usually needed for best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to control erosion. (Capability subclass IIIe, management group 9.)

Clinton silt loam, 9 to 14 percent slopes, moderately eroded (CnD2).—The profile of this well-drained soil differs from the representative profile in having a surface layer that is only 3 to 6 inches thick. The soil is low in fertility and strongly acid. However, it is moderately productive and is generally used for cultivated crops. Heavy applications of fertilizer are needed for best yields. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to prevent erosion. (Capability subclass IIIe, management group 9.)

Colo Series

The Colo series consists of slightly acid, dark-colored, imperfectly drained to poorly drained soils on bottom lands. The surface layer is 12 to 24 inches thick, and it is most commonly light silty clay loam. The subsoil is dark-colored silty clay loam and has moderately slow permeability. The soils are medium in available nitrogen, phosphorus, and potassium and high in organic matter. They have developed from alluvial material under grass.

The Colo soils are on low, first and second bottoms along the larger streams in the county in general soil area 6. They are associated with the better drained Waukegan, Dickinson, and Nodaway soils, with the very poorly drained Carlow and poorly drained Chequest soils on bottom lands, and with the Olmitz and Gravity soils at the bases of the upland slopes at a slightly higher elevation.

A representative profile of the Colo series is that of Colo silty clay loam on a slope of 2 percent (450 feet east and 200 feet south of the northwest corner of SE¼SW¼ sec. 34, T. 69 N., R. 9 W.).

A_{1p} 0 to 5 inches, very dark brown to very dark grayish-brown (10YR 2.5/2, moist), friable silt loam to light silty clay loam; weak, fine, granular structure; pH 6.8; abrupt boundary.

A_{12} 5 to 12 inches, very dark gray (10YR 3/1, moist), friable silt loam to light silty clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, faint, dark-brown (10YR 3/3, moist), mottles; weak, thick, platy structure breaking to weak, fine, granular; pH 7.0; clear boundary.

B_1 12 to 19 inches, very dark gray (10YR 3/1, moist), friable silt loam to light silty clay loam; when crushed, dark brown (10YR 3/3, moist); few, fine, faint mottles of dark brown (10YR 3/3, moist); weak, fine to medium, subangular blocky structure; thin clay skins may be present; pH 5.8; clear boundary.

B_{21} 19 to 26 inches, very dark gray (10YR 3/1, moist), friable silt loam to light silty clay loam; when crushed, dark grayish brown (10YR 4/2, moist); few, fine, faint mottles of dark brown (10YR 3/3, moist) and few, fine, distinct mottles of yellowish brown (10YR 5/8, moist); peds commonly coated with gray (5Y 5/1, moist); moderate, medium, subangular blocky structure; thin clay skins may be present; pH 5.8; clear boundary.

B_{22} 26 to 32 inches, very dark gray (10YR 3/1, moist), friable to firm, light silty clay loam; when crushed, dark brown (10YR 3/3, moist); common, medium, faint mottles of dark yellowish brown (10YR 4/4, moist) and few, fine, prominent mottles of reddish brown (5YR 4/3, moist); peds commonly coated with gray (5Y 5/1, moist); weak, medium, subangular blocky structure; thin clay skins may be present; pH 6.6; clear boundary.

C_1 32 to 40 inches, very dark gray (10YR 3/1, moist), friable to firm, light silty clay loam; when crushed, dark brown (10YR 3/3, moist); common, medium, faint mottles of dark yellowish brown (10YR 4/4, moist) and few, fine, prominent mottles of reddish brown (5YR 4/3, moist); cleavage faces coated with gray (5Y 5/1, moist); massive; pH 6.6.

Range in characteristics.—The surface layer ranges from silt loam to silty clay loam (25 to 35 percent clay) in texture and from black (10YR 2/1, moist) to very dark grayish brown (10YR 3/2, moist) in color. The subsoil ranges from light to heavy silty clay loam in texture and from black (10YR 2/1, moist) to very dark grayish brown (10YR 3/2, moist) in color. It is commonly finer than the surface layer.

About 30 acres of the Colo soils mapped on the Des Moines River bottom have silt loam surface soil, which grades to light silty clay loam subsoil.

Colo silty clay loam (Co).—This soil is imperfectly drained to poorly drained and is subject to occasional flooding from streams. Included with it are a few small areas, totaling about 30 acres, that have a silt loam surface layer, a thick, weak, platy, very dark gray (10YR 3/1, moist) A_2 horizon, and a silt loam or light silty clay loam B horizon.

Colo silty clay loam is generally wet and dries out late in spring. However, it is friable and easy to work when moisture conditions are right. It is used intensively for cultivated crops. Yields are high.

Tile drainage generally can be used in areas of this soil on the bottom land of the Des Moines River. Areas along the Fox and Little Fox Rivers, however, are adjacent to poorly drained soils that have a higher water table. In these places open-ditch drainage is more practical because suitable outlets for tile drains are difficult to find. In some places diversions can be used to protect this soil from runoff from uplands.

This soil is well suited to corn, soybeans, oats, and legumes. (Capability subclass IIw, management group 7.)

Colo-Gravity-Olmitz complex (Cp).—The soils in this mapping unit occur together as small areas along narrow, upland streams and drainageways (see fig. 3). They are so closely intermingled that they are mapped as a complex, or group of soils.

They are moderately dark to dark, moderately well drained to poorly drained, and level to gently sloping. They are moderately high to high in productivity and can be used for corn, soybeans, small grains, and legumes. As these soils occur in narrow areas, they are farmed like the surrounding uplands. They are frequently in pasture or forest.

In some places these soils are cut by meandering streams and are subject to some overflow from streams and uplands. Gully erosion is a hazard caused by concentration of runoff. Straightening of stream channels and the use of diversions are usually recommended to protect the soils. Wet and seepy areas can be drained by tile. (Capability subclass IIw, management group 7.)

Coppock Series

The Coppock series consists of imperfectly to poorly drained soils that have formed under grass or grass and trees from alluvial material. They are on 1 to 5 percent slopes along the bases of uplands and on low terraces along the large streams in general soil area 6. They occupy slightly higher elevations than the surrounding bottom-land soils and are associated with the Olmitz, Colo, Wabash, and Nodaway soils. The Coppock silt loams are most extensive along the Fox River. They are similar in general appearance to the Chariton soils but have a thicker A_2 horizon, less clay in the subsoil, and are better drained. The sandy overwash phases are most extensive along the Des Moines River. Some of the imperfectly drained to poorly drained Coppock soils are mapped with the Nodaway soils as complexes.

A representative profile is that of Coppock silt loam on a large alluvial fan with a slope of 1 percent that lies below a major drainageway (350 feet north of the southwest corner of the SW¼SE¼ sec. 8, T. 68 N., R. 11 W.):

A_1 0 to 8 inches, very dark brown (10YR 2/2, moist), friable silt loam; when dry, gray (10YR 5/1); weak, thin, platy to granular structure; clear boundary.

A_{21} 8 to 13 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; common, fine, faint mottles of dark brown (10YR 4/3, moist) and many, fine, faint mottles of gray (10YR 5/1, moist); weak, fine, subangular blocky structure; a few, fine, soft concretions of iron and manganese; gradual boundary.

A_{22} 13 to 17 inches, very dark gray (10YR 3/1, moist) and grayish-brown (10YR 5/2, moist), friable silt loam; when dry, light brownish gray (10YR 6/2) and light gray (10YR 7/1); common, fine, distinct mottles of yellowish brown (10YR 5/8, moist) to strong brown (7.5YR 5/6, moist); weak, fine and very fine, subangular blocky structure with a slight tendency to platy structure; a very few, fine concretions of iron and manganese; gradual boundary.

A_{23} 17 to 20 inches, grayish-brown (2.5Y 5/2, moist) and dark grayish-brown (10YR 4/2, moist), friable silt loam; when dry, light gray (10YR 7/1–7/2); common, fine, distinct mottles of yellowish brown (10YR 5/8, moist) and strong brown (7.5YR 5/6, moist); weak, fine to medium, subangular blocky structure; a few, fine, soft concretions; gradual boundary.

B_1 20 to 24 inches, light brownish-gray (10YR 6/2, moist), friable to slightly firm, light silty clay loam; when dry, light gray (10YR 7/2); ped surfaces, very dark gray (10YR 3/1, moist); common mottles of dark yellowish brown (10YR 4/4, moist); weak, fine and medium, angular blocky structure; common, fine concretions of iron and manganese; gradual boundary.

B_{21} 24 to 27 inches, very dark gray (10YR 3/1, moist), slightly firm, medium silty clay loam; when dry, grayish brown (10YR 5/2); few, fine, faint mottles of yellowish brown (10YR 5/6, moist); insides of peds, light gray (10YR 7/2, moist); weak, fine to medium, angular blocky structure; common, fine concretions of iron and manganese; common, thin, discontinuous clay skins of very dark brown (10YR 2/2, moist); gradual boundary.

B_{22} 27 to 34 inches, black to very dark gray (10YR 2.5/1, moist), slightly firm, light silty clay loam; when dry, gray to dark gray (10YR 5/1–4/1); when crushed, very dark gray (10YR 3/1, moist); common, fine, faint mottles of dark yellowish brown (10YR 4/4, moist) and light gray (10YR 7/2, moist); weak, medium, angular blocky structure to massive; thin, discontinuous clay skins; common, fine concretions of iron and manganese, a few grains of sand; gradual boundary.

B_{23} 34 to 44 inches, black (10YR 2/1, moist), slightly firm, light silty clay loam; when dry, very dark gray (10YR 3/1); ped surfaces, same colors; when crushed, very dark gray (10YR 3/1, moist); common, fine mottles of strong brown (7.5YR 5/6, moist); weak, medium, angular blocky structure to massive; some thin, discontinuous clay skins; gradual boundary.

B_{31} 44 to 53 inches, very dark gray (10YR 3/1, moist) and gray (10YR 5/1, dry), slightly firm, medium clay loam; few, black (10YR 2/1, moist) ped coatings that are very dark gray to dark gray (10YR 3/1–4/1) when dry; insides of peds have a few flecks of light gray; weak, medium, angular blocky structure to massive; few, thin, discontinuous clay skins.

C_1 53 to 60 inches, dark-gray (10YR 4/1, moist), friable sandy clay loam; when dry, gray or grayish brown (10YR 5/1–5/2); common, fine, faint mottles of light gray (10YR 7/2, moist) and many, coarse mottles of strong brown (7.5YR 5/6, moist) to dark reddish brown (5YR 3/3, moist); massive.

Range in characteristics.—There is considerable variation in Coppock silt loam as mapped in Van Buren County. The A_1 horizon ranges from very dark gray (10YR 3/1, moist) to dark grayish brown (10YR 4/2, moist) in color and from silt loam to light silty clay loam in texture. The A_2 horizon ranges from 10 to 24 inches in thickness. The B_2 horizon ranges from heavy silt loam to heavy silty clay loam, but a light to medium silty clay loam is dominant.

Coppock silt loam, 0 to 2 percent slopes (CsA).—This imperfectly drained to poorly drained soil is on level to nearly level foot slopes and low stream terraces. It has a silt loam surface layer that is generally about 14 inches deep over a thick, dark-gray, silty A_2 horizon. The subsoil is dark-gray, moderately permeable silty clay loam. In a few places adjacent to the Olmitz soils, this Coppock soil includes areas having a loam surface soil and a clay loam subsoil.

Nearly all this soil has been cleared except the channeled areas next to streams. The soil is friable and easy to work. It is moderately to highly productive and responds well to fertilizer. The supply of available nitrogen is low, and that of available phosphorus and potassium is medium. The soil is suited to and used extensively for corn, soybeans, oats, and legumes. Yields are high.

A high water table and runoff from uplands make this soil somewhat wet in spring. Diversion terraces constructed at the bases of upland slopes help to control runoff from uplands. Tile systems can be used to improve drainage if suitable outlets are available. (Capability subclass IIw, management group 7.)

Coppock silt loam, 2 to 5 percent slopes (CsB).—This imperfectly drained soil generally occurs along the outer edge of bottoms along the larger streams. Topographically it is below the soils on the steep uplands or terrace escarpments. The subsoil is moderately permeable. A few areas, adjacent to the Olmitz soils, have a loam surface soil and a clay loam subsoil and are mapped with this soil.

This soil is friable and easily tilled. It responds well to fertilizers and is used intensively for row crops. Yields are high.

Fieldwork may be delayed by wetness in spring and in wet seasons. However, construction of diversion terraces at the bases of slopes and the use of tile systems will improve the drainage. The soil is subject to sheet erosion, and, where practical, should be contoured. In general, however, the soil is in small areas and is farmed in the same manner as the adjacent bottom-land soils. (Capability subclass IIw, management group 7.)

Coppock soils, sandy overwash, 0 to 2 percent slopes (CwA).—Most of this mapping unit is adjacent to sandy or sandy loam terrace escarpments. Some areas, however, occupy low second bottoms in association with the Dickinson and Waukegan soils. Most of the unit occurs along the Des Moines River. The soils in this unit are somewhat similar to Coppock silt loam, 0 to 2 percent slopes, but they have a deposit of yellowish-brown sand or loamy sand, 10 to 24 inches thick, on the surface. The buried surface soil beneath the sandy material is lighter colored and coarser textured than that of Coppock silt loam. A few areas are included that have a fine sandy loam or sandy loam texture throughout the profile.

Coppock soils, sandy overwash, 0 to 2 percent slopes, are moderate to low in productivity. They are droughty in midsummer but are generally used for row crops, small grains, and legumes. Wetness may be a problem because the soils occur at the bases of slopes and receive runoff and deposition from higher slopes. They are very low in available nitrogen but medium in available phosphorus and potassium. (Capability subclass IIIs, management group 13.)

Coppock soils, sandy overwash, 2 to 5 percent slopes (CwB).—These soils are droughty in midsummer, but they are generally used for row crops, small grains, and legumes. Yields are low. Wetness may be a problem because the soils are at the bases of slopes and receive runoff and soil materials from the slopes above. (Capability subclass IIIs, management group 13.)

Dickinson Series

The Dickinson series consists of moderately dark colored, well drained to somewhat excessively drained soils that have developed in sandy alluvium. If not eroded they have very dark grayish-brown sandy loam surface and subsurface layers, 10 to 24 inches thick, and a moderately rapidly permeable, dark-brown sandy clay loam subsoil. They are slightly acid and slightly droughty. Supplies of organic matter are medium. Available nitrogen is very low, available phosphorus is low, and available potassium is medium. The soils have formed under grass.

Dickinson soils are on first and second bottoms and terraces along the Des Moines River and some of its tributaries in general soil area 6. They are associated with the Colo, Waukegan, Perks, and Hagener soils.

A representative profile of the Dickinson series is that of Dickinson sandy loam, bench position, on a slope of 3 percent (900 feet south and 100 feet east of the northwest corner of sec. 22, T. 70 N., R. 11 W.):

A_{1p} 0 to 7 inches, very dark grayish-brown (10YR 3/2, moist), friable sandy loam; weak, fine, granular structure; pH 6.8; abrupt boundary.

A_{12} 7 to 11 inches, very dark grayish-brown (10YR 3/2, moist), friable sandy loam; weak, fine, subangular blocky structure; few worm casts; clear boundary.

B_1 11 to 19 inches, very dark grayish-brown (10YR 3/2, moist) and dark-brown (10YR 4/3, moist), friable, heavy sandy loam; when crushed, dark brown to brown (10YR 4/3, moist); moderate, fine, subangular blocky structure; pH 6.8; gradual boundary.

B_2 19 to 27 inches, dark-brown (10YR 4/3, moist), friable to firm, light to medium sandy clay loam; when crushed, same color; some peds coated with very dark grayish brown (10YR 3/2, moist); moderate, medium, subangular blocky structure; gradual boundary.

B_3 27 to 36 inches, dark-brown to dark yellowish-brown (10YR 3/4, moist), friable, light sandy clay loam; when crushed, dark yellowish brown (10YR 4/4, moist); ped surfaces, very dark grayish brown (10YR 3/2, moist); weak, medium, subangular blocky structure; pH 5.0; gradual boundary.

C_1 36 to 46 inches, dark yellowish-brown (10YR 4/4, moist), friable loamy sand; when crushed, same color; massive; cleavage faces coated with very dark grayish brown (10YR 3/2, moist); pH 5.2.

Range in characteristics.—The A_1 horizon ranges from very dark grayish brown to dark brown (10YR 3/2 to 4/3, moist). The B horizon is dark-gray to dark-brown (10YR 4/1 to 4/3, moist) loam to sandy clay loam.

Dickinson sandy loam, bench position, 0 to 2 percent slopes (DbA).—This moderately dark colored, well-drained, slightly droughty soil occurs extensively on first and second bottoms along the Des Moines River. It is easily worked and moderately productive. It is used intensively for row crops but is suitable for corn, soybeans, oats, and legumes. (Capability subclass IIs, management group 5.)

Dickinson sandy loam, bench position, 2 to 5 percent slopes (DbB).—This well-drained soil is on gentle slopes and low second bottoms. It is slightly droughty and moderately productive; it responds to fertilizer and lime. It is used intensively for row crops and is suitable for corn, soybeans, oats, and legumes. The soil is friable and easy to work. Wind erosion is a hazard; consequently, a winter cover crop should be grown to control soil losses. (Capability subclass IIs, management group 5.)

Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded (DbC2).—The profile of this soil differs from that described for the series in being moderately eroded and somewhat excessively drained. This soil occurs as small areas on moderate slopes between the first and second bottoms. It is droughty and subject to wind erosion but is generally managed like the surrounding level and gently sloping soils. Yields are low. This soil is used intensively for cultivated crops and is suitable for corn, soybeans, and legumes. (Capability subclass IIIs, management group 13.)

Douds Series

Soils of the Douds series are strongly acid, light colored, and moderately well drained to somewhat excessively drained. They are low in fertility and in organic matter. As a rule, they have a loamy surface layer, 3 to 8 inches thick and a subsoil that ranges from clay loam to sand. The substratum is mainly stratified sandy alluvium. Runoff is very rapid.

The Douds soils have formed under forest from stratified alluvium considered to be of Kansan or Sangamon age. A thin mantle of eolian material or Wisconsin loess is on the surface in some places.

The Douds soils occur on strongly sloping to moderately steep side slopes of bench terraces adjacent to the Des Moines River and its tributaries. They generally are downslope from the bench-position phases of the Clinton silt loams and the bench-position phases of the Weller soils. The Douds soils occur mainly in general soil area 7.

A representative profile of the Douds series is that of Douds loam on a slope of 16 percent (800 feet east and 650 feet north of the southwest corner of sec. 24, T. 69 N., R. 10 W.):

A_1 0 to 2 inches, very dark grayish-brown (10YR 3/2, moist), friable loam; weak, fine, granular structure; clear boundary.

A_2 2 to 6 inches, dark yellowish-brown (10YR 4/4, moist), friable, coarse loam; weak, fine, granular structure; pH 5.8; abrupt boundary.

B_1 6 to 11 inches, strong-brown (7.5YR 5/6, moist), friable, light clay loam; weak, fine, subangular blocky structure; black (10YR 2/1, moist) organic stains; pH 4.8; abrupt boundary.

B_2 11 to 19 inches, strong-brown (7.5YR 5/8, moist), firm, heavy clay loam; medium, fine, subangular blocky structure; thin, discontinuous clay skins; worm casts present; pH 4.9; clear boundary.

B_{31} 19 to 21 inches, dark yellowish-brown (10YR 3/4, moist), firm, medium clay; when crushed, dark yellowish brown (10YR 4/4, moist); many, medium, faint mottles of dark yellowish brown (10YR 4/4, moist), few, fine, distinct mottles of yellowish red (5YR 5/8, moist), and common, fine, distinct mottles of light brownish gray (2.5Y 6/2, moist); weak, very fine, subangular blocky structure; thin, discontinuous clay skins; abrupt boundary.

B_{32} 21 to 28 inches, strong-brown (7.5YR 5/8, moist), firm, light silty clay loam; when crushed, strong brown (7.5YR 5/6, moist); massive; few, thin, discontinuous clay skins on cleavage faces; thin band of yellowish brown (10YR 5/4, moist); stains of yellowish red (5YR 4/6, moist); worm casts; pH 4.8; clear boundary.

D_1 28 to 34 inches, yellowish-brown (10YR 5/6, moist), very friable sandy loam; when crushed, same color; massive to single-grain structure; stains of yellowish red (5YR 4/6, moist); some clay cementation; some gravel; abrupt boundary.

D_2 34 to 35 inches, yellowish-red (5YR 4/6, moist) band colored with iron compounds; very friable sandy loam; massive to single-grain structure; pH 4.8; abrupt boundary.

D_3 35 to 41 inches, brownish-yellow (10YR 6/6, moist), loose loamy sand; when crushed, strong brown (7.5YR 5/6, moist); single-grain structure; clear boundary.

D_4 41 to 43 inches, yellowish-red (5YR 5/8, moist), very friable sandy loam; when crushed, strong brown (7.5YR 5/6, moist); massive; brownish-yellow (10YR 6/6, moist) thin band that is colored by iron compounds; abrupt boundary.

D_5 43 to 46 inches, light brownish-gray (2.5Y 6/2, moist), friable clay loam; when crushed, yellowish brown (10YR 5.5/4, moist); massive; stains of red (2.5YR 4/8, moist) and strong brown (7.5YR 5/8, moist); abrupt boundary.

D_6 46 to 49 inches, yellowish-red (5YR 5/8, moist), very friable sandy loam; massive; clear boundary.

D_7 49 to 60 inches, yellowish-brown (10YR 5/6, moist), loose loamy sand; single-grain structure; bands of yellowish red (5YR 4/6 and 5YR 5/8, moist) 2 to 3 millimeters thick.

Range in characteristics.—The A_1 horizon is very dark grayish-brown (10YR 3/2, moist) to dark-brown (10YR 4/3, moist) silt loam to sandy loam. The subsoil is generally sandy loam, sandy clay loam, or clay loam. Sometimes it is sand. The color of the subsoil is brown (10YR 5/3, moist) to yellowish brown (10YR 5/4, moist), or strong brown (7.5YR 5/6, moist). In places, it is dark red (2.5YR 3/6, moist) or red (2.5YR 4/6 or 2.5YR 4/8, moist).

Douds soils and Terrace escarpments (Ts).—This mapping unit consists of soils of the Douds series and a miscellaneous land type called Terrace escarpments. The dominant slopes range from 9 to 18 percent, but gentler and stronger slopes are included. The Douds soils are strongly sloping to moderately steep. Terrace escarpments are steep, very short slopes adjacent to the river bottoms. The components are variable in texture but are usually sandy. Shale, limestone, or glacial till crops out in many places.

The components of this mapping unit are subject to severe sheet erosion. Gullies are difficult to control, particularly if they have eroded into the sandy substratum. The soils are low in fertility and in many areas are droughty. Some of the less steep slopes are occasionally used for cultivated crops and meadow. Permanent pasture or woodland is the proper use of the steeper slopes. The components of this mapping unit are mostly in capability subclass VIs, management group 22.

Downs Series

The Downs series consists of moderately light colored, moderately well drained to well drained soils. If not eroded, they have a silt loam surface layer, 2 to 6 inches thick. The subsoil is normally friable to firm, moderately permeable, light silty clay loam. The available supply of nitrogen and phosphorus is generally low. Supplies of potassium and organic matter are medium. The soils are slightly acid. The Downs soils formed from loess under a cover of prairie grasses, but the more recent vegetation has been trees.

These soils occupy gently sloping and moderately sloping, loess-mantled bench terraces and a very few loess-mantled low terraces adjacent to the Des Moines River and its major tributaries. They are above the Douds soils and Terrace escarpments and the Downs and Lamont mapping units, which occur on steeper slopes. They are adjacent to the bench-position Clinton and Keomah soils on similar slopes and are adjacent to the Waukegan or Dickinson soils on the low terraces. Most of the Downs soils are in general soil area 7.

A representative profile of the Downs series is that of Downs silt loam, bench position, on a slope of 6 percent (southwestern edge of a quarry, 680 feet south and 700 feet east of northwest corner of SW¼NW¼ sec. 16, T. 70 N., R. 11 W.):

A_{1p} 0 to 5 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, very dark grayish brown (10YR 3.5/2, moist); common, fine, faint mottles of yellowish brown (10YR 5/4, moist); weak, medium, subangular blocky structure breaking to weak, fine, granular; iron and manganese concretions; worm casts; pH 6.6; abrupt boundary.

A_{12} 5 to 8 inches, dark-brown (10YR 4/3, moist), friable silt loam; when crushed, dark brown to dark grayish brown (10YR 4/2.5, moist); moderate, fine, subangular blocky structure; iron and manganese concretions; root channels stained very dark grayish brown (10YR 3/2, moist); worm casts; clear boundary.

B_1 8 to 12 inches, dark-brown (10YR 4/3, moist), friable silt loam; when crushed, dark grayish brown to dark brown (10YR 4/2.5, moist); ped surfaces, dark grayish brown (10YR 4/2, moist); moderate, fine, subangular blocky structure; iron and manganese concretions; root channels stained very dark grayish brown (10YR 3/2, moist); worm casts and pinholes; pH 6.4; clear boundary.

B_{21} 12 to 16 inches, yellowish-brown (10YR 5/4, moist), friable, light silty clay loam; when crushed, same color; ped surfaces, dark brown to brown (10YR 4/3, moist); strong, fine, subangular blocky structure; clay skins appear to be present; iron and manganese concretions; root channels stained very dark grayish brown (10YR 3/2, moist); pinholes; pH 6.6; clear boundary.

B_{22} 16 to 20 inches, yellowish-brown (10YR 5/4, moist), friable, light silty clay loam; when crushed, same color; strong, fine, subangular blocky structure; clay skins appear to be present; iron and manganese concretions; root channels stained very dark grayish brown (10YR 3/2, moist); pinholes; gradual boundary.

B_{23} 20 to 28 inches, yellowish-brown (10YR 5/4, moist), slightly firm, medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); strong, fine, subangular blocky structure; clay skins appear to be present; iron and manganese concretions; root channels stained very dark grayish brown (10YR 3/2, moist); pinholes; pH 6.2; gradual boundary.

B_{31} 28 to 40 inches, yellowish-brown (10YR 5/4, moist), firm very fine sandy clay loam; when crushed, same color; few, fine, distinct mottles of grayish brown (2.5Y 5/2, moist) and few, coarse, prominent mottles of yellowish red (5YR 5/8, moist); moderate, medium, angular blocky structure; clay skins appear to be present; iron and manganese concretions; pinholes; gradual boundary.

B_{32} 40 to 50 inches, yellowish-brown (10YR 5/4, moist), firm very fine sandy clay loam; when crushed, same color; many, fine, distinct mottles of strong brown (7.5YR 5/6, moist) and few, fine, prominent mottles of red (2.5YR 4/8, moist); ped surfaces, grayish brown (2.5Y 5/2, moist); weak, medium, prismatic structure to massive; iron and manganese concretions; very dark grayish-brown (10YR 3/2, moist) stains; pinholes; pH 4.9; gradual boundary.

C_1 50 to 60 inches, yellowish-brown (10YR 5/4, moist), friable very fine sandy loam; when crushed, same color; many, fine, distinct mottles of strong brown (7.5YR 5/6, moist) and few, fine, distinct mottles of yellowish red (5YR 5/8, moist); massive; iron and manganese concretions; cleavage faces coated with grayish brown (2.5Y 5/2, moist); pinholes; gradual boundary.

C_2 60 to 70 inches, yellowish-brown (10YR 5/4, moist), friable very fine sandy loam; when crushed, same color; massive; iron and manganese concretions; cleavage faces coated with grayish brown (2.5Y 5/2, moist); pinholes; pH 4.9.

Range in characteristics.—The A_1 horizon ranges from very dark grayish brown (10YR 3/2, moist) to dark grayish brown (10YR 4/2, moist) to dark brown (10YR 4/3, moist), and it is from 3 to 10 inches thick. The A_2 horizon, if one is present, is grayish brown (10YR 5/2, moist) or dark grayish brown (10YR 4/2, moist) and 2 to 6 inches thick. The B horizon ranges from dark brown (10YR 4/3, moist) to yellowish brown (10YR 5/4, 5/6, moist). The B_2 horizon is usually silty clay loam, but the C horizon is usually very fine sandy loam to sandy clay loam. The Downs soils in Van Buren County have a higher percentage of sand than is typical for the series.

Downs silt loam, bench position, 2 to 5 percent slopes (DtB).—This well drained to moderately well drained soil is on loess-mantled bench terraces and on a few loess-mantled low terraces. A few small areas of the Clinton soils are included.

This soil is friable and easily worked, and it is medium n fertility. Supplies of available nitrogen and phosphorus are low. The response to fertilizer is good. The soil is generally used for cultivated crops. Yields are good if fertilizer is applied and other management is good. The subsoil is moderately permeable. Runoff is rapid. All tillage should be on the contour to control erosion. (Capability subclass IIe, management group 3.)

Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded (DtC2).—The profile of this well-drained soil differs from that described for the series in having a dark surface layer only 3 to 6 inches thick. This soil is on loess-mantled bench terraces and a few loess-mantled low terraces. A few small areas of the Lamont and the Clinton soils are included.

This soil is friable and easily worked; it is low to medium in fertility. Supplies of available nitrogen and phosphorus are low. The response to fertilizer is good. The soil is generally used for cultivated crops. Yields are good if fertilizer is added and other management is good. The subsoil is moderately permeable. Runoff is rapid, and all tillage should be on the contour to control erosion. (Capability subclass IIIe, management group 9.)

Downs and Lamont soils, bench position, 9 to 14 percent slopes (DwD).—This undifferentiated mapping unit may consist of the Downs and the Lamont soils or of either of these alone. Some slopes less and some slopes greater than the predominant slopes are included.

The soils in this unit are very low in fertility, and they erode easily. In addition, the Lamont soils are droughty. This mapping unit is not suitable for cultivated crops. It is best suited to pasture or forestry. (Capability subclass VIs, management group 22.)

Edina Series

The Edina series consists of moderately dark colored, poorly drained soils on uplands. They have formed in Early Wisconsin loess under grasses. The loess is normally 7 to 9 feet thick and is underlain by glacial till.

The Edina soils are mainly in large areas on level upland flats south of the Des Moines River. They are adjacent to the sloping Seymour and Pershing soils and to the nearly level Belinda soils. A few small, slightly depressed areas of Edina soils are north of the Des Moines River adjacent to the level Haig soils (see fig. 3). The Edina soils are in general soil areas 1 and 5.

A representative profile of the Edina series is that of Edina silt loam on a slope of 1 percent (100 feet north of the southeast corner of the SW¼ sec. 27, T. 68 N., R. 11 W.):

A_{1p} 0 to 6 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; moderate, medium, platy structure; iron and manganese concretions; worm casts; pH 6.2; abrupt boundary.

A_{12} 6 to 10 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, dark grayish brown (10YR 4/2, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); moderate, thin, platy structure; iron and manganese concretions; worm casts; abrupt boundary.

A_{21} 10 to 13 inches, dark grayish-brown (2.5Y 4/2, moist), friable silt loam; when crushed, grayish brown (2.5Y 5/2, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); moderate, thin, platy structure; ped surfaces are white (10YR 8/1, dry); iron and manganese concretions; root channels coated with black (10YR 2/1, moist); worm casts and pinholes; clear boundary.

A_{22} 13 to 18 inches, grayish-brown (10YR 5/2, moist), friable silt loam; when crushed, grayish brown to light brownish gray (2.5Y 5.5/2, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); moderate, thin, platy structure; ped surfaces are white (10YR 8/1, dry); iron and manganese concretions; root channels coated with black (10YR 2/1, moist); worm casts and pinholes; pH 5.4; abrupt boundary.

B_{21} 18 to 21 inches, very dark gray (10YR 3/1, moist), very firm, medium silty clay; when crushed, very dark grayish brown (10YR 3/2, moist); common, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); moderate, very fine, subangular blocky structure; clay skins present; iron and manganese concretions; black (10YR 2/1, moist) organic stains in root channels; pinholes; clear boundary.

B_{22} 21 to 27 inches, very dark grayish-brown (10YR 3/2, moist), very firm, medium silty clay; when crushed, very dark grayish brown to dark grayish brown (10YR 3.5/2, moist); many, fine, faint mottles of dark yellowish brown (10YR 4/4, moist) and a few, fine, distinct mottles of strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure; iron and manganese concretions; thick, continuous clay skins; root channels coated with black (10YR 2/1, moist); pinholes; pH 6.2; clear boundary.

B_{23} 27 to 32 inches, dark grayish-brown (2.5Y 4/2, moist), very firm, light silty clay; when crushed, grayish brown (2.5Y 5/2, moist); many, fine, faint mottles of dark yellowish brown (10YR 4/4, moist) and few, fine, distinct mottles of strong brown (7.5YR 5/6, moist); moderate, medium, subangular blocky structure; clay skins appear to be present; iron and manganese concretions; root channels coated with black (10YR 2/1, moist); pinholes; clear boundary.

B_3 32 to 41 inches, olive-gray (5Y 5/2, moist), firm, heavy silty clay loam; when crushed, grayish brown (2.5Y 5/2, moist) to light olive brown (2.5Y 5/4, moist); common, few, fine mottles of strong brown (7.5YR

5/6, moist) and few, fine, prominent mottles of reddish brown (5YR 4/4, moist); weak, fine, prismatic structure to massive; thin, discontinuous clay skins on cleavage faces; root channels coated with black (10YR 2/1, moist); pH 6.6; clear boundary.

C_1 41 to 47 inches, olive-gray (5Y 5/2, moist), firm, heavy silty clay loam; when crushed, grayish brown to light olive brown (2.5Y 5/3, moist); common, medium, prominent mottles of yellowish red (5YR 5/8, moist), few, fine, prominent mottles of dark red (2.5YR 3/6, moist) and few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); massive; thin, discontinuous clay skins on cleavage faces; iron and manganese concretions; root channels coated with black (10YR 2/1); pinholes; clear boundary.

C_2 47 to 52 inches, gray (5Y 5/1, moist), firm, light silty clay loam; when crushed, olive (5Y 5/3, moist); few, fine, prominent mottles of yellowish red (5YR 5/8, moist) and dark red (10R 3/6, moist); massive; iron and manganese concretions; pinholes.

Range in characteristics.—The A_1 horizon ranges from very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2, moist), and it is 6 to 12 inches thick. The A_2 horizon ranges from grayish brown (10YR 5/2, moist) to dark grayish brown (2.5Y 4/2, moist), and it is 6 to 12 inches thick. The B horizon ranges from very dark gray (10YR 3/1, moist) to olive gray (5Y 5/2, moist), and the clay content is estimated to be 50 to 55 percent.

Edina silt loam (Ed).—This poorly drained soil on uplands has a moderately dark colored silt loam surface layer, 6 to 12 inches thick. The subsurface layer is light-colored silt loam, 6 to 12 inches thick. The subsoil is a very firm, very slowly permeable silty clay that restricts the movement of air and water. In most years, wetness delays fieldwork. The soil is moderately acid, low in available nitrogen and phosphorus, and medium in available potassium. It responds well to heavy applications of nitrogen and phosphate fertilizer, especially when it has been planted in corn that was not preceded by a good grass-legume meadow.

The soil is generally used for cultivated crops. Yields are moderately high if drainage has been improved. Tile drains are not satisfactory, because of a high percentage of clay in the subsoil. Depressed areas can be drained by surface ditches to allow field operation. Alfalfa and other legumes may be difficult to establish in wet years. (Capability subclass IIw, management group 8).

Givin Series

The Givin series consists of moderately light colored, imperfectly drained soils that are moderate in productivity. If not eroded, they have a silt loam surface layer, 6 to 10 inches thick, and a strongly developed, platy subsurface layer, 3 to 6 inches thick. The subsoil is firm, moderately slowly permeable silty clay loam. Supplies of available nitrogen and phosphorus are low; of available potassium, medium; and of organic matter, medium. The soils have formed in Wisconsin loess and are strongly acid. The Givin soils formed under prairie grasses, but the more recent vegetation has been trees.

Givin soils are on uplands and gently sloping, loess-mantled bench terraces adjacent to the Des Moines River and its major tributaries. On the loess-mantled bench terraces, these soils contain slightly more sand and are better drained than elsewhere. The Givin soils are downslope from the nearly level Rushville or Rubio soils, above the strongly sloping and moderately sloping Clinton soils, and adjacent to the Weller, Keomah, or Pershing soils on similar slopes. Most of the acreage of Givin soils is in general soil area 7.

A representative profile for the Givin series is that of Givin silt loam on a slope of 2 percent (450 feet north and 230 feet east of the southwest corner of NW¼ sec. 15, T. 70 N., R. 11 W.):

A_{1p} 0 to 6 inches, very dark gray (10YR 3/1, moist), friable silt loam; weak, fine, granular structure; pH 5.2; abrupt boundary.

A_{21} 6 to 9 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable silt loam; weak, thin, platy structure to weak, fine, subangular blocky; few, fine iron concretions; few, fine pinholes; pH 6.0; abrupt boundary.

A_{22} 9 to 12 inches, dark-gray (10YR 4/1, moist) and very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, very dark grayish brown to dark grayish brown (10YR 3.5/2, moist); ped surfaces, gray to light gray (10YR 6/1, dry); weak, fine, subangular blocky structure; few, fine iron concretions; pinholes present; abrupt boundary.

$A_{23}B_1$ 12 to 15 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2, moist), friable, light silty clay loam; when crushed, dark grayish brown (10YR 4/2, moist); moderate, fine, subangular blocky structure; few, fine iron concretions; pH 5.4; abrupt boundary.

B_{21} 15 to 18 inches, grayish-brown (2.5Y 5/2, moist), friable to firm, light silty clay loam; when crushed, brown to yellowish brown (10YR 5/3.5, moist); common, medium, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, subangular blocky structure; thin, continuous clay skins; few, fine iron concretions; black (10YR 2/1, moist) patches on ped faces; abrupt boundary.

B_{22} 18 to 24 inches, brown to dark-brown (10YR 4/2.5, moist) and grayish-brown (2.5Y 5/2, moist), medium to heavy silty clay loam; when crushed, brown to yellowish brown (10YR 5/3.5, moist); hard when dry; many, medium, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, prismatic structure breaking to strong, medium, subangular blocky; thin, continuous clay skins; few, fine iron and manganese concretions; black (10YR 2/1, moist) patches on ped faces; pH 5.4; clear boundary.

B_{23} 24 to 31 inches, grayish-brown (2.5Y 5/2, moist), light silty clay loam; when crushed, brown (10YR 5/3, moist); very hard when dry; many, coarse, prominent mottles of yellowish brown (10YR 5/6, moist) and few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); moderate, medium, prismatic structure breaking to moderate, coarse, subangular blocky; thick, continuous clay skins; iron and manganese concretions; cleavage faces stained with black (10YR 2/1, moist); clear boundary.

B_3 31 to 49 inches, dark-brown to brown (10YR 4/3, moist) and brown (10YR 5/3, moist), light silty clay loam; when crushed, brown to yellowish brown (10YR 5/3.5, moist); very hard when dry; many, medium, faint mottles of yellowish brown (10YR 5/6, moist); ped surfaces, gray to light gray (10YR 6/1, dry); weak, medium, prismatic structure to massive; thin clay skins in upper part of horizon; iron and manganese concretions present; cleavage faces and root channels coated with black (10YR 2/1, moist); pinholes; pH 5.3; gradual boundary.

C_1 49 to 60 inches, dark grayish-brown (2.5Y 4/2, moist) and grayish-brown to light olive-brown (2.5Y 5/2 to 5/4, moist), friable to firm, light silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, medium, distinct mottles of yellowish brown (10YR 5/6, moist); iron and manganese concretions; cleavage faces and root channels coated with black (10YR 2/1, moist); pinholes; pH 6.2.

Range in characteristics.—The A_1 horizon is very dark brown (10YR 2/2, moist) to dark brown (10YR 3/3, moist) or very dark gray (10YR 3/1, moist), and it is 6 to 10 inches thick. The A_2 horizon, if present, is very dark gray (10YR 3/1, moist) to dark gray (10YR 4/1, moist) and 3 to 6 inches thick. The B horizon is dark brown (10YR 3/3, moist) to brown (10YR 5/3, moist) or grayish brown (2.5Y 5/2, moist).

Givin silt loam, bench position, 2 to 6 percent slopes (GbB).—This imperfectly drained soil is on gentle slopes of bench terraces between the uplands and bottom lands. It is low in fertility and only moderately productive, but the response to fertilizer is good. It is generally used for cultivated crops, which need fertilizer for best yields. Drainage is restricted, but the soil is seldom too wet for crops. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to control erosion. (Capability subclass IIe, management group 3.)

Givin silt loam, 2 to 6 percent slopes (GnB).—This imperfectly drained soil is on gently sloping uplands. It is low in natural fertility but responds well to fertilizer. It is moderately productive and generally is used for cultivated crops. Best yields require the addition of fertilizer. The subsoil is firm, moderately slowly permeable silty clay loam. Drainage is restricted, but the soil is seldom too wet for crops. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 3.)

Gosport Series

The Gosport series consists of strongly to very strongly acid, light-colored soils that have formed from shale. If not eroded, the soils have a silt loam surface layer, 3 to 8 inches thick, and a weak, platy subsurface layer, 2 to 6 inches thick. The subsoil is firm, very slowly permeable clay that restricts the movement of air and water. Runoff is rapid. The soils erode easily when cultivated. They are generally very low in available nitrogen and phosphorus, low in available potassium, and low in organic matter. Productivity and fertility are low. The native vegetation was trees.

Gosport soils generally occupy strong to very steep slopes adjacent to the Des Moines River and its tributaries. They are downslope from the Weller, Pershing, or Adair and Clarinda soils, which occupy less steep slopes; are adjacent to the Lindley or the Shelby soils on similar slopes; or may occur above steeper areas occupied by the Sogn, Gosport, and Lindley soils. Most of the Gosport soils are in general soil area 3.

A representative profile of the Gosport series is that of Gosport silt loam on a slope of 16 percent (50 feet north and 200 feet east of the southwest corner of the NE¼ sec. 25, T. 70 N., R. 10 W.):

A_1 0 to 4 inches, dark-brown (10YR 4/3, moist), friable, gritty silt loam; weak, very fine, granular structure; fine concretions of manganese; pH 7.0; abrupt boundary.

A_2 4 to 6 inches, dark-brown (10YR 4/3, moist), friable, gritty silt loam; weak, thin, platy structure; fine iron and manganese concretions; pH 6.9; abrupt boundary.

A_3B_1 6 to 7 inches, strong-brown (7.5YR 5/6, moist), friable, heavy loam; weak, fine, subangular blocky structure; fine iron and manganese concretions; pH 6.6; abrupt boundary.

B_{21} 7 to 12 inches, yellowish-red (5YR 5/8, moist), firm, heavy clay loam; strong, fine, subangular blocky structure; few, thin, discontinuous clay skins; pH 4.8; clear boundary; at 8 inches there is a discontinuous layer of sandstone fragments five-eighths of an inch thick.

B_{22} 12 to 16 inches, yellowish-red (5YR 5/8, moist), firm clay; strong, fine, subangular blocky structure; few, thin, discontinuous clay skins; pH 4.5; clear boundary.

B_{23} 16 to 21 inches, yellowish-red (5YR 5/8, moist), firm clay; when crushed, reddish brown (5YR 5/4, moist) to yellowish red (5YR 5/6, moist); few, medium, prominent mottles of red (10R 4/8, moist) and few, medium, distinct mottles of light brownish gray (2.5Y 6/2, moist) and gray (2.5Y N 6/, moist); strong, fine, subangular blocky structure; few, thin, discontinuous clay skins; pH 4.3; clear boundary.

B_3 21 to 27 inches, yellowish-red (5YR 5/8, moist), firm clay; when crushed, reddish brown (5YR 5/4, moist) to yellowish red (5YR 5/6, moist); medium, prominent mottles of red (10R 4/8, moist) and few, medium, distinct mottles of light brownish gray (2.5Y 6/2, moist) and gray (2.5Y N 6/, moist); weak, fine, prismatic structure breaking to medium, fine, subangular blocky; clay skins present; pH 4.4; gradual boundary.

C_1 27 to 38 inches, light olive-gray (5Y 6/2, moist), firm clay; common, medium, prominent mottles of red (10R 4/8, moist); massive; many weathered fragments of sandstone; below this layer is unweathered shale and sandstone.

Range in characteristics.—The A_1 horizon ranges from dark-brown (10YR 3/3, moist) to brown (10YR 5/3, moist) silt loam to silty clay loam. If not severely eroded, it is 3 to 8 inches thick. The A_2 horizon ranges from dark brown to brown (10YR 4/3, moist) or strong brown (7.5YR 5/6, moist), and, if not severely eroded, it is 2 to 6 inches thick. The B horizon ranges from yellowish-red (5YR 5/8, moist) to reddish-brown (5YR 5/4, moist) silty clay to clay that is 12 to 30 inches thick.

Gosport silt loam, 9 to 14 percent slopes, moderately eroded (GoD2).—This moderately well drained soil is very low in fertility. Runoff is rapid. This soil includes small areas of the Adair and Clarinda soils that were impractical to map separately.

This soil is used for pasture or timber and is not suitable for cultivated crops. Pastures are only moderately productive. Fertilizer and lime are needed for good yields of forage because supplies of plant nutrients and organic matter are low to very low. (Capability subclass VIe, management group 21.)

Gosport silt loam, 14 to 18 percent slopes, moderately eroded (GoE2).—This moderately well drained soil is very low in fertility and low in productivity. Runoff is rapid. The soil is used for pasture and timber and is not suitable for cultivated crops. Fertilizer and lime are needed for best forage yields because the nutrient level is very low. (Capability subclass VIIe, management group 23.)

Gosport silt loam, 18 to 40 percent slopes, moderately eroded (GoG2).—This moderately well drained soil is low in fertility. In some areas there are outcrops of limestone on the lower parts of the slopes. The soil is used for pasture or timber, but it is low in productivity. (Capability subclass VIIe, management group 23.)

Gosport soils, 9 to 14 percent slopes, severely eroded (GpD3).—This mapping unit has less than 3 inches of surface soil, and in most places the subsoil is exposed. It includes small areas of the Adair and Clarinda soils that were impractical to map separately.

The soils of this mapping unit are moderately well drained but very low in fertility and low in productivity. Runoff is rapid. The soils are used for pasture and timber, and they are not suitable for cultivated crops. Fertilizer and lime are needed for best forage yields, but pastures are difficult to establish. (Capability subclass VIIe, management group 23.)

Gosport soils, 14 to 18 percent slopes, severely eroded (GpE3).—This mapping unit has a surface layer of loam to silty clay loam that is less than 3 inches thick. In most places the subsoil is exposed. The soils of this mapping unit are moderately well drained. Runoff is rapid, fertility is very low, and productivity is low. These soils are used for pasture or timber. (Capability subclass VIIe, management group 23.)

Gravity Series

Soils of the Gravity series have developed in moderately fine textured alluvium that washed down from the adjacent slopes. The native vegetation was grass. Gravity soils are on slopes of 2 to 5 percent at the bases of steep upland slopes adjacent to the larger stream bottoms in general soil area 6. They occur in close association with the Olmitz soils that are on similar slopes and with the Coppock, Wabash, Carlow, and Chequest soils that are on adjacent first bottoms and on low second bottoms. Some of the imperfectly drained to poorly drained Gravity soils are mapped with the Olmitz soils as an undifferentiated unit.

A representative profile for the Gravity series is that of Gravity silty clay loam on a slope of 3 percent (360 feet south and 320 feet east of the northwest corner of the SE¼ sec. 32, T. 67 N., R. 9 W.):

A_p 0 to 6 inches, very dark gray (10YR 3/1, moist), friable, light silty clay loam; weak, fine, granular structure; pH 6.6; abrupt boundary.

A_{12} 6 to 11 inches, very dark gray (10YR 3/1, moist), friable, medium silty clay loam; when crushed, very dark gray and very dark grayish brown (10YR 3/1.5, moist); common, medium, faint mottles of dark brown (10YR 3/3, moist); weak, fine, subangular blocky structure breaking to moderate, fine, granular; few, fine concretions of iron; clear boundary.

B_1 11 to 17 inches, very dark gray (10YR 3/1, moist), friable, medium silty clay loam; when crushed, very dark gray and very dark grayish brown (10YR 3/1.5, moist); common, medium, faint mottles of dark brown (10YR 3/3, moist); moderate, fine, subangular blocky structure; thin, discontinuous clay skins; few, fine iron concretions; pH 5.6; clear boundary.

B_2 17 to 27 inches, very dark gray (10YR 3/1, moist), friable to firm, medium silty clay loam; when crushed, very dark gray (10YR 3/1, moist); few, medium, faint mottles of dark brown (10YR 3/3, moist); weak, medium, prismatic structure breaking to moderate, fine, angular blocky; thin, continuous clay skins; common, fine iron concretions; pH 5.5; clear boundary.

to 32 inches, very dark gray (10YR 3/1, moist), firm, medium silty clay loam; when crushed, very dark gray (10YR 3/1, moist); few, fine, faint mottles of dark brown (10YR 3/3, moist) and common, medium, faint mottles of dark grayish brown (10YR 4/2, moist); weak, medium, angular blocky structure; thin, discontinuous clay skins; common, fine iron concretions; pH 5.6; clear boundary.

B_{32} 32 to 37 inches, black (10YR 2/1, moist), firm, light silty clay loam; when crushed, black to very dark gray (10YR 2.5/1, moist); many, medium, faint mottles of dark brown (10YR 3/3, moist) and few, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist); peds coated with dark gray (10YR 4/1, moist); weak, fine, subangular blocky structure; thin, discontinuous clay skins; common, fine iron concretions; pH 6.2; clear boundary.

C_1 37 to 50 inches, black (10YR 2/1, moist), firm, light silty clay loam; when crushed, black to very dark gray (10YR 2.5/1, moist); common, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist) and few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); cleavage faces coated with dark gray (10YR 4/1, moist); massive; common, fine iron concretions; pH 6.2.

Range in characteristics.—The surface layer ranges from black (10YR 2/1, moist) to very dark gray (10YR 3/1, moist) silt loam to silty clay loam. The subsoil ranges from silty clay loam to light silty clay. Some areas are included that are covered by as much as 6 inches of lighter colored loam or silt loam.

Gravity silty clay loam, 2 to 5 percent slopes (GrB).—This dark-colored, imperfectly to poorly drained soil is moderately high in productivity. Normally, it has silty clay loam surface and subsurface layers, 10 to 24 inches thick, and a subsoil of very dark gray silty clay loam that is moderately slow in permeability. Included are small areas of the Olmitz and the Coppock soils that were impractical to map separately.

Gravity silty clay loam, 2 to 5 percent slopes, is subject to overflow and to deposition from the upland slopes. Commonly, it is wet in spring because of seepage and overflow from the uplands. This soil is high in organic matter and medium in available nitrogen, phosphorus, and potassium. It is suitable for cultivated crops, and yields are moderately high if drainage is improved. The soil often occurs in small areas and must be used the same as the surrounding soils. Diversions at the bases of upland slopes generally help to reduce erosion and wetness. Tile drains will work fairly well if suitable outlets can be obtained. (Capability subclass IIw, management group 7.)

Grundy Series

The Grundy series consists of moderately acid, dark to moderately dark soils that are of moderate to moderately high productivity. If not eroded, the surface and subsurface layers are silt loam or silty clay loam, 6 to 14 inches thick. The subsoil is firm, slowly permeable silty clay. Runoff is rapid. The soils erode easily if cultivated. They are generally low in available nitrogen and phosphorus, medium in available potassium, and medium to high in organic matter. They were formed under grass in loess of Wisconsin glacial age.

Grundy soils are on gentle slopes below the Haig soils on the broad upland flats and on moderate to strongly sloping sides and tops of ridges above the Adair and Clarinda soils (see fig. 3). They are also associated with the Pershing soils, which occur on similar slopes. A few small areas of the Grundy soils are in bench positions near the town of Douds. Grundy soils more commonly occupy uplands, and they are mostly in general soil area 1. The Grundy soils of the uplands are underlain by glacial till at depths of 3 to 7 feet. On the lower slopes, where Grundy soils are adjacent to the Adair and Clarinda soils, the depths to till are least. The bench-position phases of Grundy soils are underlain by alluvium at depths of 6 to 10 feet.

A representative profile of the Grundy series is that of Grundy silty clay loam on a slope of 3 percent (600 feet north and 25 feet east of the southwest corner of sec. 34, T. 70 N., R. 9 W.):

A_{1p} 0 to 5 inches, very dark gray (10YR 3/1, moist), friable, light silty clay loam; weak, fine, granular structure; few, fine iron concretions; pH 6.7; abrupt boundary.

A_{12} 5 to 9 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable, light silty clay loam; weak, fine, granular structure; few, fine iron concretions; worm casts; pH 6.5; clear boundary.

A_3 9 to 12 inches, very dark grayish-brown (10YR 3/2, moist), friable, light silty clay loam; common, fine, faint, low-contrast mottles of dark brown (10YR 4/3, moist); weak, fine, granular structure to weak, fine, subangular blocky; few, fine iron concretions; worm casts; pH 6.0; clear boundary.

B_1 12 to 16 inches, dark grayish-brown (10YR 4/2, moist), friable to firm, medium silty clay loam; when crushed, color is the same; few, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, subangular blocky structure; thin, continuous clay skins; few, fine iron and manganese concretions; peds stained very dark brown (10YR 2/2, moist); worm casts; pH 5.7; clear boundary.

B_{21} 16 to 24 inches, dark grayish-brown (2.5Y 4/2, moist), firm, light silty clay; when crushed, yellowish brown (10YR 5/4, moist); few, fine, prominent mottles of strong brown (7.5YR 5/8, moist) and many, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, subangular blocky structure; thick, continuous clay skins; few, fine iron and manganese concretions; peds stained very dark brown (10YR 2/2, moist); pH 5.4; clear boundary.

B_{22} 24 to 29 inches, grayish-brown (2.5Y 5/2, moist), firm, light silty clay; when crushed, yellowish brown (10YR 5/4, moist); common, fine, distinct mottles of yellowish brown (10YR 5/6, moist) and few, fine, prominent mottles of strong brown (7.5YR 5/8, moist); moderate, fine, subangular blocky structure; thick, continuous clay skins; few, fine iron and manganese concretions; peds stained very dark brown (10YR 2/2, moist); pH 5.4; clear boundary.

B_{31} 29 to 35 inches, olive-gray (5Y 5/2, moist), firm, heavy silty clay loam; when crushed, olive brown (2.5Y 4/4, moist); common, fine, faint, low-contrast mottles of light olive brown (2.5Y 5/4, moist); weak, fine, prismatic structure; thin, discontinuous clay skins; few, fine iron and manganese concretions; peds and root channels stained very dark brown (10YR 2/2, moist); pH 6.6; clear boundary.

B_{32} 35 to 42 inches, grayish-brown (2.5Y 5/2, moist), firm, medium silty clay loam; when crushed, same color; many, fine, faint mottles of light olive brown (2.5Y 5/4, moist); weak, fine, prismatic structure; thin, discontinous clay skins; few, fine iron and manganese concretions; root channels coated with strong brown (7.5YR 5/8, moist); iron and manganese stains; clear boundary.

B_{33} 42 to 51 inches, light brownish-gray (2.5Y 6/2, moist), firm, medium to light silty clay loam; when crushed, yellowish brown (10YR 5/6, moist); many, fine, faint mottles of light olive brown (2.5Y 5/4, moist); weak, medium, prismatic structure; thin, discontinuous clay skins; few, fine iron and manganese concretions; root channels coated with strong brown (7.5YR 5/8, moist); iron and manganese stains; pH 6.6; clear boundary.

C_1 51 to 56 inches, light brownish-gray (2.5Y 6/2, moist), firm, light silty clay loam; when crushed, light yellowish brown to light olive brown (2.5Y 5.5/4, moist); many, fine, faint mottles of light olive brown (2.5Y 5/4, moist); massive; few, fine iron and manganese concretions; root channels coated with strong brown (7.5YR 5/8, moist); iron and manganese stains; clear boundary.

C_2 56 to 63 inches, light brownish-gray (2.5Y 6/2, moist), firm, light silty clay loam; when crushed, yellowish brown (10YR 5/6, moist); many, coarse, prominent mottles of strong brown (7.5YR 5/8, moist); massive; few, fine concretions and stains of iron and manganese; pH 6.6.

Range in characteristics.—The A_1 horizon ranges from very dark gray (10YR 3/1, moist) to very dark grayish brown (10YR 3/2, moist) and from heavy silt loam to light silty clay loam. The B horizon ranges from light silty clay to medium silty clay. Where the Grundy soils are closely associated with the Pershing soils, some of the peds in the lower A horizon are coated with gray, and the surface soil is silt loam. Where the Grundy soils occur in shallow upland drainageways and the underlying gumbotil is within 3 feet of the surface, the lower B horizon may have reddish mottles, a deoxidized layer, or both.

Grundy silty clay loam, 2 to 5 percent slopes (GsB).—This soil is imperfectly drained and moderately high in productivity. It is friable, easily worked, and responds well to fertilizers. The subsoil is slowly permeable, and in wet years, fieldwork may be delayed. The soil is used intensively for cultivated crops, and it is well suited to corn, soybeans, small grains, and legumes. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 4.)

Grundy silty clay loam, 5 to 9 percent slopes (GsC).—This upland soil has a surface layer about 6 to 12 inches thick. It is moderately well drained to imperfectly drained, high in organic matter, and moderately high in productivity. The response to fertilizer and lime is good. The soil is used for cultivated crops, meadow, and pasture. It is subject to severe sheet and gully erosion. The subsoil is slowly permeable silty clay that restricts the downward movement of water. Tillage should be on the contour, the fields terraced, and the waterways grassed. (Capability subclass IIIe, management group 12.)

Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded (GsC2).—This moderately well drained to imperfectly drained soil has a 3- to 6-inch surface layer that generally has been mixed with the upper subsoil during tillage. The soil is medium in organic matter, moderately productive, and responsive to fertilizer. It is generally used for row crops, small grains, meadow, and pasture.

The slowly permeable subsoil makes this soil susceptible to severe sheet and gully erosion. Consequently, row crops should not be grown intensively, unless tillage is on the contour and fields are terraced. Waterways should be grassed. (Capability subclass IIIe, management group 12.)

Grundy silt loam, bench position, 2 to 5 percent slopes (GtB).—This soil is on loess-covered bench terraces north of the Des Moines River near Douds. The dark surface and subsurface layers are 8 to 14 inches thick and may be either silt loam or silty clay loam. The soil is moderately high in productivity and responds well to fertilizer. It is used intensively for cultivated crops and is suitable for corn, soybeans, small grains, and meadow. (Capability subclass IIe, management group 4.)

Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded (GtC2).—This moderately well drained to imperfectly drained soil is on loess-covered benches. The surface layer is generally only 3 to 6 inches thick, but some areas in which it is 6 to 12 inches thick are included.

This soil is medium in organic matter and high in productivity. The response to fertilizer is good. The soil is generally used for cultivated crops and meadow, and it is suitable for corn, soybeans, small grains, and legumes. Fields should be terraced and tilled on the contour to protect them from sheet and gully erosion. Waterways should be kept in grass. (Capability subclass IIIe, management group 12.)

Hagener Series

The Hagener series consists of excessively drained, medium acid soils that have developed from sandy alluvium. The surface layer is very dark brown, and the substratum is dark grayish brown. The soils are rapidly permeable, very droughty, and sandy throughout. They are very low in available nitrogen and phosphorus and low in potassium.

The Hagener soils occur as elongated bars or strips of sand on the Des Moines River bottom. Where adjacent to the riverbank, they are wooded. Some areas are in association with the Perks, Waukegan, Dickinson, Chariton, and Colo soils. The Hagener soils are similar to Perks soils but are darker colored.

In Van Buren County, soils of the Hagener series were mapped with those of the Perks series as undifferentiated units.

A representative profile of the Hagener series is that of Hagener sand, natural bench position, on a slope of 3 percent (300 feet south and 100 feet west of the center of the NW¼NW¼ sec. 34, T. 69 N., R. 9 W.):

A_{11} 0 to 5 inches, very dark brown (10YR 2/2, moist), loose, medium sand; single grain; pH 5.2.

A_{12} 5 to 30 inches, very dark grayish-brown (10YR 3/2, moist), loose, medium sand; single grain; pH 6.0.

C_1 30 to 45 inches, dark grayish-brown (10YR 3.5/2, moist), loose sand; few, medium, distinct mottles of strong brown (7.5YR 5/6, moist) and grayish brown (10YR 5/2, moist); single grain; pH 6.0.

Range in characteristics.—The profile ranges from sand to loamy sand throughout.

Haig Series

Soils of the Haig series are dark colored and poorly drained. They occur on broad, level upland flats and have developed from Wisconsin loess under grass. They are mostly in general soil areas 1 and 2. They are associated with the level Edina and Belinda soils and with the sloping Grundy and Pershing soils (see fig. 3). The fine-textured phase mapped in this county, however, is associated with Haig silty clay loam and with the Grundy soils on gentle slopes around dissecting drainageways in general soil area 2. The Haig soils are underlain by glacial till at depths of 7 to 9 feet.

Two profiles that represent the Haig series are described. The first profile is that of Haig silty clay loam on a slope of 1 percent (600 feet south and 30 feet east of northwest corner of SW¼ sec. 34, T. 70 N., R. 9 W.):

A_{1p} 0 to 8 inches, black to very dark gray (10YR 2.5/1, moist), friable, light silty clay loam; weak, very fine, granular structure; pH 6.7; abrupt boundary.

A_{12} 8 to 13 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable to firm, light silty clay loam; moderate, very fine, subangular blocky structure breaking to very fine, granular; pH 6.3; clear boundary.

A_3B_1 13 to 18 inches, very dark gray (10YR 3/1, moist), firm, medium silty clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, faint, low-contrast mottles of dark yellowish brown (10YR 3/4, moist); moderate, fine, subangular blocky structure; thin clay skins may be present; abundant, fine concretions of iron and manganese; pH 6.2; clear boundary.

B_{21} 18 to 21 inches, very dark gray (10YR 3/1, moist), firm, medium silty clay; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, distinct mottles of yellowish brown (10YR 5/6, moist) and common, fine, faint mottles of dark grayish brown (10YR 4/2, moist); moderate, fine, subangular blocky structure; thick, continuous clay skins; abundant, fine concretions of iron and manganese; pH 6.0; clear boundary.

B_{22} 21 to 26 inches, very dark gray (10YR 3/1, moist), very firm, medium silty clay; when crushed, very dark grayish brown (2.5Y 3/2, moist); common, fine, faint mottles of yellowish brown (10YR 5/6, moist) and common, fine, distinct mottles of light olive brown (2.5Y 5/4, moist); moderate, medium, subangular blocky structure; thin, continuous clay skins; abundant, fine concretions of iron and manganese; pH 6.2; clear boundary.

B_{31} 26 to 34 inches, very dark grayish-brown to dark grayish-brown (2.5Y 3.5/2, moist), very firm, heavy silty clay loam; when crushed, dark grayish brown to light olive brown (2.5Y 4/2 to 5/4, moist); common, medium, distinct mottles of yellowish brown (10YR 5/6, moist) and few, medium, prominent mottles of strong brown (7.5YR 5/6, moist); weak, medium, prismatic structure breaking to weak, medium, subangular blocky; thin, discontinuous clay skins; abundant, medium concretions of iron and manganese; fine root channels coated with organic matter; pH 6.2; clear boundary.

B_{32} 34 to 42 inches, grayish-brown (2.5Y 5/2, moist), firm, medium to light silty clay loam; when crushed, grayish brown to light olive brown (2.5Y 5/2 to 5/4, moist); common, medium, prominent mottles of strong brown (7.5 YR 5/8, moist) and common, medium, faint mottles of light olive brown (2.5Y 5/4, moist); weak, medium, prismatic structure breaking to weak, medium, subangular blocky; thin, discontinuous clay skins; abundant, medium concretions of iron and manganese; fine root channels coated with organic matter; pH 6.2; gradual boundary.

C_1 42 to 51 inches, olive-gray (5Y 5/2, moist), firm, light silty clay loam; when crushed, grayish brown to light olive brown (2.5Y 5/2 to 5/4, moist); common medium, prominent mottles of strong brown (7.5YR 5/6, moist) and few, fine, prominent mottles of yellowish brown to brownish yellow (10YR 5/6 to 6/8, moist); weak, medium, subangular blocky structure to massive; thin, discontinuous clay skins on cleavage faces; few, medium concretions of iron and manganese; fine root channels coated with organic matter; pH 6.2.

The second profile is that of Haig silty clay loam, fine textured, in a level area (150 feet west and 230 feet south of the northeast corner of the NE¼NW¼ sec. 14, T. 69 N., R. 8 W.):

A_{1p} 0 to 7 inches, black (10YR 2/1, moist), firm, heavy silty clay loam; weak to moderate, fine, subangular blocky structure; iron and manganese concretions; pH 6.4; clear boundary.

A_{12} 7 to 14 inches, black (10YR 2/1, moist), firm, heavy silty clay loam to light silty clay; moderate, very fine, subangular blocky structure; iron and manganese concretions; pH 6.3; clear boundary.

B_1 14 to 18 inches, black (10YR 2/1, moist), firm, light silty clay; moderate, very fine, subangular blocky structure; thin, continuous clay skins; iron and manganese concretions; clear boundary.

B_{21} 18 to 24 inches, very dark gray (10YR 3/1, moist), firm, medium silty clay; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, faint, low-contrast mottles of dark grayish brown (10YR 4/2, moist); moderate, fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; pH 6.6; gradual boundary.

B_{22} 24 to 32 inches, olive-gray (5Y 5/2, moist), very firm, heavy silty clay; when crushed, dark grayish brown (2.5Y 4/2, moist); common, fine, distinct mottles of yellowish brown (10YR 5/6, moist); moderate, fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; pH 6.4; gradual boundary.

B_{23} 32 to 40 inches, gray (5Y 5/1, moist), very firm, light silty clay; when crushed, grayish brown (2.5Y 5/2.5, moist); common, medium, prominent mottles of yellowish brown (10YR 5/8, moist); moderate, fine, angular blocky structure; thick, continuous clay skins; iron and manganese concretions; pH 6.2; gradual boundary.

B_3C_1 40 to 53 inches, olive-gray to light olive-gray (5Y 5.5/2, moist), firm, heavy silty clay loam; when crushed, grayish brown (2.5Y 5/2, moist); common, medium, prominent mottles of strong brown (7.5YR 5/8, moist) and yellowish brown (10YR 5/8, moist); moderate, medium, angular blocky structure; thin, discontinuous clay skins in upper part; iron and manganese concretions; gradual boundary.

C_1 53 to 60 inches, strong-brown (7.5YR 5/8, moist) and olive-gray (5Y 5/2, moist), firm, light to medium silty clay loam; when crushed, yellowish brown (10YR 5/6, moist); massive; cleavage faces stained black (10YR 2/1, moist); pH 6.8.

Range in characteristics.—The A_1 horizon of Haig silty clay loam is black (10YR 2/1, moist) to very dark gray (10YR 3/1, moist), heavy silt loam to light silty clay loam, and it is 12 to 18 inches thick. In areas adjacent to the Belinda, Edina, or the Pershing soils, the lower part of the A horizon of Haig silty clay loam may be slightly grayer than the upper. In the fine-textured phase, the A_1 horizon is always black, medium to heavy silty clay loam, 14 to 24 inches thick. This phase is more poorly drained, has more clay throughout the profile, and is more difficult to manage than the Haig silty clay loam.

Haig silty clay loam (Ha).—This level soil is moderately high in productivity. The surface soil is 12 to 18 inches thick, and the subsoil is firm, slowly permeable silty clay. Some areas of Edina silt loam, too small to map separately, are included.

The Haig soil is generally medium in available nitrogen and potassium and low in available phosphorus. It is slightly acid and high in organic matter, and it responds well to fertilizers. The soil is generally used for cultivated crops, and if drainage has been improved, it is one of the most productive soils in the county. Corn, soybeans, small grains, and legumes are suitable for this soil. Good stands of alfalfa are difficult to establish in wet years.

The subsoil somewhat restricts the downward movement of water and allows it to collect on the surface in some places. Fieldwork is often delayed in spring or in a rainy season. Tile drains do not function well. Surface drains are needed in areas that have few or no waterways. (Capability subclass IIw, management group 6.)

Haig silty clay loam, fine textured (Hc).—This level soil is moderately high in productivity. The surface soil is black silty clay loam, 14 to 24 inches thick. The subsoil is very firm, slowly permeable silty clay, which restricts the downward movement of water. This soil dries out late in spring, and it is wetter and more difficult to manage than Haig silty clay loam. It puddles and hardens if tillage is delayed too long after rainfall, and it hardens and clods if worked when too wet. The range of moisture in which this soil can be worked is limited.

This soil is medium in available nitrogen and potassium and low in phosphorus. It is slightly acid, high in organic matter, and responds well to fertilizers. It is used intensively for cultivated crops and is suitable for corn, soybeans, grain sorghum, small grains, and legumes. Alfalfa may be difficult to establish because of wetness.

Tile drainage does not work well, because of the very slow permeability of the subsoil. Surface drains are needed in most areas. (Capability subclass IIw, management group 6.)

Keomah Series

Soils of the Keomah series are light colored, imperfectly drained, and moderately high in productivity. They have a silt loam surface layer, 6 to 10 inches thick, and a strongly developed, platy subsurface layer, 6 to 11 inches thick. The subsoil is firm, moderately slowly permeable silty clay loam. The soils are generally low in available nitrogen and phosphorus and medium in available potassium. They are low in supply of organic matter and very strongly acid. They have formed from Wisconsin loess under forest.

These soils are on gently sloping uplands and on loess-mantled, gently sloping bench terraces adjacent to the Des Moines River and its tributaries. On loess-mantled bench terraces, these soils contain slightly less clay and more sand, and they are in the upper end of the drainage range for the series. Keomah soils occur above the strongly sloping and moderately sloping Clinton soils, below and adjacent to the nearly level Rushville soils, and adjacent to the Givin or Pershing soils on similar slopes. Most of the Keomah soils are in general soil area 7.

A representative profile of the Keomah series is that of Keomah silt loam, bench position, on a slope of 2 percent (1,050 feet north and 550 feet east of the southwest corner of sec. 4, T. 69 N., R. 10 W.):

A_{1p} 0 to 5 inches, dark grayish-brown (10YR 4/2, moist), friable silt loam; weak, fine, granular structure; iron and manganese concretions; quartz grains on ped faces; pH 5.7; abrupt boundary.

A_{12} 5 to 8 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, dark grayish brown (10YR 4/2, moist); few, fine, faint, low-contrast mottles of yellowish brown (10YR 5/4, moist); weak, thin, platy structure breaking to weak, fine, granular; iron and manganese concretions; root channels coated with grayish brown (2.5Y 5/2, moist); quartz grains on ped faces; worm casts; abrupt boundary.

A_{21} 8 to 12 inches, grayish-brown (2.5Y 5/2, moist), friable silt loam; when crushed, dark brown (10YR 4/3, moist); common, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); ped surfaces, white (10YR 8/1, dry); weak, thin, platy structure to moderate, fine, subangular blocky; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; worm casts and pinholes; abrupt boundary.

A_{22} 12 to 16 inches, grayish-brown (2.5Y 5/2, moist), friable silt loam; when crushed, brown (10YR 5/3, moist); common, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist); ped surfaces, white (10YR 8/1, dry); weak, thin, platy structure to moderate, fine, subangular blocky; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes and worm casts; pH 5.4; clear boundary.

A_{23} 16 to 19 inches, grayish-brown (2.5Y 5/2, moist), firm, heavy silt loam; when crushed, brown (10YR 5/3, moist); few, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and many, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist); ped surfaces, white (10YR 8/1, dry); weak, thin, platy structure to moderate, fine, subangular blocky; iron and manganese concretions; quartz grains on ped faces; pinholes; clear boundary.

B_1 19 to 24 inches, grayish-brown (2.5Y 5/2, moist), firm, light silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and few, fine, prominent mottles of reddish brown (5YR 4/4, moist); ped surfaces, white (10YR 8/1, dry); weak, fine, prismatic structure breaking to weak, medium, subangular blocky; thin clay skins may be present; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes; pH 4.8; clear boundary.

B_{21} 24 to 28 inches, grayish-brown (2.5Y 5/2, moist), firm, medium to heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and few, fine, prominent mottles of reddish brown (5YR 4/4, moist); ped surfaces, white (10YR 8/1, dry); weak, fine, prismatic structure breaking to strong, medium, subangular blocky; thick, continuous clay skins; iron and manganese concretions; black (10YR 2/1, moist) organic stains in root channels; quartz grains on ped faces; pinholes; clear boundary.

B_{22} 28 to 34 inches, grayish-brown (2.5Y 5/2, moist), heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); when dry, hard; common, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and few, fine, prominent mottles of dark yellowish brown (10YR 4/4, moist); moderate, fine, prismatic structure breaking to moderate, medium, subangular blocky; continuous clay skins but thicker than in B_{21} layer; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes; pH 4.8; clear boundary.

B_{31} 34 to 40 inches, grayish-brown (2.5Y 5/2, moist), medium silty clay loam; when crushed, yellowish brown (10YR 5/5, moist); when dry, hard; few, medium, prominent mottles of reddish brown (5YR 4/4, moist) and common, medium, prominent mottles of strong brown (7.5YR 5/6, moist); ped surfaces, white (10YR 8/1, dry); weak, medium, prismatic structure; thin clay skins appear to be present on some peds; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes; gradual boundary.

B_{32} 40 to 46 inches, gray (5Y 5/1, moist), medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); when dry, hard; common, medium, prominent mottles of reddish brown (5YR 4/4, moist) and few, medium, prominent mottles of strong brown (7.5YR 5/6, moist); weak, medium, prismatic structure to massive; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes; gradual boundary.

C_1 46 to 50 inches, gray (5Y 5/1, moist), medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); when dry, hard; few, fine, prominent mottles of strong brown (7.5YR 5/6, moist) and many medium, prominent mottles of reddish brown (5YR 4/4, moist); massive; iron and manganese concretions; root channels stained black (10YR 2/1, moist); quartz grains on ped faces; pinholes; pH 4.9.

Range in characteristics.—The A_1 horizon ranges from very dark grayish brown (10YR 3/2, moist) to dark grayish brown (10YR 4/2, moist) and is 6 to 10 inches thick. The A_2 horizon is grayish brown (2.5Y 5/2, moist) to brown (10YR 5/3, moist) and is 6 to 11 inches thick. The B horizon is dark brown (10YR 3/3, 4/3, moist) to grayish brown (2.5Y 5/2, moist).

Keomah silt loam, 2 to 5 percent slopes (KaB).—This is a gently sloping, moderately productive upland soil. Plant nutrients and organic matter are low in supply. The soil is generally used for cultivated crops, and fertilizers are normally needed for good yields. It is imperfectly drained but seldom too wet for crops. The subsoil is firm, moderately slowly permeable silty clay loam. Runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 3.)

Keomah silt loam, bench position, 2 to 5 percent slopes (KbB).—This soil is on loess-mantled, gently sloping bench terraces. Supplies of plant nutrients and organic matter are low, but productivity is moderately high. The soil is generally used for cultivated crops. Fertilizers are generally needed for good yields. The soil is imperfectly drained but seldom too wet for crops. The subsoil is firm, moderately slowly permeable silty clay loam; runoff is rapid. All tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 3.)

Lamont Series

Soils of the Lamont series are somewhat excessively drained. They have a moderately light colored, fine sandy loam surface layer that is 3 to 8 inches thick. The subsoil is friable, moderately rapidly permeable sandy loam or sandy clay loam.

The Lamont soils are slightly acid and low to very low in plant nutrients and organic matter. They have developed in eolian sand under forest vegetation. The Lamont soils occupy strongly sloping bench terraces adjacent to the Des Moines River and its tributaries. They are downslope from the Downs soils, which generally occur on slopes that are less steep.

A representative profile of the Lamont series is that of Lamont fine sandy loam on a slope of 10 percent in a slightly eroded alfalfa field (440 feet west and 400 feet north of southeast corner of sec. 16, T. 70 N., R. 11 W.):

A_1 0 to 5 inches, very dark grayish-brown to dark-brown (10YR 3/2.5, moist), friable fine sandy loam; when dry, pale brown (10YR 6/3); weak, fine, granular structure; pH 6.2; abrupt boundary.

A_2 5 to 8 inches, very dark grayish-brown and dark-brown (10YR 3/2 and 4/3, moist), friable fine sandy loam; when crushed, dark grayish brown (10YR 4/2, moist); when dry, very pale brown (10YR 7/4); moderate, medium, platy structure; pH 6.4; gradual boundary.

B_1 8 to 15 inches, dark-brown to dark yellowish-brown (10YR 4/3.5, moist), friable, light sandy clay loam; when dry, yellowish brown (10YR 5/4); moderate, medium, angular blocky structure; pH 6.0; gradual boundary.

B_2 15 to 34 inches, dark-brown to dark yellowish-brown (10YR 4/3.5, moist), friable, light sandy clay loam; when dry, light yellowish brown (10YR 6/4); moderate, coarse, subangular blocky structure; pH 5.8; gradual boundary.

C_1 34 to 46 inches, dark-brown and yellowish-brown (10YR 4/3 and 5/4, moist), friable fine sandy loam; massive to weak, prismatic structure; pH 6.0.

In Van Buren County, the Lamont soils were mapped as an undifferentiated unit with the Downs soils.

Landes Series

The Landes series consists of somewhat droughty, moderately dark to light colored, sandy soils on first bottoms. They generally have a dark grayish-brown, friable loamy sand to sandy loam surface layer. The subsoil is rapidly permeable sand to sandy loam, which often contains layers of sand and silt. Landes soils are generally well drained, but some areas have a high water table. They are low in organic matter and slightly acid.

These soils were formed under forest from recent mixed alluvium deposited by stream overflow. They are on level and nearly level first bottoms along the larger streams in the county in general soil area 6. Several large areas of the Landes soils occur on the Fox River bottom near Mt. Sterling. Landes soils are commonly associated with the Nodaway, Wabash, Carlow, and Chequest soils, which occur in similar positions.

A representative profile of the Landes series is that of Landes loamy fine sand on a slope of 1 percent (100 feet south and 820 feet east of the northwest corner of the SE¼ sec. 7, T. 67 N., R. 9 W.):

A_p 0 to 7 inches, dark grayish-brown to very dark grayish-brown (10YR 3.5/2, moist), very friable loamy fine sand; weak, fine, subangular blocky structure to single grain; common, coarse streaks of black (10YR 2/1, moist); pH 6.6; abrupt boundary.

C 7 to 55 inches, stratified, highly variable alluvium consisting of loose, coarse sand to friable very fine sandy loam; alternating layers of dark-gray (5Y 4/1, moist) and olive-gray (5Y 5/2, moist) silt loam and alternating lenses of strong-brown (7.5YR 5/8, moist), yellowish-brown (10YR 5/4, moist), dark reddish-brown (5YR 3/4, moist), and light-gray (5Y 7/2, moist) sand; common, fine mottles of black (10YR 2/1, moist) throughout; pH 6.4; abrupt boundary.

D 55 to 63 inches, dark-gray (5Y 4/1, moist) and light-gray (5Y 7/2, moist), very friable loamy fine sand; common, medium, prominent mottles of strong brown (7.5YR 5/6, moist) and reddish brown; pH 6.2.

Range in characteristics.—The Landes soils are extremely variable, depending on the amount and character of recent alluvium. The surface layer is dark grayish brown (10YR 4/2, moist) to very dark grayish brown (10YR 3/2, moist) and is usually sandy loam to loam. The soil is well drained to excessively drained, depending upon depth to the water table.

Landes soils (La).—These soils generally occur as small areas adjacent to other bottom-land soils. Some large areas are on bottom lands near Mt. Sterling. Landes soils are normally well drained, but they are frequently flooded in spring and occasionally in midsummer. They may have a high water table in spring. In addition to being subject to flooding, these soils are somewhat droughty.

Supplies of available nitrogen tend to be low, and those of phosphorus and potassium are medium. The soils are friable and easily tilled, but the response to fertilization is limited by droughtiness. Most areas of these soils have been cleared and are used extensively for corn, oats, soybeans, and other legumes. Yields are generally low.

Open ditches, levees, and diversion terraces can be used to improve drainage if the areas needing protection are large enough. Tile drainage is generally not needed. (Capability subclass IIIs, management group 13.)

Lindley Series

Soils of the Lindley series are light colored, moderately well to well drained, and very low in fertility. If not severely eroded, they have a loam surface layer that is 3 to 8 inches thick; under this is a weak, platy layer, 2 to 6 inches thick. The subsoil is firm, moderately slowly permeable clay loam that restricts the downward movement of water in some places. Runoff is very rapid, and the soils erode easily if cultivated. Supplies of available nitrogen and phosphorus are very low, and those of potassium are medium. The soils are low in organic matter and strongly acid. They have formed from Kansan till under trees.

These soils are usually on moderately steep to very steep side slopes in the more dissected upland areas of the county (see fig. 3). They occur downslope from the Adair soils, which are on lesser slopes; are adjacent to the Gosport soils on similar slopes; and may occur above steeper areas of the Gosport or the Sogn soils. Most of the Lindley soils are in general soil area 3.

A representative profile of the Lindley series is that of Lindley loam on a slope of 18 percent (200 feet east and 400 feet south of the northwest corner of the NE¼NE¼ sec. 17, T. 70 N., R. 10 W.):

A_0 1 inch to 0, very dark brown (10YR 2/2, moist) litter and decayed grass; abrupt boundary.

A_1 0 to 5 inches, very dark grayish-brown (10YR 3/2, moist), friable loam; when crushed, dark yellowish brown (10YR 4/4, moist); few, medium, faint, low-contrast mottles of yellowish brown (10YR 5/4, moist); weak, fine, subangular blocky structure breaking to weak, fine, granular; few concretions of iron; few, very coarse grains of sand; pH 5.6; abrupt boundary.

A_{21} 5 to 8 inches, dark-brown (10YR 4/3, moist), friable loam; when crushed, dark yellowish brown (10YR 4/4, moist); few, medium, faint, low-contrast mottles of yellowish brown (10YR 5/4, moist); weak, thin, platy structure to weak, fine, subangular blocky; few iron concretions; root channels stained black (10YR 2/1, moist); a few pebbles; some worm casts; clear boundary.

A_{22} 8 to 11 inches, brown (10YR 5/3, moist), very friable sandy loam; few, coarse, faint mottles of yellowish brown (10YR 5/8, moist); weak, thin, platy structure to weak, fine, subangular blocky; few iron concretions; root channels stained black (10YR 2/1, moist); a few pebbles; some worm casts and pinholes; pH 6.0; clear boundary.

A_2B_1 11 to 15 inches, yellowish-brown (10YR 5/8, moist), friable, heavy sandy loam; when crushed, same color; common, medium, faint, low-contrast mottles of yellowish brown (10YR 5/6, moist); weak, fine, subangular blocky structure; few iron concretions; root channels stained black (10YR 2/1, moist); worm casts, pinholes, and a few, fine pebbles; clear boundary.

B_{21} 15 to 18 inches, yellowish-brown (10YR 5/4, moist), firm, medium clay loam; when crushed, yellowish brown (10YR 5/6, moist); many, coarse, prominent mottles of red (10R 4/6, moist) and many, medium, prominent mottles of yellowish red (5YR 4/6, moist); moderate, fine, subangular blocky structure; continuous clay skins; few iron concretions; root channels stained black (10YR 2/1, moist); worm casts, pinholes, and a few pebbles; pH 6.0; gradual boundary.

B_{22} 18 to 25 inches, yellowish-brown (10YR 5/6, moist), very firm, medium sandy clay; when crushed, strong brown (7.5YR 5/6, moist); few, fine, distinct mottles of strong brown (7.5YR 5/6, moist); moderate, medium, subangular blocky structure; thick, continuous clay skins; few iron and manganese concretions; root channels stained black (10YR 2/1, moist); worm casts, pinholes, and a few pebbles; pH 5.4; gradual boundary.

B_{23} 25 to 32 inches, yellowish-brown (10YR 5/6, moist) and dark yellowish-brown (10YR 4/4, moist), very firm, light sandy clay; when crushed, yellowish brown (10YR 5/8, moist); many, medium, distinct mottles of light brownish gray (2.5Y 6/2, moist); moderate, medium, subangular blocky structure; continuous clay skins; few iron and manganese concretions; root channels stained black (10YR 2/1, moist); a few pebbles; gradual boundary.

B_3 32 to 44 inches, yellowish-brown (10YR 5/8 and 10YR 5/4, moist), firm, heavy clay loam; many, coarse, distinct mottles of light brownish gray (2.5Y 6/2, moist); nearly massive; thin, discontinuous clay skins on cleavage faces; few iron and manganese concretions; many, coarse, distinct, black (10YR 2/1, moist) stains of manganese; a few pebbles pH 5.6; gradual boundary.

C_{ca} 44 to 50 inches, yellowish-brown (10YR 5/8 and 10YR 5/4, moist), friable to firm, medium clay loam; when crushed, yellowish brown (10YR 5/6, moist); many, coarse, distinct mottles of light brownish gray (2.5Y 6/2, moist); massive; few iron and manganese concretions; large lime concretions; many, coarse, distinct stains of black (10YR 2/1, moist); a few pebbles; pH 7.3.

Range in characteristics.—The A_1 horizon is very dark grayish-brown (10YR 3/2, moist) to dark-brown (10YR 3/3, moist) loam to clay loam, and, if not severely eroded, it is 3 to 8 inches thick, The A_2 horizon is dark-brown (10YR 4/3, moist) to brown (10YR 5/3, moist) loam to sandy loam, and, if not severely eroded, it is 2 to 6 inches thick. The B horizon is yellowish-brown (10YR 5/4 to 5/6, moist) to dark yellowish-brown (10YR 4/4, moist) clay loam to sandy clay or clay. Clay in the B horizon is estimated at 35 to 42 percent. The depth to carbonates is usually more than 40 inches.

Lindley loam, 14 to 18 percent slopes, moderately eroded (LdE2).—This moderately well drained soil includes small areas of the Adair and Clarinda soils that could not be mapped separately.

This soil is low in plant nutrients, fertility, and organic matter and is not suitable for cultivation. It is used for pasture and forestry. Pastures are only moderately productive and require lime and fertilizer for good forage yields. Runoff is rapid. (Capability subclass VIe, management group 21.)

Lindley loam, 18 to 25 percent slopes, moderately eroded (LdF2).—This steep upland soil is well drained to moderately well drained. It is low in organic matter and very low in fertility. It is used for pasture or trees and is only moderately productive for pasture. Heavy applications of fertilizer and lime are needed to obtain good forage. The subsoil is friable, moderately slowly permeable clay loam. Runoff is very rapid. Tillage, if any, should be on the contour to reduce sheet erosion. (Capability subclass VIIe, management group 23.)

Lindley loam, 25 to 40 percent slopes, moderately eroded (LdG2).—The profile of this upland soil differs from that described for the series in having a subsoil of friable, moderately slowly permeable clay loam. The soil is well drained to moderately well drained and very low in fertility. It is used for pasture and trees and is not suitable for cultivation. The slopes are so steep that pasture renovation may not be possible with normal farm machinery. Runoff is very rapid. (Capability subclass VIIe, management group 23.)

Lindley soils, 14 to 18 percent slopes, severely eroded (LsE3).—The profile of these soils differs from that described for the series in having a dark surface layer of loam to clay loam less than 3 inches thick. The subsoil is exposed in many places. Small areas of the Adair and Clarinda soils that could not be mapped separately are included.

This soil is low in fertility and organic matter and not suitable for cultivation. It is used for pasture or trees but is only moderately productive. Fertilizer and lime are needed for best yields of forage. (Capability subclass VIIe, management group 23.)

Lindley soils, 18 to 25 percent slopes, severely eroded (LsF3).—The profile of these soils differs from that described for the series in having a surface layer less than 3 inches thick. In many places the subsoil is exposed. These soils are very low in fertility and low in organic matter. They are used for pasture and trees. When in pasture, they are only moderately productive. Heavy applications of fertilizer and lime are needed for good forage yields. These soils are moderately well drained to well drained. The subsoil is friable, moderately slowly permeable clay loam. Runoff is very rapid. Tillage should be on the contour to reduce sheet erosion. (Capability subclass VIIe, management group 23.)

Nodaway Series

The Nodaway series consists of moderately dark to light colored soils on low bottom lands. The soils occur in close association with the Coppock and the Chequest soils in general soil area 6. They have formed from recent alluvium under trees or grasses. Nodaway silt loam, silty clay substratum, has formed in recent alluvium that was deposited over a finer textured, older alluvium. This phase of Nodaway silt loam occurs on low, second bottoms in close association with Nodaway silt loam and with soils of the Chequest series. It differs from Nodaway silt loam in having a silty clay substratum.

Two profiles that represent the Nodaway series are described. The first is that of Nodaway silt loam on a slope of 2 percent (200 feet south and 200 feet east of the northwest corner of the NE¼ of sec. 17, T. 68 N., R. 10 W.):

A_1 0 to 12 inches, very dark gray (10YR 3/1, moist), friable silt loam; weak, fine, granular structure; pH 6.5.

C_1 12 to 34 inches, dark grayish-brown to brown (10YR 4/2.5, moist), friable very fine sandy loam; few peds coated with dark gray (10YR 4/1, moist); very weak, fine subangular blocky structure; pH 5.6.

C_2 34 to 50 inches, dark grayish-brown (10YR 4/2, moist), very friable fine sandy loam; single grain (structureless).

The second representative profile is that of Nodaway silt loam, silty clay substratum, on a slope of 1 percent (680 feet south and 460 feet west of the northwest corner of the SE¼ of sec. 7, T. 67 N., R. 9 W.):

A_1 0 to 9 inches, dark-gray to dark grayish-brown (10YR 4/1.5, moist), firm silt loam to light silty clay loam; common, fine, prominent mottles of yellowish red (5YR 4/6, moist); weak, fine, subangular blocky structure breaking to weak, fine, granular; pH 5.8; abrupt boundary.

A_{31} 9 to 14 inches, yellowish-brown (10YR 5/4, moist) and very dark gray (10YR 3/1, moist) very fine sandy loam; coarse streaks of light gray (5Y 7/2, moist); when crushed, dark grayish brown (2.5Y 4/2, moist); massive; a few, fine pinholes; pH 6.4; abrupt boundary.

$A_{32}C_1$ 14 to 18 inches, dark-gray (5Y 4/1, moist) and light-gray (5Y 6/1, moist), friable very fine sandy loam; common, fine, prominent mottles of reddish brown (5YR 4/4, moist) and yellowish brown (10YR 5/4, moist); massive; many, fine pinholes; abrupt boundary.

C_2 18 to 24 inches, dark-gray (5Y 4/1, moist), light olive-gray (5Y 6/2, moist), and grayish-brown (2.5Y 5/2, moist), firm silt loam; many, medium, prominent mottles of strong brown (7.5YR 5/6, moist); weak, medium, subangular blocky structure; many concretions of iron and manganese; pH 6.2; clear boundary.

A_{b1} 24 to 30 inches, very dark gray (10YR 3/1, moist) and dark grayish-brown (2.5Y 4/2, moist), firm, medium silty clay loam; many, fine, prominent mottles of reddish brown (5YR 4/4, moist) and common, coarse mottles of light gray (5Y 7/1, moist); moderate, medium, subangular blocky structure; many concretions of iron and manganese; numerous pinholes; gradual boundary.

A_{b2} 30 to 37 inches, very dark gray to black (10YR 2.5/1, moist), firm, light silty clay; few, fine, prominent mottles of dark red (2.5YR 3/6, moist); moderate, medium, angular blocky structure; iron and manganese concretions; numerous pinholes; pH 5.7; clear boundary.

A_{b3} 37 to 43 inches, black (10YR 2/1, moist), very firm, medium silty clay; few, fine, prominent mottles of dark red (2.5YR 3/6, moist); moderate, fine, prismatic structure breaking to moderate, fine, angular blocky; manganese concretions; pinholes; pH 5.8; clear boundary.

A_{b4} 43 to 49 inches, very dark gray (10YR 3/1, moist), very firm, heavy silty clay; common, fine, distinct mottles of reddish brown (2.5YR 5/4, moist); moderate, very fine, angular blocky structure; manganese concretions; pinholes.

Range in characteristics.—The surface soil ranges from grayish-brown (10YR 5/2, moist) to very dark gray (10YR 3/1, moist) fine sandy loam to light silty clay loam. The C horizon is mainly silt loam, but it ranges from silt loam to fine sandy loam.

Nodaway-Coppock complex (Nc).—The soils in this complex were mapped together because the areas of each soil are small and intermingled with each other. This mapping unit is in all the general soil areas; it occurs along small streams and drainageways that are generally less than 300 feet wide. The areas are level to gently sloping and occur below the adjacent Lindley or the Gosport soils or the Sogn, Gosport, and Lindley soils.

The surface soils are light to moderately dark colored loam to silt loam. The soils are imperfectly drained and sometimes are subject to flooding by meandering streams or by runoff from uplands. They are highly productive and suitable for corn, soybeans, small grains, and legumes. Generally, it is most practical to manage these soils with the surrounding uplands because they are in long, narrow, irregular areas of 2 to 3 acres or less and are separated by meandering streams and side channels. Pasture is a common use of these soils.

The larger areas used intensively for row crops should be protected from overflow by the use of diversion terraces. Streams should be straightened. (Capability subclass IIw, management group 7.)

Nodaway-Coppock complex, flaggy (Nf).—This mapping unit differs from the Nodaway-Coppock complex in that it is underlain by fragments of limestone or shale or by beds of coarse gravel at depths of 36 inches or less.

The soils have formed from alluvium. They occupy level to moderate slopes along tributaries and drainageways of the Des Moines River that flow through the Gosport soils or the Sogn, Gosport, and Lindley soils in general soil area 3. Nodaway-Coppock soils are subject to frequent flooding and are moderately well to imperfectly drained. They are not cultivated but are used for unimproved pasture along with the adjacent steep upland soils. They are of minor extent in the county. (Capability subclass Vs, management group 20.)

Nodaway silt loam (No).—This is a light to moderately dark colored soil on level to nearly level first bottoms. The surface soil is friable, easily worked silt loam, 12 to 24 inches thick. It overlies a brown, moderately permeable silt loam subsoil. Available supplies of nitrogen tend to be low, and those of phosphorus and potassium are medium. The soil is moderately acid and low to medium in supply of organic matter. It responds well to nitrogen fertilizer and is one of the most productive soils in the county. It is used intensively for cultivated crops and is suitable for corn, soybeans, small grains, and legumes. Floods and deposits of fresh silt occasionally cover this soil, but they seldom make it too wet for crops.

Nodaway silt loam is generally well drained, but a few imperfectly drained areas have been included. These areas have a grayish-brown substratum at depths of more than 24 inches, and the soil appears to grade toward Coppock silt loam. (Capability class I, management group 1.)

Nodaway silt loam, silty clay substratum (Ns).—This is a light to moderately dark colored, poorly to imperfectly drained soil on low, second bottoms. The layer of loam or silt loam is 18 to 36 inches thick over a substratum of black or very dark gray, slowly permeable silty clay.

This soil is moderately acid, low in available nitrogen, medium in available phosphorus and potassium, and medium in supply of organic matter. It responds well to nitrogen fertilizer. It is subject to occasional overflow and often is wet late in spring. Moderately high yields of cultivated crops can be produced if wetness does not interfere. The soil can be used intensively and is suitable for corn, soybeans, and small grains. Legumes may not grow well because of wetness.

If suitable outlets can be found, tile drainage systems are satisfactory in this soil if the substratum of silty clay is at least 30 inches below the surface. (Capability subclass IIIw, management group 15.)

Olmitz Series

Soils of the Olmitz series are dark colored, moderately well drained, and highly productive. The surface layer generally is 18 to 30 inches of loam; the subsoil is a moderately permeable, dark grayish-brown clay loam. Available nitrogen is in low supply, and available phosphorus and potassium are medium. The soils are moderately acid and high in organic matter. They formed under grass from alluvial material that washed from the uplands.

Olmitz soils occupy gentle slopes near the large streams in general soil area 6. They are at the bases of the steep slopes occupied by the Shelby or Lindley soils, along the outer edge of the bottom-land area. They are often closely associated with the Gravity soils, which occur in similar positions, and with the level Colo, Chariton, Carlow, Chequest, and Wabash soils, which are on the adjacent bottom land at a lower elevation.

A representative profile of the Olmitz soils is that of Olmitz loam on a slope of 4 percent (180 feet east of gate and 25 feet south of fence, or approximately 280 feet east and 100 feet south of center of the SW¼ sec. 31, T. 68 N., R. 8 W.):

A+ 0 to 10 inches, very dark grayish-brown (10YR 3/2, moist) to very dark brown (10YR 2/2, moist), friable, coarse loam; weak, very fine, granular structure; pH 6.0; abrupt boundary.

A_{11} 10 to 16 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable loam; weak, fine, subangular blocky structure breaking to weak, fine, granular; pH 6.0; clear boundary.

A_{12} 16 to 20 inches, dark grayish-brown (10YR 4/2, moist) and very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable loam; when crushed, very dark grayish brown (10YR 3/2, moist); moderate, medium, subangular blocky structure; clear boundary.

A_3 20 to 24 inches, very dark gray (10YR 3/1, moist) and very dark grayish-brown (10YR 3/2, moist), but predominantly dark grayish-brown (10YR 4/2, moist), friable, light clay loam; moderate, medium, angular blocky structure; pH 5.8 clear boundary.

B_1 24 to 30 inches, very dark grayish-brown to dark-brown (10YR 3/2.5, moist), friable, light clay loam; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); weak, medium, subangular blocky structure; pH 5.4; clear boundary.

B_2 30 to 37 inches, dark grayish-brown (10YR 4/2, moist), friable to firm clay loam; when crushed, dark brown (10YR 3/3, moist); common, fine, prominent mottles of strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure; old root channels stained very dark gray (10YR 3/1, moist); pH 5.4; clear boundary.

B_3 37 to 45 inches, dark grayish-brown (10YR 4/2, moist), friable to firm clay loam; when crushed, very dark grayish brown to dark brown (10YR 3.5/2.5, moist); many, medium, prominent mottles of strong brown (7.5YR 5/6, moist) and common, fine, prominent mottles of reddish brown (5YR 4/4, moist); weak, medium, subangular blocky structure; accumulations of clay in old root channels; clear boundary.

C_1 45 to 50 inches, strong-brown (7.5YR 5/6, moist) and grayish-brown (2.5Y 5/2, moist), friable to firm clay loam; when crushed, dark yellowish brown (10YR 4/4, moist); massive; few concretions of manganese; dark stains in old root channels; pH 5.6.

Range in characteristics.—The surface layer is black to very dark grayish-brown (10YR 2/1 to 3/2, moist) loam to silt loam. The subsoil is black (10YR 2/1, moist) to very dark grayish-brown (10YR 3/2, moist) loam to medium clay loam.

Olmitz loam, 2 to 5 percent slopes (OmB).—This moderately well drained soil occupies gentle slopes at the bases of steeper upland slopes. Small areas of the Gravity soils are sometimes mapped with it.

The soil is friable, easily worked, and highly productive. It is occasionally wet in spring because of runoff and seepage from adjacent upland. Erosion is a slight hazard. Areas of this soil along large bottom lands are in cultivation, but along the small streams they are in pasture. Management is generally the same as that given the adjacent bottom-land soils. Diversion terraces constructed at the bases of upland slopes will protect this soil from overflow. (Capability subclass IIe, management group 2.)

Olmitz and Gravity soils, 2 to 5 percent slopes (OsB).—This mapping unit consists of small areas of the dark-colored, moderately well drained Olmitz soil and of the imperfectly to poorly drained Gravity soils that are closely associated and were mapped as an undifferentiated unit. These soils occur along small stream bottoms and along some of the narrow upland streams and drainageways.

These soils are highly productive and are suitable for corn, soybeans, small grains, and legumes. They generally make up only a small part of a field; consequently, they are farmed with the associated Colo, Wabash, Coppock, and Chequest soils. They are sometimes flooded by runoff from the uplands and should be protected by diversion terraces. (Capability subclass IIe, management group 2.)

Perks Series

The Perks series consists of excessively drained, medium acid soils that have developed from sandy alluvium. The surface layer is dark-brown sand; the substratum is a rapidly permeable, yellowish-brown sand. The Perks soils are very droughty, and they are low in available nitrogen, phosphorus, and potassium.

The Perks soils occur on the Des Moines River bottoms in general soil area 6. They are associated with the Waukegan, Dickinson, Chariton, and Colo soils. Many areas are used for row crops along with the associated soils; some areas are wooded.

The Perks soils are lighter colored and contain less organic matter than the Hagener soils. In Van Buren County, soils of the Perks and Hagener series were not differentiated.

A representative profile of the Perks series is that of Perks sand on a slope of about 7 percent (400 feet north and 100 feet west of the center of the NW¼ sec. 2, T. 68 N., R. 10 W.):

A_1 0 to 9 inches, dark-brown (10YR 4/3, moist), loose, medium sand; single grain.

C_1 9 to 27 inches, yellowish-brown (10YR 5/4, moist), loose, medium sand; single grain.

C_2 27 to 40 inches, yellowish-brown (10YR 5/4, moist), loose, medium sand; common, medium, prominent mottles of dark brown to brown (7.5YR 4/4, moist); single grain; a few concretions of iron and manganese, very weakly cemented (probably with iron).

Range in characteristics.—The profile ranges from sand to loamy sand throughout.

Perks and Hagener soils, 0 to 2 percent slopes (PhA).—This mapping unit consists of light colored to moderately dark colored sandy soils that are very droughty. They occur on small, level and nearly level areas and are usually cropped with the surrounding soils. They are subject to wind erosion and, whenever possible, should be left in permanent vegetation. (Capability subclass IIIs, management group 14.)

Perks and Hagener soils, 2 to 5 percent slopes (PhB).—This mapping unit consists of very droughty sandy soils. They occur in small, gently sloping areas and are usually farmed like the surrounding soils. They are subject to wind erosion and, whenever possible, should be kept in permanent vegetation. Areas now in trees should not be cleared. (Capability subclass IIIs, management group 14.)

Pershing Series

The Pershing series consists of moderately well drained to imperfectly drained soils on uplands and on bench terraces. The soils are generally low to moderate in productivity and moderately to slightly acid. If not eroded, the surface layer is moderately dark colored silt loam, 6 to 12 inches thick. The subsoil is firm, slowly permeable silty clay, which somewhat restricts the movement of air and water. On gentle slopes, the lower 3 to 5 inches of the surface layer may be grayer and siltier than the upper part.

Pershing soils are low in available nitrogen and phosphorus, medium in available potassium, and low to medium in supply of organic matter. They are subject to sheet and gully erosion if cultivated.

The Pershing soils have formed from Wisconsin loess under prairie grasses, but the more recent vegetation has been trees. They occupy gentle slopes below the level Belinda soils and are on narrow ridgetops and side slopes above the Adair and Clarinda and the Lindley soils. On similar slopes, the Pershing soils are generally associated with the Seymour, Grundy, or Weller soils. The Pershing soils also occur on the loess-covered bench terraces along the large streams in the county. They are in general soil areas 1, 3, 5, and 7.

The Pershing soils on bench terraces along the Des Moines River contain less clay and slightly more sand, and they are somewhat better drained than those on uplands. Pershing soils are underlain by glacial till at depths of 3 to 9 feet on uplands and by alluvial soil material on bench terraces. The depth to till is least on the lower slopes.

A representative profile of the Pershing series is that of Pershing silt loam on a slope of 4 percent (300 feet west and 800 feet south of the northeast corner of the NW¼ sec. 18, T. 70 N., R. 9 W.):

A_{1p} 0 to 4 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; weak, fine, granular structure; pH 6.6; abrupt boundary.

A_{12} 4 to 6 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, very dark grayish brown to dark brown (10YR 3/2.5, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); weak, fine, granular structure to weak, thin, platy; grains of sand on ped faces; abrupt boundary.

A_2 6 to 8 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; when crushed, dark grayish brown (10YR 4/2, moist); few, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); ped surfaces are gray to light gray (10YR 6/1, dry); weak, thin, platy structure; grains of sand on ped faces; pinholes; pH 6.6; abrupt boundary.

B_{11} 8 to 11 inches, dark yellowish-brown (10YR 4/4, moist), friable to firm, light silty clay loam; when crushed, dark brown to brown to dark yellowish brown (10YR 4/3.5, moist); ped surfaces coated with white (10YR 8/1, dry); weak, thin, platy structure to weak, fine, subangular blocky; few, fine concretions of iron and manganese; black (10YR 2/1, moist) stains; grains of sand on cleavage faces; pinholes; clear boundary.

B_{12} 11 to 15 inches, dark yellowish-brown (10YR 4/4, moist), firm, medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); peds coated with white (10YR 8/1, dry); moderate, fine, subangular blocky structure; thin clay skins appear to be present; few, fine concretions of iron and manganese; black (10YR 2/1, moist) stains; grains of sand on cleavage faces; pinholes; pH 5.8; clear boundary.

B_{21} 15 to 22 inches, dark yellowish-brown (10YR 4/4, moist), light silty clay; when crushed, same color; when dry, very hard; ped surfaces coated with white (2.5Y 8/2, dry); strong, fine, subangular blocky structure; thick, continuous clay skins; few, fine concretions of iron and manganese; black (10YR 2/1, moist) stains; grains of sand on ped faces; pinholes common; pH 5.8; clear boundary.

B_{22} 22 to 37 inches, grayish-brown (2.5Y 5/2, moist), very firm, light to medium silty clay; when crushed, yellowish brown (10YR 5/4, moist); few, fine, distinct mottles of strong brown (7.5YR 5/8, moist) and dark yellowish brown (10YR 4/4, moist); ped surfaces, white (2.5Y 8/2, dry); weak, medium, prismatic structure breaking to weak, fine, subangular blocky; thin, continuous clay skins; common, medium concretions of iron and manganese; black (10YR 2/1, moist) stains; grains of sand on ped faces; pinholes more numerous than in B_{21} layer; gradual boundary.

B_3 37 to 50 inches, grayish-brown to light brownish-gray (2.5Y 5.5/2, moist), very firm, medium silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); common, fine, distinct mottles of strong brown (7.5YR 5/8, moist) and a few, fine, distinct mottles of dark yellowish brown (10YR 4/4, moist); white (2.5Y 8/2, dry) coatings on peds that disappear with increase in depth; weak, medium, prismatic structure breaking to weak, fine, subangular blocky; thin, discontinuous clay skins may be present in upper part of horizon; medium, common concretions and stains of iron and manganese; black (10YR 2/1, moist) stains; many pinholes; pH 6.6; gradual boundary.

C_1 50 to 62 inches, light-gray (5Y 7/1, moist), firm, light silty clay loam; when crushed, yellowish brown (10YR 5/6, moist); many, coarse, prominent mottles of strong brown (7.5YR 5/8, moist); massive; common, large stains and concretions of iron and manganese; many pinholes; pH 6.6.

Range in characteristics.—The color of the surface layer ranges from very dark gray (10YR 3/1, moist) to very dark grayish brown (10YR 3/2, moist). The A_2 layer ranges from 2 to 5 inches in thickness and is only weakly developed on the steeper slopes. The texture of the subsoil ranges from heavy silty clay loam to medium silty clay.

Pershing silt loam, 2 to 5 percent slopes (PrB).—This imperfectly drained soil includes small areas of the Adair and Clarinda soils. The soil is moderately productive and the response to fertilizer is fairly good. The subsoil is slowly permeable, and wetness delays tillage and reduces yields in some seasons. Supplies of organic matter are medium. The response to fertilizer is good. The soil is generally used for cultivated crops; it is suited to corn, soybeans, small grains, and legumes. Tillage should be on the contour to reduce runoff and erosion. (Capability subclass IIe, management group 4.)

Pershing silt loam, 5 to 9 percent slopes (PrC).—This is a moderately productive, moderately well drained to imperfectly drained soil. Small areas of the Adair and Clarinda soils may be included. The surface layer is silt loam 6 to 10 inches thick, and the subsoil is slowly permeable silty clay. Wetness may delay tillage and reduce yields in some seasons. Supplies of organic matter are medium. The soil is generally used for cultivated crops and meadow; corn, oats, and legumes are suitable crops. Fertilizer is needed for good yields. The soil is subject to erosion when used for row crops. Fields should be terraced, waterways kept in grass, and tillage done on the contour. (Capability subclass IIIe, management group 12.)

Pershing silt loam, 5 to 9 percent slopes, moderately eroded (PrC2).—This moderately well drained to imperfectly drained soil has a silt loam surface layer that is 3 to 6 inches thick. In some places the subsoil has been mixed with the surface soil during tillage, and in these places the surface soil is somewhat lighter colored than where it has not been eroded. Many small areas of silty clay subsoil have been exposed through erosion. Small areas of the Adair and Clarinda soils have been mapped with this soil.

This soil is medium in supply of organic matter and low in productivity. It is not well suited to row crops, because yields are generally low. Wetness delays fieldwork in some seasons. Lime and fertilizer are needed for best yields. If cultivated, the soil erodes easily. Consequently, fields should be terraced and waterways kept in grass. Tillage should be on the contour. The best use of this soil is for hay or pasture. (Capability subclass IIIe, management group 12.)

Pershing soils, 5 to 9 percent slopes, severely eroded (PsC3).—These soils have a profile that is similar to the representative profile except that less than 3 inches of the original A horizon remain and the surface texture is a silty clay loam. They generally are difficult to work. In most places their subsoil has been exposed through erosion. Small areas of the Adair and Clarinda soils are included with this mapping unit.

These soils are commonly used for row crops, small grains, meadow, and pasture. Some of the acreage has been abandoned. The soils are poorly suited to row crops, and, when used for them, sheet and gully erosion are serious problems. Fields should be terraced and waterways kept in grass. Tillage should be along the contour. The best use is for hay or pasture. Average yields will be low, even though large quantities of fertilizer are applied. (Capability subclass IVe, management group 19.)

Pershing silt loam, bench position, 2 to 5 percent slopes (PtB).—This imperfectly drained soil occurs on bench terraces mainly along the Des Moines River. It has a silt loam surface layer and subsurface layer totaling 6 to 12 inches in thickness and a slowly permeable silty clay subsoil. The subsurface layer contains slightly less clay than the surface layer, and it is more gray.

This soil is moderately productive and is used for cultivated crops and meadow. It is suitable for corn, soybeans, small grains, and legumes. Fertilizer should be applied for best yields. Tillage should be on the contour to reduce sheet erosion. (Capability subclass IIe, management group 4.)

Pershing silt loam, bench position, 5 to 9 percent slopes (PtC).—This moderately well drained to imperfectly drained soil is on bench terraces mainly along the Des Moines River. It has a dark surface layer that is usually 6 to 8 inches thick. Some areas have been included in which the surface soil is only 3 to 6 inches thick. The subsoil is slowly permeable silty clay.

The soil is used for row crops and meadow and is suitable for corn, small grains, and legumes. Fertilizers and lime are needed for best yields. The soil is subject to sheet and gully erosion. If used intensively for row crops, fields should be terraced and all tillage should be on the contour. (Capability subclass IIIe, management group 12.)

Rubio Series

The Rubio series consists of moderately dark, moderately productive, poorly drained soils. They have a silt loam surface layer, 7 to 11 inches thick; a strongly developed, platy subsurface layer, 6 to 10 inches thick; and a firm to very firm, slowly permeable to very slowly permeable silty clay subsoil. Rubio soils are medium in supply of organic matter and strongly acid. They have formed from loess under prairie grasses, but the more recent vegetation has been trees.

Rubio soils are on nearly level, loess-mantled bench terraces adjacent to the Des Moines River and its major tributaries. They occur above the gently sloping, adjacent Givin soils and on similar slopes with the Rushville soils. Most of the Rubio soils are in general soil area 7.

A representative profile of the Rubio series is that of Rubio silt loam, bench position, on a slope of 1 percent (470 feet north and 15 feet east of the southwest corner of SW¼NW¼ sec. 15, T. 70 N., R. 11 W.):

A_{1p} 0 to 7 inches, very dark brown (10YR 2/2, moist), very friable silt loam; weak, fine, granular structure; gradual boundary.

A_{12} 7 to 11 inches, very dark brown (10YR 2/2, moist), friable silt loam; weak, thin, platy structure to weak, fine, subangular blocky; gradual boundary.

A_{21} 11 to 15 inches, very dark gray (10YR 3/1, moist), friable silt loam; when crushed, very dark grayish brown (10YR 3/2, moist); few, fine, faint, low-contrast mottles of very dark grayish brown (10YR 3/2, moist); moderate, thin to medium, platy structure; pinholes common; clear boundary.

A_{22} 15 to 19 inches, gray to grayish-brown (10YR 5/1.5, moist), friable silt loam; when crushed, grayish brown (10YR 5/2, moist); few, medium, faint mottles of dark brown (10YR 4/3, moist); strong, thin to medium, platy structure; few, fine, distinct concretions of iron and manganese; pinholes numerous; abrupt boundary.

B_1 19 to 22 inches, gray (10YR 5/1, moist), friable, light silty clay loam; when crushed, grayish brown (10YR 5/2, moist); common, fine, distinct mottles of brown (10YR 5/3, moist); moderate, medium, subangular blocky structure; few, fine, distinct concretions of iron and manganese; abrupt boundary.

B_{21} 22 to 27 inches, very dark grayish-brown (10YR 3/2, moist), heavy silty clay loam; when crushed, dark grayish brown (10YR 4/2, moist); when dry, very hard; many, medium, distinct mottles of yellowish brown (10YR 5/6, moist); many, coarse, prominent patches of very dark gray (10YR 3/1, dry) on ped surfaces; strong, medium, subangular blocky structure; thin, continuous clay skins; gradual boundary.

B_{22} 27 to 33 inches, dark-gray (10YR 4/1, moist), light silty clay; when crushed, dark grayish brown to brown (10YR 4/2.5, moist); when dry, very hard; many, medium, distinct mottles of dark brown (10YR 4/3, moist); strong, coarse, subangular blocky structure; thick, continuous clay skins; common, medium, distinct stains of very dark gray (10YR 3/1, moist) on root channels; gradual boundary.

C_1 33 to 45 inches, dark-gray (10YR 4/1, moist), medium silty clay loam; when crushed, dark grayish brown to dark brown (10YR 4/2.5, moist); when dry, very hard; many, medium, distinct mottles of dark yellowish brown (10YR 4/6, moist) and strong brown (7.5YR 5/6, moist); massive; thin, continuous clay skins on cleavage faces; common, medium, distinct stains of black (10YR 2/1, moist) on root channels.

Range in characteristics.—The A_1 horizon ranges from dark brown (10YR 3/3, moist) to very dark brown (10YR 2/2, moist) and from 7 to 11 inches in thickness. The A_2 horizon ranges from dark gray (10YR 3/1, moist) to grayish brown (10YR 5/2, moist) and from 6 to 10 inches in thickness. The B horizon ranges from grayish-brown (10YR 5/2, moist) to dark-gray (10YR 4/1) or very dark grayish-brown (10YR 3/2, moist), light silty clay to medium silty clay.

Rubio silt loam, bench position (Rb).—This nearly level, poorly drained soil occurs on loess-mantled bench terraces. It is generally used for cultivated crops; productivity is moderately high. Available nitrogen and phosphorus are low, so fertilizers are needed for highest yields. The subsoil is slowly to very slowly permeable and restricts the downward movement of air and water. Wetness, in some seasons, delays fieldwork. Tile drains do not work well, but drainage can be improved by shallow surface ditches. (Capability subclass IIw, management group 8.)

Rushville Series

The Rushville series consists of light-colored, poorly drained soils that are moderate in productivity. They have a silt loam surface layer, 6 to 10 inches thick; a strongly contrasting platy subsurface layer, 6 to 10 inches thick; and a very firm, very slowly permeable, silty clay subsoil. These soils are low in supply of organic matter

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and strongly acid. They have formed from loess under trees.

Rushville soils are on nearly level, loess-mantled bench terraces adjacent to the Des Moines River and its major tributaries. They occur above the gently sloping, adjacent Keomah and the moderately sloping and strongly sloping associated Clinton soils. On similar slopes they are associated with the Rubio soils. Most of the Rushville soils are in general soil area 7. The Rushville soils have less strongly developed B horizons that contain less clay than those of the Beckwith soils.

A representative profile of the Rushville series is that of Rushville silt loam, bench position, on a level, loess-covered bench terrace planted to red clover (840 feet west and 15 feet south of the center of sec. 26, T. 69 N., R. 10 W.):

A_{1p} 0 to 4 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, moist), friable silt loam; moderate, fine, granular structure; pH 5.4; abrupt boundary.

A_{12} 4 to 7 inches, dark-gray (10YR 4/1, moist), friable silt loam; when crushed, gray (10YR 5/1, moist); common, coarse mottles of pale brown (10YR 6/3, moist); weak, medium, platy structure to moderate, fine, subangular blocky; pH 4.8; clear boundary.

A_{21} 7 to 11 inches, brown (10YR 5/3, moist), friable silt loam; peds coated with gray (10YR 6/1, moist); moderate, fine, subangular blocky structure; pH 4.6; gradual boundary.

A_{22} 11 to 17 inches, pale-brown (10YR 6/3, moist), friable silt loam; peds coated with gray (10YR 6/1, moist); weak, platy structure to moderate, fine, subangular blocky; pH 4.6; clear boundary.

B_{21} 17 to 20 inches, dark-gray (10YR 4/1, moist), firm, light silty clay; when crushed, brown (10YR 4/3, moist); many, fine mottles of dark reddish brown (5YR 3/4, moist) and a few, fine mottles of very dark gray (10YR 3/1, moist); strong, fine, subangular blocky structure; thick, continuous clay skins on peds; pH 4.8; clear boundary.

B_{22} 20 to 28 inches, dark-brown and grayish-brown (10YR 4/3 and 5/2, moist), very firm silty clay; few, fine, faint mottles of yellowish brown (10YR 5/6, moist); strong, very fine, subangular blocky structure; thick, continuous clay skins on peds; many, fine concretions of iron and manganese; pH 5.0; gradual boundary.

B_3 28 to 35 inches, dark-brown and brown (10YR 4/3 and 5/3, moist), firm silty clay loam; common, coarse mottles of dark brown (7.5YR 4/4, moist) and common, fine mottles of black (10YR 2/1, moist); moderate, medium, subangular blocky structure; discontinuous clay skins on peds; many, fine concretions of iron and manganese; pH 5.8; gradual boundary.

C_1 35 to 45 inches, dark-brown and brown (10YR 4/3 and 5/3, moist), firm silty clay loam; common, coarse mottles of very pale brown (10YR 7/3, moist) and common, medium mottles of very dark gray (10YR 3/1, moist); massive; some clay skins on cleavage faces; many, fine concretions of iron and manganese; pH 6.0.

Range in characteristics.—The A_1 horizon ranges from dark brown (10YR 3/3, moist) to very dark grayish brown (10YR 3/2, moist) or dark grayish brown (10YR 4/2, moist); it is 6 to 10 inches thick. The A_2 horizon is dark grayish brown (10YR 4/2, moist) to pale brown (10YR 6/3, moist) and 6 to 10 inches thick. The color of the B horizon ranges from dark brown (10YR 4/3, moist) to dark grayish brown (10YR 4/2, moist), grayish brown (10YR 5/2, moist), or dark gray (10YR 4/1, moist). The B horizon is dominantly a silty clay.

Rushville silt loam, bench position (Rt).—This nearly level soil is on loess-mantled bench terraces. It is low in fertility, but moderately productive; it is generally used for cultivated crops. Fertilizers are usually needed for highest yields. The subsoil is very slowly permeable, and it restricts the downward movement of air and water. Wetness will delay fieldwork in some seasons. Tile drains do not work well. (Capability subclass IIw, management group 8.)

Seymour Series

The Seymour series consists of moderately dark, imperfectly drained to moderately well drained soils on uplands. If not severely eroded, the surface layer is silt loam and ranges from 3 to 14 inches in thickness. The subsoil is very firm, very slowly permeable clay or silty clay, which restricts the movement of air and water. In some seasons wetness may delay fieldwork. The soils are usually low in available nitrogen and phosphorus and medium in available potassium. Productivity is moderately high to low.

Seymour soils have developed from Wisconsin loess under grass. The loess is 3 to 7 feet thick, and it is thickest on the gentle slopes. The soils occupy gently and moderately sloping ridgetops. They are below the nearly level Edina soils, above the Adair and Clarinda soils on similar or steeper slopes, and adjacent to the Pershing or Weller soils on similar slopes. Most of the Seymour soils are in general soil area 5. The Seymour soils are similar to the Grundy soils in appearance and in position on the landscape but have finer textured B horizons and are more poorly drained.

A representative profile of the Seymour soils is that of Seymour silt loam on a slope of 3 percent (30 feet north and 175 feet east of center of the SW¼SW¼ sec. 17, T. 68 N., R. 9 W.):

A_1 0 to 8 inches, very dark gray (10YR 2.5/1, moist), friable silt loam; when crushed, very dark gray (10YR 3/1, moist); weak, very fine, granular structure; few, fine concretions of manganese; pH 6.4.

A_3 8 to 13 inches, very dark grayish-brown (10YR 3/2, moist), friable, light silty clay loam; when crushed, very dark gray (10YR 3/1, moist); common, fine, faint mottles of dark brown (10YR 3/3, moist); moderate, fine, granular structure; few, fine concretions of manganese; pH 6.4.

A_3B_1 13 to 16 inches, very dark grayish-brown (10YR 3/2, moist), friable, medium silty clay loam; when crushed, very dark grayish brown to dark brown (10YR 3/2.5, moist); many, fine, faint mottles of dark yellowish brown (10YR 4/4, moist); moderate, very fine, angular blocky structure; many, fine iron and manganese concretions; pH 5.9.

B_{21} 16 to 19 inches, dark grayish-brown (2.5Y 4/2, moist), firm, light silty clay; when crushed, dark brown (10YR 3.5/3, moist); many, fine, distinct mottles of yellowish brown (10YR 5/4, moist) and common, fine, prominent mottles of strong brown (7.5YR 5/6, moist); strong, very fine, subangular blocky structure; thin, continuous clay skins; many, fine concretions of iron and manganese; pH 5.8.

B_{22} 19 to 27 inches, dark grayish-brown (2.5Y 4/2, moist), very firm silty clay; when crushed, brown to yellowish brown (10YR 5/3.5, moist); common, medium, prominent mottles of strong brown (7.5YR 5/6, moist) and many, fine, prominent mottles of yellowish brown (10YR 5/4, moist); strong, fine, angular blocky structure; thick, continuous clay skins; many, fine concretions of iron and manganese; pH 5.9.

B_{23} 27 to 32 inches, yellowish-brown (10YR 5/4, moist) and grayish-brown (2.5Y 5/2, moist), firm, light silty clay; when crushed, yellowish brown (10YR 5/4, moist); common, fine, prominent mottles of strong brown (7.5YR 5/6, moist); moderate, fine, subangular blocky structure; thin, discontinuous clay skins; many, fine concretions of iron and manganese; pH 6.0.

B_3 32 to 45 inches, grayish-brown (2.5Y 4.5/2, moist), firm, heavy silty clay loam; when crushed, yellowish brown (10YR 5/3.5, moist); common, medium, prominent mottles of strong brown (7.5YR 5/6, moist) and yellowish brown (10YR 5/4, moist); weak, coarse, angular blocky structure; thin clay skins appear to be present; many, fine concretions of iron and manganese; pH 6.2.

C_1 45 to 52 inches, gray (5Y 5/1, moist), firm, medium silty clay loam; when crushed, yellowish brown (10YR 5/5, moist); common, medium, distinct mottles of yellowish brown (10YR 5/4, moist) and common, medium, prominent mottles of strong brown (7.5YR 5/8, moist); massive; many, fine concretions of iron and manganese; pH 6.4.

C_2 52 to 62 inches, gray (5Y 5/1, moist), firm, medium silty clay loam; when crushed, very dark gray (10YR 3/1, moist); many, coarse, prominent mottles of strong brown (7.5YR 5/8, moist); massive; few, fine concretions of iron and manganese; old root channels stained by organic material; pH 6.6.

Range in characteristics.—The A_1 layer ranges from very dark gray (10YR 3/1, moist) to very dark grayish brown (10YR 3/2, moist) and, if not severely eroded, is 3 to 14 inches thick. The B horizon is very dark grayish-brown (10YR 3/2, moist) to grayish-brown (2.5Y 5/2, moist) silty clay to clay. The loess is 3 to 7 feet thick, and it is thinnest on the stronger slopes.

Seymour silt loam, 2 to 5 percent slopes (SaB).—This soil is friable and easily worked under the right conditions. It is somewhat slow to dry but will produce moderately high yields. Surface runoff is fairly rapid, but the subsoil restricts the movement of water. Available nitrogen and phosphorus are low.

This soil is generally used for cultivated crops, but heavy fertilization is usually necessary for best yields. All tillage should be on the contour to control sheet erosion. (Capability subclass IIe, management group 4.)

Seymour silt loam, 5 to 9 percent slopes, moderately eroded (SaC2).—The profile of this moderately well drained to imperfectly drained soil differs from the one described for the series in having a dark surface layer only 3 to 6 inches thick. In a few places the subsoil is exposed. The soil is less likely to be wet than the Seymour soils on slopes of 2 to 5 percent. Small areas of the Adair and Clarinda soils are included.

This soil is generally used for cultivated crops, and it is moderately productive. Heavy applications of fertilizer are needed because the soil is very low in nitrogen and low in phosphorus. Runoff is rapid, and all tillage should be on the contour to reduce sheet erosion. (Capability subclass IIIe, management group 12.)

Seymour soils, 5 to 9 percent slopes, severely eroded (SbC3).—The dark surface layer of this soil is less than 3 inches thick, and the subsoil is exposed. The surface soil, a silty clay loam, is sticky and difficult to work. Small areas of the Adair and Clarinda soils are included.

This soil is very low in available nitrogen, low in available phosphorus, and medium in available potassium. It is best suited to hay and pasture because productivity is low, even with adequate fertilization. (Capability subclass IVe, management group 19.)

Shelby Series

This series consists of steep, well-drained, dark to moderately light colored soils on uplands. If not severely eroded, the surface layer is loam, 3 to 9 inches thick. The subsoil is generally firm, moderately slowly permeable clay loam, which somewhat restricts the downward movement of water. Runoff is very rapid. The soils are moderately productive and seldom too wet for crops, but they erode easily in cultivation. They are moderately acid. Supplies of available nitrogen and phosphorus are very low, and the available supply of potassium is low. The content of organic matter is medium to low. The soils have formed under grasses and from Kansan till.

These soils are generally on moderately steep to steep side slopes of the more severely dissected parts of general soil area 4. They are below the sloping Adair and Clarinda soils (see fig. 3) and adjacent to the Lindley soils on similar slopes.

A representative profile of the Shelby series is that of Shelby loam on a slope of 15 percent (125 feet east and 600 feet south of the northwest corner of the NE¼NW¼ sec. 5, T. 67 N., R. 11 W.):

A_{11} 0 to 4 inches, very dark gray to dark gray (10YR 3.5/1, moist), friable loam; weak, fine, granular structure; pH 7.0; clear boundary.

A_{12} 4 to 7 inches, matrix of very dark gray (10YR 3/1, moist) and dark brown (10YR 4/3, moist), friable loam; when crushed, very dark grayish brown (10YR 3/2, moist); weak, fine, subangular blocky structure breaking to weak, fine, granular; pH 6.8; clear boundary.

A_3 7 to 11 inches, matrix of very dark gray (10YR 3/1, moist) and dark yellowish-brown (10YR 4/4, moist), friable loam; when crushed, dark brown (10YR 3/3, moist); moderate, fine, subangular blocky structure; pH 6.6; clear boundary.

B_1 11 to 15 inches, dark-brown to brown (7.5YR 4/4, moist), friable clay loam; moderate, fine, subangular blocky structure; some clay skins present; pH 5.4; clear boundary.

B_{21} 15 to 22 inches, yellowish-brown (10YR 5/6, moist), firm, heavy clay loam; moderate, fine, subangular blocky structure; continuous clay skins; root channels coated with very dark gray (10YR 3/1, moist); pH 5.4; clear boundary.

B_{22} 22 to 29 inches, yellowish-brown (10YR 5/6, moist), firm clay loam; peds coated with brown (10YR 5/3, moist); weak, fine, prismatic structure breaking to moderate, fine, subangular blocky; clay skins present; pH 5.4; clear boundary.

C_1 29 to 43 inches, yellowish-brown (10YR 5/6, moist), firm clay loam; peds coated with gray to light gray (10YR 6/1, dry); mainly massive; thin, discontinuous clay skins on cleavage faces; many, fine stains and soft concretions of manganese.

Range in characteristics.—The A_1 horizon is very dark gray (10YR 3/1, moist) to dark brown (10YR 3/3, moist) and, if not severely eroded, is 3 to 9 inches thick. The texture of the A_1 horizon ranges from loam to clay loam. The B_2 horizon is yellowish-brown (10YR 5/6, moist) to brown (10YR 5/3, moist) clay loam. Clay in the B horizon is estimated to be 30 to 40 percent. The Shelby soils are free of mottles to an average depth of 30 inches. The depth to carbonates is generally greater than 48 inches.

Shelby loam, 14 to 18 percent slopes, moderately eroded (ShE2).—This moderately steep soil of the uplands is very low in fertility and medium to low in organic matter. A small part is used for cultivated crops, but most of the acreage is in pasture. Included with this soil are small areas of uneroded Adair and Clarinda soils that could not be mapped separately.

Because of steepness, runoff is very rapid, and the soil erodes easily when cultivated. Row crops should be grown only 1 year in 5 or 6 years. All tillage should be on the contour to control erosion. This soil is suited best to pasture or hay, and it has a potential for alfalfa-bromegrass or trefoil-bluegrass pasture. Large quantities of fertilizer are needed for good yields. (Capability subclass IVe, management group 18.)

Shelby loam, 18 to 25 percent slopes, moderately eroded (ShF2).—This steep soil of the uplands is low in fertility. It is best suited to permanent pasture, and it has a good potential for trefoil and bluegrass pasture. Fertilizers and lime are generally needed for good yields of forage because supplies of plant nutrients are very low and the content of organic matter is medium to low. (Capability subclass VIe, management group 21.)

Shelby soils, 14 to 18 percent slopes, severely eroded (SmE3).—The soils of this mapping unit generally have a clay loam surface layer that is less than 3 inches thick. The subsoil is exposed in many places, and, in some places, it has been mixed with the surface layer in tillage. Included with this mapping unit are small areas of the uneroded Adair and Clarinda soils that could not be mapped separately.

The soils of this mapping unit are very low in fertility and low to very low in organic matter. They are seldom used for cultivated crops and are suited best to permanent pasture. They have a good potential for improved pasture consisting of trefoil and bluegrass. Fertilizers and lime are generally needed for best yields of forage. (Capability subclass VIe, management group 21.)

Shelby soils, 18 to 25 percent slopes, severely eroded (SmF3).—The soils of this mapping unit generally have a clay loam surface layer that is less than 3 inches thick. The subsoil is exposed in many places. These soils of the uplands are very low in fertility and organic matter. They are best suited to permanent pasture. (Capability subclass VIIe, management group 23.)

Sogn Series

In the Sogn series are moderately light colored soils less than 15 inches deep to limestone bedrock. Outcroppings of limestone bedrock are common. The Sogn soils are on steep and very steep side slopes adjacent to the Des Moines River and its tributaries. They are downslope from the Lindley and Gosport soils.

In Van Buren County, the Sogn soils were mapped with the Gosport and the Lindley soils as an undifferentiated unit. The Gosport and the Lindley series are described elsewhere in this report.

Following is a composite profile description for the Sogn series:

A_1 0 to 4 inches, very dark grayish-brown (10YR 3/2, moist), friable coarse loam; single grain (structureless) to moderate, fine, granular structure; clear boundary.

A_3 4 to 10 inches, dark-brown (10YR 3/3, moist), friable stony loam; moderate, fine, subangular blocky structure; pH 5.4.

D 10 inches +, limestone.

Range in characteristics.—The Sogn soils are 6 to 15 inches thick over limestone bedrock. Their surface layer is generally very dark gray (10YR 3/1, moist) to dark grayish-brown (10YR 4/2, moist) loam or silt loam.

Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes (SyG).—This undifferentiated group of soils, consisting of members of three soil series, is characterized by steep slopes and limestone or shale outcrops. As many as three or as few as one of the soil series may occur in one area. In this mapping unit there are minor inclusions of soils derived from loess or eolian sand or of soils on terrace escarpments.

These steep to very steep soils are very low in fertility. They are best suited to forestry. They are not suitable for cultivated crops and, if used for pasture, are difficult to manage. (Capability subclass VIIe, management group 23.)

Steep Sandy Land

This miscellaneous land type consists of strongly sloping to very steep sandy soils above the bench terraces and bottom lands along the Des Moines River. These soils have developed from eolian sand of local origin, and they have various degrees of profile development including that of the reddish paleosols. Small outcrops of glacial till, limestone, or shale occur throughout the areas of Steep sandy land. The soils are very low in fertility and strongly acid; they have developed under trees. Most of them are in general soil area 3. They occur in close association with the Lindley soils and with Douds soils and Terrace escarpments on similar slopes.

A representative profile of this miscellaneous land type is on a slope of 20 percent (90 feet west and 170 feet north of the southeast corner of the NE¼SW¼ sec. 36, T. 68 N., R. 8 W.):

A_{11} 0 to 2 inches, very dark grayish-brown (10YR 3/2, moist), very friable to loose loamy sand; single grain; pH 6.4; clear boundary.

A_{12} 2 to 8 inches, dark-brown (10YR 4/3, moist and 10YR 3/3, moist), very friable to loose loamy sand; single grain; clear boundary.

B_{11} 8 to 20 inches, dark yellowish-brown (10YR 4/4, moist), loose sand; single grain; pH 6.2; clear boundary.

B_{12} 20 to 25 inches, dark yellowish-brown (10YR 4/4, moist), loose sand; single grain; pH 5.4; abrupt boundary.

D–B_{13} 25 to 26 inches, weakly to strongly cemented, dark reddish-brown (5YR 3/4, moist) sand; abrupt boundary.

D–B_2 26 to 31 inches, dark-brown to brown (7.5YR 4/4, moist), friable to firm, light sandy clay loam; many, medium, prominent mottles of yellowish red (5YR 5/8, moist) and common, medium, distinct mottles of brown (10YR 5/3, moist); moderate, medium, subangular blocky structure; gradual boundary.

D–B_3 31 to 39 inches, light brownish-gray (10YR 6/2, moist) and reddish-brown (5YR 4/4, moist), friable, medium sandy clay loam; when crushed, yellowish brown (10YR 5/4, moist); weak, coarse, angular blocky structure; pH 5.4; gradual boundary.

D–C_1 39 to 52 inches, light-gray (10YR 7/2, moist), firm, light sandy clay loam; many, medium, distinct mottles of reddish brown (5YR 4/4, moist) and common, medium, distinct mottles of reddish yellow (7.5YR 6/8, moist); massive with some stratification; pH 5.2.

Range in characteristics.—The A_1 horizon is dark grayish-brown (10YR 4/2, moist) to dark-brown (10YR 4/3, moist) sand to loamy sand, 6 to 12 inches thick. The subsoil is dark-brown (10YR 4/3, moist) to yellowish-brown (10YR 5/4, 5/6, moist) sandy loam to sandy clay loam, but where the reddish paleosols occur, there are redder colors.

Steep sandy land (SsF).—This mapping unit consists of strongly sloping to very steep soils. They are droughty, strongly acid, and very low in fertility. They are best suited to woodland, pasture, or wildlife. (Capability subclass VIIs, management group 24.)

Wabash Series

This series consists of moderately acid, dark-colored, poorly drained, bottom-land soils. They have a black, silty clay loam layer, 10 to 20 inches thick, that lies over a firm, dark-colored, slowly permeable silty clay or clay subsoil. They are high in organic matter, low in available nitrogen, and medium in available phosphorus and potassium.

The Wabash soils are in level areas or in depressions on the first bottoms along the larger streams. They are generally about midway between the natural stream channel and the uplands, in a slightly lower position than the associated Coppock, Gravity, Colo, Carlow, Chequest, and Nodaway soils. Overflow from streams and runoff from uplands flood these soils. A few areas are ponded unless artificial drainage has been provided. Some areas are covered by several inches of recently deposited lighter colored loam or silt loam.

A representative profile of the Wabash series is that in a level area of Wabash silty clay loam (northwest corner of NE¼NW¼NW¼ sec. 33, T. 68 N., R. 10 W.):

A_{1p} 0 to 6 inches, black to very dark gray (10YR 2.5/1, moist), friable, light silty clay loam; weak, fine, granular structure.

A_{12} 6 to 12 inches, black (10YR 2/1, moist), friable, heavy silty clay loam; weak, medium, granular structure; pH 4.9.

B_2 12 to 19 inches, black (N 2/, moist), firm, light silty clay; weak, very fine, subangular blocky structure; pH 4.9.

C_1 19 to 30 inches, black (N 2/, moist), very firm, medium silty clay; massive; pH 5.0.

C_{12} 30 to 40 inches, black (N 2/, moist), very firm silty clay to clay; massive; pH 5.6.

Range in characteristics.—The surface layer is black (10YR 2/1, moist) to very dark gray (10YR 3/1, moist), heavy silty clay loam to silty clay. Some areas have a recently deposited surface layer of lighter colored loam to silt loam.

Wabash silty clay loam (Wa).—This poorly drained soil of the bottom lands is frequently flooded (fig. 4). It is generally wet late in spring. Small areas of the closely associated Carlow soils were frequently mapped with it.

This soil has been cleared and is used extensively for row crops; yields are moderate. It is suited to corn, soybeans, small grains, and most legumes but not to alfalfa. The soil is sticky when wet and difficult to till. Tile drains do not function properly, so open ditches or diversion terraces are needed for drainage. Weed control is a problem in wet years. (Capability subclass IIIw, management group 15.)

Wabash silty clay loam, overwashed (Wb).—The profile of this soil differs from that described for the series in having 6 to 16 inches of light-colored loam or silt loam on the surface. Mapped with this soil are small areas of the closely associated Carlow soils.

This soil is friable and easy to till if moisture is right. It is used intensively for row crops, and it produces moderately good yields. It is suited to corn, soybeans, small grains, and legumes. This soil is subject to occasional flooding. Diversion terraces, surface drains, or open ditches are generally needed for drainage. (Capability subclass IIIw, management group 15.)

***Figure 4.*—Wabash silty clay loam after light flooding on flood plain of the Fox River. Crop is soybeans.**

Waukegan Series

The Waukegan series consists of dark-colored soils on low terraces or second bottoms along the Des Moines River in general soil area 6. These soils were formed from medium to moderately fine textured alluvium over sand or gravel. The native vegetation was grass.

The Waukegan series is mapped in Van Buren County as Waukegan loam, deep, and Waukegan loam, moderately deep. The former is the most extensive and is underlain by sand or gravel at depths of 40 inches or more. The latter, underlain by sand or gravel at depths of 12 to 26 inches, covers about 60 acres in the county.

Two representative profiles of the Waukegan series are described. The first profile is that of Waukegan loam, deep, on a slope of 1 percent (140 feet south and 100 feet east of the northwest corner of the NE¼SE¼ sec. 22, T. 70 N., R. 11 W.):

A_{1p} 0 to 8 inches, very dark grayish-brown (10YR 3/2, moist), friable loam; weak, fine, granular structure; pH 6.8; abrupt boundary.

A_{12} 8 to 14 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; weak, fine, subangular blocky structure; few worm casts; pH 6.8; clear boundary.

A_3B_1 14 to 20 inches, matrix very dark grayish-brown and dark-brown (10YR 3/2 and 3/3, moist), friable to firm, heavy silt loam; when crushed, dark brown (10YR 3/3, moist); moderate, fine, subangular blocky structure; clear boundary.

B_{21} 20 to 27 inches, very dark grayish-brown (10YR 3/2, moist), friable to firm, light silty clay loam; few, very dark brown (10YR 2/2, moist) organic coatings on peds; moderate, fine, subangular blocky structure; thin, discontinuous clay skins may be present; pH 6.6; clear boundary.

B_{22} 27 to 34 inches, dark yellowish-brown (10YR 3/4, moist), medium silty clay loam; when dry, slightly hard; few, fine, distinct mottles of yellowish brown (10YR 5/8, moist); strong, medium, subangular blocky structure; clay skins may be present; root channels coated very dark brown (10YR 2/2, moist); clear boundary.

B_{23} 34 to 44 inches, dark yellowish-brown (10YR 3/4, moist), light silty clay loam; when dry, hard; few, fine, distinct mottles of yellowish brown (10YR 5/8, moist) and very dark brown (10YR 2/2, moist); strong, coarse, subangular blocky structure; pH 5.6; gradual boundary.

B_3 44 to 48 inches, dark yellowish-brown (10YR 4/4, moist) sandy clay loam; when dry, slightly hard; common, medium mottles of yellowish brown (10YR 5/8, moist); weak, coarse, subangular blocky structure; gradual boundary.

D 48 to 56 inches, dark yellowish-brown (10YR 4/4, moist), friable, heavy sandy loam; massive; some thin yellowish red (5YR 5/8, moist) bands colored by iron compounds; pH 5.6.

The second representative profile of the Waukegan series is that of Waukegan loam, moderately deep, on a slope of 1 percent (940 feet east and 80 feet south of the northwest corner of the NW¼SW¼ sec. 1, T. 67 N., R. 8 W.):

A_{1p} 0 to 8 inches, very dark gray (10YR 3/1, moist), friable loam; weak, fine, granular structure; pH 6.6; abrupt boundary.

A_{12} 8 to 12 inches, very dark gray (10YR 3/1, moist), friable loam; weak, medium, subangular blocky structure; abrupt boundary.

B 12 to 22 inches, dark-brown to dark yellowish-brown (10YR 3.5/3.5, moist), friable, heavy loam; few, fine, faint mottles of very dark gray (10YR 3/1, moist); weak, fine, subangular blocky structure; pH 6.4; clear boundary.

D_1 22 to 38 inches, dark-brown to dark yellowish-brown (10YR 3.5/3.5, moist), very friable, gravelly sandy loam; single grain (structureless); pH 6.4; diffuse boundary.

D_2 38 to 48 inches, dark-brown to dark yellowish-brown (10YR 3.5/3.5, moist), loose sand and gravel; single grain (structureless); pH 6.2.

Some gravel on surface and mixed throughout upper 22 inches of profile.

Range in characteristics.—The surface layer ranges from very dark grayish-brown (10YR 3/2, moist) to very dark gray (10YR 3/1, moist) silt loam to loam. The subsoil is heavy silt loam to medium silty clay loam but is dominantly silty clay loam.

Waukegan loam, deep, 0 to 2 percent slopes (WdA).—This is a dark, moderately acid, well drained to moderately well drained soil. It has a surface layer of loam or silt loam, 14 to 24 inches thick, and a subsoil that is moderately permeable, brown to yellowish-brown silty clay loam. Under the subsoil, at depths of 3½ to 6 feet, is sand and gravel.

This soil occupies second bottoms or low terraces, and it is extensive along the Des Moines River in general soil area 6. It is associated with the Dickinson and Coppock soils at about similar elevations and with the Colo and Nodaway soils that are at slightly lower elevations.

This soil is easy to work. It is highly productive and can be used intensively for row crops. It also produces high yields of hay and small grains. The supply of organic matter is high. The supply of available nitrogen is low and that of phosphorus and potassium is medium. The soil responds well to fertilizers. (Capability class I, management group 1.)

Waukegan loam, deep, 2 to 5 percent slopes (WdB).—This moderately well to well drained soil has a loam or silt loam surface layer that is 10 to 18 inches thick. Mapped with it are small areas of the Dickinson soils.

This soil is friable, easy to work, and high in organic matter. It responds well to fertilizer. It is very highly productive and is used extensively for row crops. The risk of erosion is slight, and the soil should be managed like the surrounding soils. (Capability subclass IIe, management group 3.)

Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded (WdC2).—The profile of this soil differs from that described for the series in having a loam surface soil only 3 to 6 inches thick. Small areas of the Dickinson soils were mapped with this soil.

This soil is easy to work and highly productive. It is used for row crops and meadow. The soil is in long, narrow areas on short slopes between level and gently sloping soils at higher and lower topographic positions. Erosion is a hazard, but it is generally more practical to manage this soil the same as the surrounding soils. (Capability subclass IIIe, management group 9.)

Waukegan loam, moderately deep, 0 to 3 percent slopes (WmA).—This droughty, excessively drained soil is on gentle slopes of low terraces along the Des Moines River bottom in the eastern part of the county. It is in general soil area 6. The surface soil is dark-colored loam, 6 to 14 inches thick. The subsoil is rapidly permeable, brown to yellowish-brown loam, which overlies sand or gravel at depths of 12 to 26 inches. The soil is associated with Waukegan loam, deep phases, and with the Colo and the Coppock soils.

This soil is slightly acid and high in organic matter. It tends to be low in available nitrogen and medium in available phosphorus and potassium. It is used for row crops and meadow. Yields are low. The use of winter cover crops and stubble-mulch tillage are suggested because this soil is subject to some wind erosion. (Capability subclass IIIs, management group 13.)

Waukegan loam, moderately deep, 3 to 6 percent slopes (WmB).—This soil has a low moisture-holding capacity and is droughty. It is used for row crops and meadow, but yields are poor. The use of winter cover crops and stubble-mulch tillage are suggested because the soil is subject to wind erosion. (Capability subclass IIIs, management group 13.)

Weller Series

Soils of the Weller series are strongly acid, light colored, and moderately well drained to imperfectly drained. They are low in fertility and moderate to low in productivity. If not severely eroded, they have a silt loam surface layer, 3 to 8 inches thick, and a light-colored silt loam subsurface layer, 2 to 6 inches thick. The subsoil is slowly permeable silty clay that restricts the movement of air and water. Runoff is rapid. The soils erode easily under cultivation. They are generally low in available nitrogen and phosphorus, medium in potassium, and low in organic matter. They have formed under trees and from Wisconsin loess.

These soils generally occur on gently sloping ridgetops or on gently rolling side slopes in the steep and more strongly dissected areas of the county (see fig. 3). They are associated with the nearly level Beckwith soils, which occupy higher positions on the landscape. They are also associated with the undifferentiated Adair and Clarinda soils and with the Lindley, the Gosport, or the undifferentiated Sogn, Gosport, and Lindley soils, all of which occupy positions downslope from the Weller soils. Some of the Weller soils occupy benches near streams, but most of them occur in the uplands. Most of the Weller soils are in general soil area 3.

These soils in the strongly dissected areas near the Des Moines River or other large streams have been modified to some extent by local loess. In these places, they are generally somewhat coarser textured, contain slightly more sand, and are less mottled than Weller soils farther from the streams. They also grade toward the Clinton series. About 30 percent of the total area of Weller soils has been influenced by this local loess.

The upland Weller soils are normally underlain by glacial till at depths of 3 to 7 feet. Where influenced by local loess, the depth to till ranges from 5 to 10 feet. The shallowest depths to till occur on the downslope side of the Weller areas adjacent to the Lindley or Adair soils. Weller soils on loess-covered benches are usually underlain by stratified alluvium at depths of 6 to 10 feet.

A representative profile of the Weller series is that of Weller silt loam on a slope of 4 percent (50 feet west and 500 feet south of the northeast corner of the NW¼NE¼ sec. 17, T. 70 N., R. 10 W.):

A_0 1 inch to 0, very dark brown (10YR 2/2, moist), spongy, partly decomposed, mixed forest litter; abrupt boundary.

A_1 0 to 5 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; weak, fine, subangular blocky structure crushing to weak, fine, granular; iron and manganese concretions; pH 6.6; abrupt boundary.

A_{21} 5 to 8 inches, brown (10YR 5/3, moist), friable silt loam; when crushed, brown to yellowish brown (10YR 5/3.5, moist); ped surfaces, light gray (10YR 7/2, dry); weak, thin, platy structure and moderate, fine, subangular blocky structure; iron and manganese concretions; root channels stained black (10YR 2/1, moist); pinholes; clear boundary.

A_{22} 8 to 11 inches, yellowish-brown (10YR 5/4, moist), friable, heavy silt loam; when crushed, same color; ped surfaces, light gray (10YR 7/2, dry); moderate, fine, subangular blocky structure; iron and manganese concretions; root channels stained black (10YR 2/1, moist); few worm casts; pH 5.6; clear boundary.

B_1 11 to 15 inches, dark yellowish-brown to yellowish-brown (10YR 4.5/4, moist), friable to firm, light silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); ped surfaces, light gray (10YR 7/2, dry); moderate to strong, fine, subangular blocky structure; clay skins appear to be present; iron and manganese concretions; root channels stained black (10YR 2/1, moist); pinholes; abrupt boundary.

B_{21} 15 to 18 inches, dark yellowish-brown (10YR 4/4, moist), heavy silty clay loam; when crushed, yellowish brown (10YR 5/4, moist); hard when dry; few, fine, faint, low-contrast mottles of yellowish brown (10YR 5/4, moist); ped surfaces very pronounced light gray (10YR 7/2, dry); strong, fine, subangular blocky structure; continuous clay skins; iron and manganese concretions; pinholes; pH 5.4; abrupt boundary.

B_{22} 18 to 23 inches, dark-brown to brown (7.5YR 5/4, moist), medium silty clay; when crushed, yellowish brown (10YR 5/4, moist); when dry, very hard; few, fine, faint mottles of yellowish brown (10YR 5/4, moist); ped surfaces, light gray (10YR 7/2, dry) and less pronounced than above; moderate, fine, prismatic structure breaking to strong, medium, angular blocky; thick, continuous clay skins; iron and manganese concretions; few pinholes; clear boundary.

B_{23} 23 to 28 inches, brown (7.5YR 5/4, moist) and grayish-brown (2.5Y 5/2, moist), light silty clay; when crushed, yellowish brown (10YR 5/4, moist); when dry, very hard; common, fine, distinct mottles of yellowish brown (10YR 5/4, moist); ped surfaces, light gray (10YR 7/2, dry); moderate, fine, prismatic structure breaking to strong, medium, angular blocky; thin, continuous clay skins; iron and manganese concretions; very few pinholes; pH 5.4; gradual boundary.

B_{31} 28 to 37 inches, dark yellowish-brown (10YR 4/4, moist) and grayish-brown (2.5Y 5/2, moist), heavy silty clay loam; when crushed, yellowish brown (10YR 5/5, moist); when dry, very hard; common, medium, faint mottles of yellowish brown (10YR 5/4, moist) and few, fine, prominent mottles of strong brown (7.5YR 5/6, moist); ped surfaces, light gray (10YR 7/2, dry); moderate, fine, prismatic structure breaking to strong, medium, angular blocky; thin clay skins; iron and manganese concretions; pinholes; gradual boundary.

B_{32} 37 to 52 inches, grayish-brown (2.5Y 5/2, moist), medium silty clay loam; when crushed, yellowish brown (10YR 5/5, moist); when dry, very hard; many, fine, distinct mottles of yellowish brown (10YR 5/4, moist) and common, fine, prominent mottles of strong brown (7.5YR 5/6, moist); massive ranging to weak, medium, subangular blocky; iron and manganese concretions; pinholes; diffuse boundary.

C_1 52 to 60 inches, dark-brown (7.5YR 4/4, moist) and light brownish-gray (2.5Y 6/2, moist), light silty clay loam; when dry, very hard; many, fine, distinct mottles of yellowish brown (10YR 5/4, moist) and many, fine, prominent mottles of strong brown (7.5YR 5/6, moist); massive; iron and manganese concretions; numerous pinholes; pH 5.5.

Range in characteristics.—The A_1 horizon is very dark gray (10YR 3/1, moist) to dark grayish brown (10YR 4/2, moist). Unless severely eroded, it is 3 to 8 inches thick. In many cultivated areas, it is mixed with the A_2 horizon and is light brownish gray (10YR 6/2, moist) to dark grayish brown (10YR 4/2, moist). The content of clay in the B horizon is about 45 to 50 percent.

Weller silt loam, 2 to 5 percent slopes (WrB).—This is an imperfectly drained, upland soil. Included with it are areas of the Adair and Clarinda soils, and of the Beckwith soils, that could not be mapped separately.

Plant nutrients and organic matter in this soil tend to be low. Productivity is also low, but the soil is generally used for cultivated crops. Fertilizers are needed for best yields. The subsoil is firm to very firm, slowly permeable silty clay, which restricts the downward movement of water. Runoff is rapid, and tillage should be on the contour. The surface soil tends to seal during rains, and it becomes hard and crusty on drying. Wetness may delay fieldwork. At the proper moisture content, the soil is friable and easily worked. (Capability subclass IIIe, managment group 10.)

Weller silt loam, 2 to 5 percent slopes, moderately eroded (WrB2).—This soil has a surface layer only 3 to 6 inches thick. Included with it are areas of the Adair and Clarinda soils and of the Beckwith soils.

This soil is on gentle slopes but is of limited value for row crops. Yields are low. The subsoil is slowly to very slowly permeable silty clay. Runoff is rapid, so all tillage should be on the contour to control erosion. The surface soil tends to seal during rains, and it becomes hard and crusty on drying. Under favorable moisture conditions, it is friable and easily worked. The soil is best suited to hay and pasture, but high forage yields require the use of fertilizer. (Capability subclass IIIe, management group 10.)

Weller silt loam, 5 to 9 percent slopes (WrC).—This moderately well drained soil is low in fertility. Included with it are small areas of the Adair and Lindley soils.

The subsoil is firm, slowly permeable silty clay, which restricts the movement of air and water. Runoff is rapid, so all tillage should be on the contour. Wetness may delay fieldwork at times. Row crops should be grown only on terraced fields. Fertilizers are needed for best yields. The best use is for hay or pasture. (Capability subclass IIIe, management group 11.)

Weller silt loam, 5 to 9 percent slopes, moderately eroded (WrC2).—This moderately well drained to imperfectly drained soil has a surface layer only 3 to 6 inches thick and the subsoil is exposed in a few places. Included with it are small areas of the Adair and Lindley soils.

The soil is on upland slopes and is low in fertility. Yields of corn and soybeans are low. The subsoil is firm to very firm, slowly permeable silty clay. Runoff is rapid, so all tillage should be on the contour. The soil is best suited to hay and pasture, but fertilizers are needed for good yields. (Capability subclass IIIe, management group 11.)

Weller soils, 5 to 9 percent slopes, severely eroded (WsC3).—The surface layer of these soils is less than 3 inches thick. Tillage has exposed the subsoil or mixed it with the surface soil. Where subsoil has been mixed with the original surface layer, the texture of the present surface layer is silty clay loam. A few small areas of Adair and Lindley soils are included.

This mapping unit is on moderate upland slopes. It is moderately well drained to imperfectly drained and very low in fertility. Yields of corn and soybeans are very low. The best use is for hay or pasture. Fertilizers are needed for best forage yields. Forage plants are hard to establish because clay in the surface soil makes the preparation of a proper seedbed difficult. (Capability subclass IVe, management group 19.)

Weller silt loam, bench position, 2 to 5 percent slopes (WtB).—This imperfectly drained soil is on bench terraces between the uplands and bottom lands. It is low in fertility and only moderately productive, but it is generally used for cultivated crops. Applications of fertilizer are generally needed for best yields. The subsoil is firm to very firm, slowly permeable silty clay. Runoff is rapid, so all tillage should be on the contour to prevent erosion. The surface soil tends to seal during rains, and it hardens and clods on drying. If moisture is favorable, it is friable and easily worked. (Capability subclass IIIe, management group 10.)

Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded (WtB2).—This imperfectly drained soil has a silt loam surface layer that is only 3 to 6 inches thick. It is on gentle slopes of bench terraces between the uplands and bottom lands. It tends to be low in plant nutrients and organic matter but is generally used for cultivated crops. Heavy applications of fertilizer are generally needed for good yields. The subsoil is firm to very firm, slowly permeable silty clay. Runoff is rapid. All tillage should be on the contour to prevent erosion. The surface soil tends to seal during rains, and it hardens and crusts on drying. If moisture is favorable, it is friable and easily worked. (Capability subclass IIIe, management group 10.)

Weller silt loam, bench position, 5 to 9 percent slopes (WtC).—This moderately well drained soil occupies bench terraces. It is low in productivity and tends to be low in plant nutrients and organic matter. It is generally used for cultivated crops, but heavy applications of fertilizers are needed for good yields. The subsoil is firm to very firm, slowly permeable silty clay, which restricts the movement of air and water. Runoff is rapid. All tillage should be on the contour to control erosion. The surface soil tends to seal during rains, and it hardens and crusts on drying. At times wetness may delay fieldwork. If moisture is right, the soil is friable and easy to work. The best use is for hay or pasture. (Capability subclass IIIe, management group 11.)

Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded (WtC2).—This moderately well drained to imperfectly drained soil has a silt loam surface layer that is only 3 to 6 inches thick. In a few places, subsoil has been mixed with the plow layer. The soil occupies moderate slopes of bench terraces. It tends to be low in fertility. Yields of crops are low. The subsoil is slowly permeable and runoff is rapid; all tillage should be along the contour. The best use is for hay or pasture, but fertilizer is needed for good yields. (Capability subclass IIIe, management group 11.)

Weller soils, bench position, 5 to 9 percent slopes, severely eroded (WvC3).—In some places these moderately well drained to imperfectly drained soils have a silt loam surface layer, less than 3 inches thick, that has been mixed with subsoil during tillage. In most places, however, the subsoil is exposed and the surface layer is now a silty clay loam.

This mapping unit is on moderately sloping bench terraces. The subsoil is slowly permeable; runoff is rapid. All tillage should be on the contour. It is difficult to work the soil and to prepare a good seedbed. Yields of grain are very low. These soils are best for hay or pasture, but applications of fertilizer are needed for good forage yields. (Capability subclass IVe, management group 19.)

Use and Management of the Soils

This section deals with soil management and farm planning. It discusses soil characteristics in relation to management and describes several management practices that are important in the proper handling of Van Buren County soils. Suggestions on planning a farm are included.

Many soils have similar characteristics, similar management problems, and require about the same practices and cropping systems. For convenience, they can be discussed in management groups. The management groups in Van Buren County, which fit into the capability classification, are described.

Soil Characteristics That Affect Management

Proper management requires a basic knowledge of soil characteristics and their effect on productivity. With this information, an effective program of erosion control, drainage improvement, cropping systems, and fertilization can be selected to suit the soils on individual farms. Some of the major characteristics of soils in Van Buren County are given in table 2.

Drainage and permeability

Soil drainage has an important effect on crop yields. Plants growing in well-drained soils can develop deep, well-balanced root systems and obtain plant nutrients more readily. They are capable of producing good yields if management is good. Plants on poorly drained soils tend to develop shallow root systems, which cannot obtain enough nutrients for growth. Planting and cultivation are generally delayed by wetness. Weeds are more difficult to control, and crop yields are usually low.

Permeability affects soil drainage, and it influences the rate of runoff and of erosion. Level, poorly drained soils that are moderately permeable or moderately slowly permeable can be drained by tile systems if outlets are available. Level, poorly drained soils that are very slowly permeable should be drained by open ditches or surface drains because tile drains generally do not function efficiently. Slowly permeable soils absorb water more slowly than rapidly permeable soils. Moderately permeable soils are most desirable. Level soils are more difficult to drain than sloping soils; the latter have faster runoff and are subject to more erosion.

The drainage and permeability classification of the soils are defined in the Glossary at the end of the report.

Texture

Soil texture affects the water-holding capacity, the permeability to air, water, and roots, and the ease with which a soil can be cultivated. Texture must be considered in deciding what kinds of crops to grow and what drainage and erosion control practices to use.

Silt loams and loams are the most desirable soil textures. Clay restricts the movement of air and water and is difficult to work. Sand does not have good water-holding capacity and may be droughty. The texture of a soil is seldom the same for all layers. Consequently, the characteristics of each layer must be considered in determining the management or productive capacity of a soil. The texture of the surface layer determines the name of a soil type. Thus, Grundy silty clay loam refers only to the surface soil and not to any of the other layers.

Organic matter

Organic matter in the soil is usually related to the color of the soil and the amount of nitrogen. Dark-colored surface soils generally contain more organic matter, and have more nitrogen than the lighter colored surface soils. Organic matter in the form of crop residues or manure should be returned to the soil whenever possible. This practice tends to improve the tilth and workability of the soil, reduce erosion, and increase the infiltration of water.

Slope

Runoff and erosion increase as the slope increases. Therefore, slope is an important characteristic that determines what erosion control practice and cropping system ought to be used. Soils on slopes of more than 2 percent are usually subject to erosion when cultivated or overgrazed. Erosion losses are greater from soils that have no cover of growing vegetation. Cropping systems for the more steeply sloping soils should provide for a higher percentage of grass and legumes than those for the level or nearly level soils.

Practices of Good Soil Management

Cropping systems

A suitable cropping system varies with the needs of the farmer and of the soil. Producers of livestock, for example, generally use cropping systems that have a higher percentage of hay and meadow than those having a cash-grain type of farming. The suggested management of all soils in Van Buren County is given in the subsection "Management by Groups of Soils" and in table 3.

The use of the suggested cropping systems and supporting practices will give the best crop yields over the years. At the same time these practices will maintain soil productivity, control losses from erosion, and provide for the maximum feasible acreage of row crops.

The choice of a cropping system depends on the slope, drainage, permeability, content of organic matter, fertility, and productivity of the soil. In addition, the type of farming, the drainage and erosion control practices used by the operator, his financial resources and skill in management, and the economic conditions of the times must be considered.

Control of erosion

All of the sloping soils in Van Buren County are subject to erosion. Sheet erosion causes the loss of surface soil that generally contains the largest supply of organic matter and plant nutrients. Gully erosion forms ditches and gullies that advance up the slope. Some severely gullied areas in the county are no longer suitable for cropland.

Soil material washed from uplands generally fills ponds and drainage and road ditches and is deposited as alluvium on fertile bottom lands. Erosion causes loss in fertility, lower crop yields, and higher production costs. It can be controlled or reduced to a safe minimum through the use of various erosion control practices. Field terraces, diversion terraces, contour cultivation and stripcropping, and the use of sod crops help to prevent water erosion. Mulch tillage and winter cover crops help to reduce wind erosion.

Various combinations of cropping systems and conservation practices can be used to control erosion. For example, soil erosion losses can be held to a safe minimum on Grundy silty clay loam, 5 to 9 percent slopes, by one of the following combinations of cropping systems and supporting practices:

(a) Meadow 4 years, corn 1 year, and oats 1 year.
(b) Meadow 2 years, corn 1 year, and oats 1 year if tillage is on the contour.
(c) Meadow 1 year, corn 2 years, and oats 1 year if fields are terraced.

Operators who want to grow mostly row crops should terrace the soils that are suitable and perform the tillage operations on the contour. This will help protect the soils from excessive erosion.

Fertilizers and lime

This report gives only general information on fertilizer and lime needs. A detailed recommendation should be based on laboratory analysis of a soil sample. The amounts of fertilizer and lime needed depend upon the results of the soil test, the crops to be grown, the past cropping history, and the level of yield desired, as well as on the soil type.

Soil samples for laboratory testing should consist of a single soil type. The soil map is a good guide for taking soil samples. Each sample should represent no more than 10 acres. The county extension director can supply detailed information and instructions regarding soil sampling for fertilizer tests.

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TABLE 2.—*Major characteristics of*

Soil	Topographic position	Parent material	Native vegetation	Content of organic matter
Adair and Clarinda soils, 5 to 9 percent slopes	Upland	Till	Trees and grass	Medium
Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded.	Upland	Till	Trees and grass	Medium
Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded.	Upland	Till	Trees and grass	Low
Adair and Clarinda soils, 9 to 14 percent slopes.	Upland	Till	Trees and grass	Medium
Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded.	Upland	Till	Trees and grass	Low
Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded.	Upland	Till	Trees and grass	Low
Beckwith silt loam	Upland	Loess	Trees	Low
Beckwith silt loam, bench position	Bench	Loess	Trees	Low
Belinda silt loam	Upland	Loess	Grass and trees	Medium to low
Belinda silt loam, bench position	Bench	Loess	Grass and trees	Medium to low
Carlow silty clay loam	Bottom land	Alluvium	Grass	Medium
Carlow silty clay loam, overwashed	Bottom land	Alluvium	Grass	Medium
Chariton silt loam	Bottom land	Alluvium	Grass	High
Chequest silty clay loam	Bottom land	Alluvium	Trees	Medium
Clinton silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess or alluvium	Trees	Low
Clinton silt loam, bench position, 5 to 9 percent slopes.	Bench	Loess	Trees	Low
Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	Bench	Loess	Trees	Low
Clinton silt loam, bench position, 9 to 14 percent slopes.	Bench	Loess	Trees	Low
Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded.	Bench	Loess	Trees	Low
Clinton silt loam, 5 to 9 percent slopes	Upland	Loess	Trees	Low
Clinton silt loam, 5 to 9 percent slopes, moderately eroded.	Upland	Loess	Trees	Low
Clinton silt loam, 9 to 14 percent slopes	Upland	Loess	Trees	Low
Clinton silt loam, 9 to 14 percent slopes, moderately eroded.	Upland	Loess	Trees	Low
Colo silty clay loam	Bottom land	Alluvium	Grass	High
Colo-Gravity-Olmitz complex	Narrow bottom land	Alluvium	Grass	High
Coppock silt loam, 0 to 2 percent slopes	Foot slopes and bottom land.	Alluvium	Grass and trees	Medium to low
Coppock silt loam, 2 to 5 percent slopes	Foot slopes and bottom land.	Alluvium	Grass and trees	Medium to low
Coppock soils, sandy overwash, 0 to 2 percent slopes.	Foot slopes and bottom land.	Alluvium	Grass and trees	Medium to low
Coppock soils, sandy overwash, 2 to 5 percent slopes.	Foot slopes and bottom land.	Alluvium	Grass and trees	Medium to low
Dickinson sandy loam, bench position, 0 to 2 percent slopes.	Bottom land and terraces.	Alluvium	Grass	Medium
Dickinson sandy loam, bench position, 2 to 5 percent slopes.	Bottom land and terraces.	Alluvium	Grass	Medium
Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded.	Bottom land	Alluvium	Grass	Medium
Douds soils and Terrace escarpments	Terrace escarpment	Sandy alluvium	Trees	Low
Downs silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess	Trees and grass	Medium
Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	Bench	Loess	Trees and grass	Low to medium
Downs and Lamont soils, bench position, 9 to 14 percent slopes.	Bench	Loess and eolian sand	Trees	Low
Edina silt loam	Upland	Loess	Grass	Medium
Givin silt loam, bench position, 2 to 6 percent slopes.	Bench	Loess	Grass and trees	Medium
Givin silt loam, 2 to 6 percent slopes	Upland	Loess	Grass and trees	Medium
Gosport silt loam, 9 to 14 percent slopes, moderately eroded.	Upland	Shale	Trees	Low

See footnotes at end of table.

soils in Van Buren County

Natural drainage [1]	Reaction	A1 horizon		Subsoil	
		Color	Range in thickness	Dominant texture	Permeability
			Inches		
Poor to moderately good.	Very strongly acid	Moderately dark	6–14	Silty clay	Very slow.
Poor to moderately good.	Very strongly acid	Moderately dark	3–6	Silty clay	Very slow.
Poor to moderately good.	Very strongly acid	Moderately light	0–3	Silty clay	Very slow.
Moderately good	Very strongly acid	Moderately dark	6–12	Silty clay, clay, or clay loam.	Slow to very slow.
Moderately good	Very strongly acid	Moderately dark	3–6	Clay loam, silty clay, or clay.	Slow to very slow.
Moderately good	Very strongly acid	Moderately light	0–3	Clay loam, silty clay, or clay.	Slow to very slow.
Poor	Strongly acid	Light	4–8	Silty clay	Very slow.
Poor	Very strongly acid	Light	4–8	Silty clay	Very slow.
Poor	Strongly acid	Moderately light	5–10	Silty clay	Very slow.
Poor	Strongly to very strongly acid.	Moderately light	5–10	Silty clay	Very slow.
Very poor	Strongly acid	Moderately dark	8–14	Silty clay or clay	Very slow.
Very poor	Strongly acid	Light	6–16	Silty clay or clay	Very slow.
Poor	Strongly acid	Dark	6–15	Silty clay loam to silty clay.	Slow.
Poor	Very strongly acid	Moderately dark	12–20	Silty clay loam	Moderately slow.
Moderately good to good.	Moderately acid	Light	12–18	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	6–10	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	3–6	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	6–12	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	3–6	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	6–10	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	3–6	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	6–10	Silty clay loam	Moderately slow.
Good	Strongly acid	Light	3–6	Silty clay loam	Moderately slow.
Imperfect to poor	Slightly acid	Dark	12–24	Silty clay loam	Moderately slow.
Moderately good to poor.	Moderately acid	Dark to moderately dark.	24–36	Silt loam or silty clay loam.	Moderately slow.
Imperfect to poor	Strongly acid	Moderately dark	8–16	Heavy silt loam to silty clay loam.	Moderate.
Imperfect to poor	Very strongly acid	Moderately dark	8–16	Silty clay loam	Moderate.
Imperfect	Moderately acid	Light	10–24	Loam to sandy clay loam, silty clay loam.	Rapid to moderate.
Imperfect	Moderately acid	Light	10–24	Loam to sandy clay loam, silty clay loam.	Rapid to slow.
Good	Slightly acid	Moderately dark	12–24	Loam to sandy clay loam.	Moderately rapid.
Good	Slightly acid	Moderately dark	10–18	Sandy loam to sandy clay loam.	Moderately rapid.
Good to somewhat excessive.	Slightly acid	Moderately dark	3–6	Sandy loam to sandy clay loam.	Moderately rapid.
Moderately good to somewhat excessive.	Strongly acid	Light	2–9	Variable	Moderately rapid to slow.
Good to moderately good.	Slightly acid	Moderately light	3–10	Silty clay loam	Moderate.
Good	Slightly acid	Moderately light	3–8	Silty clay loam	Moderate.
Good to somewhat excessive.	Slightly acid	Moderately light	3–10	Sandy loam to silty clay loam.	Moderate to moderately rapid.
Poor	Moderately acid	Moderately dark	6–12	Silty clay	Very slow.
Imperfect	Strongly acid	Moderately light	6–10	Silty clay loam	Moderately slow.
Imperfect	Strongly acid	Moderately light	6–10	Silty clay loam	Moderately slow.
Moderately good	Strongly to very strongly acid.	Light	3–8	Clay	Very slow.

TABLE 2.—*Major characteristics of soils*

Soil	Topographic position	Parent material	Native vegetation	Content of organic matter
Gosport silt loam, 14 to 18 percent slopes, moderately eroded.	Upland	Shale	Trees	Low
Gosport silt loam, 18 to 40 percent slopes, moderately eroded.	Upland	Shale	Trees	Low
Gosport soils, 9 to 14 percent slopes, severely eroded.	Upland	Shale	Trees	Low
Gosport soils, 14 to 18 percent slopes, severely eroded.	Upland	Shale	Trees	Low
Gravity silty clay loam, 2 to 5 percent slopes	Foot slopes	Alluvium	Grass	High
Grundy silty clay loam, 2 to 5 percent slopes	Upland	Loess	Grass	High
Grundy silty clay loam, 5 to 9 percent slopes	Upland	Loess	Grass	High
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded.	Upland	Loess	Grass	Medium
Grundy silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess	Grass	High
Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	Bench	Loess	Grass	Medium
Haig silty clay loam	Upland	Loess	Grass	High
Haig silty clay loam, fine textured	Upland	Loess	Grass	High
Keomah silt loam, 2 to 5 percent slopes	Upland	Loess	Trees	Low
Keomah silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess	Trees	Low
Landes soils	Bottom land	Alluvium	Trees	Low
Lindley loam, 14 to 18 percent slopes, moderately eroded.	Upland	Till	Trees	Low
Lindley loam, 18 to 25 percent slopes, moderately eroded.	Upland	Till	Trees	Low
Lindley loam, 25 to 40 percent slopes, moderately eroded.	Upland	Till	Trees	Low
Lindley soils, 14 to 18 percent slopes, severely eroded.	Upland	Till	Trees	Low
Lindley soils, 18 to 25 percent slopes, severely eroded.	Upland	Till	Trees	Low
Nodaway-Coppock complex	Along streams and drainageways.	Alluvium	Trees	Medium
Nodaway-Coppock complex, flaggy	Along streams and drainageways.	Alluvium	Trees	Medium
Nodaway silt loam	Bottom land	Alluvium	Trees	Medium to low
Nodaway silt loam, silty clay substratum	Bottom land	Alluvium	Trees and grass	Medium
Olmitz loam, 2 to 5 percent slopes	Foot slopes	Alluvium	Grass	High
Olmitz and Gravity soils, 2 to 5 percent slopes	Foot slopes or along streams and drainageways.	Alluvium	Grass	High
Perks and Hagener soils, 0 to 2 percent slopes	Bottom land	Alluvium	Grass and trees	Low
Perks and Hagener soils, 2 to 5 percent slopes	Bottom land	Alluvium	Grass and trees	Low
Pershing silt loam, 2 to 5 percent slopes	Upland	Loess	Grass and trees	Medium
Pershing silt loam, 5 to 9 percent slopes	Upland	Loess	Grass and trees	Medium
Pershing silt loam, 5 to 9 percent slopes, moderately eroded.	Upland	Loess	Grass and trees	Medium
Pershing soils, 5 to 9 percent slopes, severely eroded.	Upland	Loess	Grass and trees	Low
Pershing silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess	Grass and trees	Medium
Pershing silt loam, bench position, 5 to 9 percent slopes.	Bench	Loess	Grass and trees	Medium
Rubio silt loam, bench position	Bench	Loess	Grass and trees	Medium
Rushville silt loam, bench position	Bench	Loess	Trees	Low
Seymour silt loam, 2 to 5 percent slopes	Upland	Loess	Grass	High
Seymour silt loam, 5 to 9 percent slopes, moderately eroded.	Upland	Loess	Grass	Medium

See footnotes at end of table.

in Van Buren County—Continued

Natural drainage [1]	Reaction	A_1 horizon		Subsoil	
		Color	Range in thickness	Dominant texture	Permeability
			Inches		
Moderately good	Strongly to very strongly acid.	Light	3–8	Clay	Very slow.
Moderately good	Strongly to very strongly acid.	Light	3–6	Clay	Very slow.
Moderately good	Strongly to very strongly acid.	Light	0–3	Clay	Very slow.
Moderately good	Strongly to very strongly acid.	Light	0–3	Clay	Very slow.
Imperfect to poor	Moderately acid	Dark	10–24	Silty clay loam to light silty clay.	Moderately slow.
Imperfect	Moderately acid	Dark	8–14	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Dark	6–12	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Moderately dark	3–6	Silty clay	Slow.
Imperfect to moderately good.	Moderately acid	Dark	8–14	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Moderately dark	3–6	Silty clay	Slow.
Poor	Slightly acid	Dark	12–18	Silty clay	Slow.
Poor	Slightly acid	Dark	14–24	Silty clay to clay	Slow.
Imperfect	Very strongly acid	Light	6–10	Silty clay loam	Moderately slow.
Imperfect	Very strongly acid	Light	6–10	Silty clay loam	Moderately slow.
Good to excessive	Slightly acid	Moderately dark to light.	(2)	Variable	Rapid.
Moderately good	Strongly acid	Light	3–8	Clay loam to clay	Moderately slow.
Moderately good to good.	Strongly acid	Light	3–8	Clay loam	Moderately slow.
Moderately good to good.	Strongly acid	Light	3–8	Clay loam	Moderately slow.
Moderately good to good.	Strongly acid	Light	0–3	Clay loam to clay	Moderately slow.
Moderately good to good.	Strongly acid	Light	0–3	Clay loam	Moderately slow.
Good to imperfect	Moderately acid	Moderately dark to light.	15–24	Silt loam to silty clay loam.	Moderate to slow.
Moderately good to imperfect.	Moderately acid	Moderately dark to light.	(2)	Loam, silty clay loam, clay loam.	Moderate.
Good to moderately good.	Moderately acid	Moderately dark to light.	12–24	Silt loam or loam	Moderate.
Imperfect to poor	Moderately acid	Moderately dark to light.	18–36	Silty clay or clay	Slow.
Moderately good	Moderately acid	Dark	18–30	Loam to clay loam	Moderate.
Poor to moderately good.	Moderately acid	Dark	15–24	Loam, clay loam, silty clay loam.	Moderate to moderately slow.
Excessive	Moderately acid	Light to moderately dark.	(2)	Sand	Very rapid.
Excessive	Moderately acid	Light to moderately dark.	(2)	Sand	Very rapid.
Imperfect	Moderately acid	Moderately dark	6–12	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Moderately dark	6–10	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Moderately dark	3–6	Silty clay	Slow.
Moderately good to imperfect.	Moderately acid	Light	0–3	Silty clay	Slow.
Imperfect	Slightly acid	Moderately dark	6–12	Silty clay	Slow.
Moderately good to imperfect.	Slightly acid	Moderately dark	6–8	Silty clay	Slow.
Poor	Strongly acid	Moderately dark	7–11	Silty clay	Slow to very slow.
Poor	Strongly acid	Light	6–10	Silty clay	Very slow.
Imperfect	Strongly acid	Moderately dark	6–14	Clay or silty clay	Very slow.
Moderately good to imperfect.	Strongly acid	Moderately dark	3–6	Silty clay or clay	Very slow.

TABLE 2.—*Major characteristics of soils*

Soil	Topographic position	Parent material	Native vegetation	Content of organic matter
Seymour soils, 5 to 9 percent slopes, severely eroded.	Upland	Loess	Grass	Low
Shelby loam, 14 to 18 percent slopes, moderately eroded.	Upland	Till	Grass	Medium
Shelby loam, 18 to 25 percent slopes, moderately eroded.	Upland	Till	Grass	Medium
Shelby soils, 14 to 18 percent slopes, severely eroded.	Upland	Till	Grass	Low
Shelby soils, 18 to 25 percent slopes, severely eroded.	Upland	Till	Grass	Low
Steep sandy land	Upland	Eolian sand	Trees	Low
Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes.	Upland	Loess, till, limestone or shale.	Trees	Low
Wabash silty clay loam	Bottom land	Alluvium	Grass	High
Wabash silty clay loam, overwashed	Bottom land	Alluvium	Grass	High
Waukegan loam, deep, 0 to 2 percent slopes	Terrace	Alluvium	Grass	High
Waukegan loam, deep, 2 to 5 percent slopes	Terrace	Alluvium	Grass	High
Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded	Terrace	Alluvium	Grass	High
Waukegan loam, moderately deep, 0 to 3 percent slopes	Terrace	Alluvium	Grass	High
Waukegan loam, moderately deep, 3 to 6 percent slopes.	Terrace	Alluvium	Grass	High
Weller silt loam, 2 to 5 percent slopes	Upland	Loess	Trees	Low
Weller silt loam, 2 to 5 percent slopes, moderately eroded.	Upland	Loess	Trees	Low
Weller silt loam, 5 to 9 percent slopes	Upland	Loess	Trees	Low
Weller silt loam, 5 to 9 percent slopes, moderately eroded.	Upland	Loess	Trees	Low
Weller soils, 5 to 9 percent slopes, severely eroded.	Upland	Loess	Trees	Low
Weller silt loam, bench position, 2 to 5 percent slopes.	Bench	Loess	Trees	Low
Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded.	Bench	Loess	Trees	Low
Weller silt loam, bench position, 5 to 9 percent slopes.	Bench	Loess	Trees	Low
Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	Bench	Loess	Trees	Low
Weller soils, bench position, 5 to 9 percent slopes, severely eroded.	Bench	Loess	Trees	Low

[1] Soils with good drainage are well drained soils; soils with moderately good drainage are moderately well drained soils.

The soil-test summary for Van Buren County over a 6-year period shows that nearly 87 percent of the soil samples were low or very low in available nitrogen, 84 percent were low or very low in available phosphorus, and 69 percent were low or very low in available potassium. More than 75 percent of the samples needed lime in varying amounts.

Extra nitrogen is needed to produce satisfactory yields of corn on most Van Buren County soils unless the crop follows a legume sod, a green-manure crop, or the application of manure. Extra nitrogen may be applied to the soil late in fall or in spring. Nitrogen is equally satisfactory on corn if (1) broadcast and plowed under, (2) disked in, or (3) applied as a side dressing as late as the second cultivation, provided weeds are adequately controlled. All nitrogen fertilizers are of comparable value when properly applied.

Phosphate for corn on the Grundy, Pershing, Edina, Belinda, and Haig soils generally can be applied with a hill or row fertilizer. On the Weller, Shelby, Clinton, Downs, Keomah, Beckwith, Rushville, Rubio, and the Adair and Clarinda soils, extra phosphate, in addition to that applied in the hills or rows, should be plowed down in fall or spring.

In this county, proper liming is of primary importance in a good soil management program.

The bottom-land soils need differing quantities of fertilizer, and general suggestions are difficult to give for any crop. Specific nutrient needs can be determined through laboratory tests of the soils.

Pasture management

In 1950, 20.7 percent of all farmland was open, permanent pasture, 18.3 percent was woodland pasture, and 10.1 percent was pasture on cropland.

This large acreage in pasture is an important potential resource. At the present time, however, most permanent *in Van Buren County*—Continued

Natural drainage [1]	Reaction	A₁ horizon: Color	A₁ horizon: Range in thickness	Subsoil: Dominant texture	Subsoil: Permeability
			Inches		
Moderately good to imperfect.	Strongly acid	Moderately light	0–3	Silty clay or clay	Very slow.
Good	Moderately acid	Dark	3–9	Clay loam	Moderately slow.
Good	Moderately acid	Moderately dark	3–6	Clay loam	Moderately slow.
Good	Moderately acid	Moderately light	0–3	Clay loam	Moderately slow.
Good	Moderately acid	Moderately light	0–3	Clay loam	Moderately slow.
Good to excessive	Strongly acid	Light	6–12	Sandy loam	Very rapid.
Good	Moderately acid	Light to moderately light.	(2)	Variable	Moderate to very slow.
Poor to very poor	Very strongly acid	Dark	10–20	Silty clay to clay	Very slow.
Poor	Moderately acid	Light	6–16	Silty clay to clay	Very slow.
Good to moderately good.	Moderately acid	Dark	14–24	Silty clay loam	Moderate.
Good to moderately good.	Moderately acid	Dark	10–18	Silty clay loam	Moderate.
Good	Moderately acid	Dark	3–8	Silty clay loam	Moderate.
Excessive	Slightly acid	Dark	6–14	Loam	Rapid.
Excessive	Slightly acid	Dark	6–10	Loam	Rapid.
Imperfect	Strongly acid	Light	3–8	Silty clay	Slow.
Imperfect	Strongly acid	Light	3–6	Silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	3–8	Silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	3–6	Silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	0–3	Silty clay	Slow.
Imperfect	Strongly acid	Light	3–8	Light silty clay	Slow.
Imperfect	Strongly acid	Light	3–6	Light silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	3–8	Light silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	3–6	Light silty clay	Slow.
Moderately good to imperfect.	Strongly acid	Light	0–3	Light silty clay	Slow.

[2] Variable, depending on amount and character of recent alluvium or other parent material.

pastures do not produce as much forage as they should. Pastures usually occupy the poorest land on the farm, and many of them are on rough, infertile cropland. Soil erosion, declining fertility, and poor management are the causes of low pasture production.

Brush and low-grade timber cover many acres that are grazed (fig. 5). The development of productive pastures on this kind of land requires the removal of brush and trees. This operation is expensive, and the longer the job is delayed, the greater will be the cost.

Bluegrass pastures not covered by brush and trees have produced about 100 pounds of beef per acre according to long-time Iowa grazing trials. The production is much lower in pastures covered by brush and trees. Such pastures do not produce cheap forage, if fences, taxes, land, and other costs are considered.

Pastures can be improved by proper management, control of undesirable vegetation, the application of lime and fertilizer, reseeding on undisturbed grass sod, renovation, and combinations of these practices. All of these may improve production under some conditions, but renovation is the most dependable.

Renovation considers all major factors affecting plant growth because it includes liming and fertilizing according to soil needs, preparing a seedbed, and seeding pasture legumes that are suitable for the soil and climate. Birdsfoot trefoil is one of the most dependable legumes for permanent pastures in Van Buren County. It grows on wet land and will survive long periods of continuous grazing. Practices for improving pastures are often disappointing because of limiting factors. For example, nitrogen usually is the first need of grass pastures, whereas lime and phosphate are nearly always required before legumes can be established satisfactorily. Providing the fertilizer but neglecting other management is not the proper method of improving pastures.

Renovated pastures have produced about two and one-half times as much beef per acre as unimproved, open,

Figure 5.—**Brush and trees invading pasture on Lindley loam.**

permanent pastures, according to long-time studies in Monroe and Ringgold Counties, Iowa. Renovation costs may range from $25 to $40 or more per acre, depending on the need for essential material. These costs should be distributed over the productive life of the improved pasture.

Favorable results can be expected from proper grazing of pastures. The beneficial effects of protecting pastures have been demonstrated. Grazing should not be allowed in winter or in spring until about the first week in May; close grazing should not be allowed late in September or in October. With careful planning, winter rye can be depended upon for grazing late in April. In fall, when permanent pastures should be protected, rotation and supplemental pastures can be grazed.

Productive pastures are the result of careful planning, sound culture, and good management. Improved permanent pastures, rotation pastures on cropland, and supplemental pastures should have combined use to obtain full-season grazing.

Planning the farm

After the different soil types of a farm have been identified and the requirements of good soil management have been noted, the operator may want to plan a more efficient program of land use on his farm. Information on soil fertility, crop varieties, soil conserving practices, and livestock management can be obtained from the county extension director. Technical assistance in preparation of conservation farm plans and in the layout of terraces, contour lines, drainage, and gully control practices can be obtained from the Soil Conservation Service through the Van Buren County Soil Conservation District.

Many fields, especially those in rolling terrain, contain two or more soils that need different management and different cropping systems. If one of the soil areas is very small, it may have to be farmed like the rest of the field. In some cases one rotation is suitable for the entire farm, but supporting practices, such as contouring, terracing, or drainage, may be different for each kind of soil. Some soil areas may be large enough to permit the use of a separate cropping system, or field boundaries can be rearranged so as to group similar soils and farm them according to their suitabilities. Usually more than one field arrangement and cropping system can be worked out to suit the operator of a given farm.

A farm plan should include consideration of cropping systems, erosion control, drainage, fertilizer and lime requirements, crops and expected yields, soil capability, and type of livestock program. If erosion is the major problem, then erosion control measures should be applied first. If meadows are to be established, soil tests need to be made to determine fertilizer and lime requirements before seeding. If contouring is established on first-year corn after meadow, headlands and waterways can be left unplowed and be safe from erosion.

In the past 15 years, many farmers in Van Buren County have changed from cropping uphill and downhill to cropping along the contour. Some of the benefits of this management are increased yields, less runoff and erosion, and more intake of rainfall.

Land Capability Classification

The capability classification is a grouping of soils that shows, in a general way, how suitable they 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. The eight capability classes in the broadest grouping 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, grazing, or wood products. Van Buren County has no class VIII land.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a 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*, 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 have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are called management groups. There are groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management.

Thus, the management group is a convenient grouping of soils for many statements about their management.

Soils are classified in capability classes and subclasses and management groups 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 seven capability classes, the subclasses, and the management groups in this county are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.
- (No subclasses.)
  - Management group 1.—Well-drained, nearly level bottom-land and terrace soils.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils that have a moderate risk of erosion if they are not protected.
  - Management group 2.—Dark-colored, moderately well drained to imperfectly drained, highly productive soils on gentle slopes.
  - Management group 3.—Light to moderately dark colored, gently sloping soils in which erosion is a problem.
  - Management group 4.—Dark-colored, imperfectly drained, gently sloping upland soils that are subject to sheet and gully erosion.
- Subclass IIs. Soils that have moderate limitations of moisture-holding capacity or tilth.
  - Management group 5.—Moderately dark colored bench-position soils.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Management group 6.—Dark-colored, poorly drained to very poorly drained soils on upland flats.
  - Management group 7.—Level to gently sloping bottom-land soils.
  - Management group 8.—Poorly to very poorly drained, level soils.

Class III. Soils that have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- Subclass IIIe. Soils that have a severe risk of erosion if they are cultivated and not protected.
  - Management group 9.—Well-drained, moderately to strongly sloping soils that are subject to sheet and gully erosion.
  - Management group 10.—Gently sloping soils that are low in fertility.
  - Management group 11.—Moderately sloping soils that are low in fertility and subject to severe sheet and gully erosion.
  - Management group 12.—Moderately sloping soils that are subject to severe sheet and gully erosion.
- Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.
  - Management group 13.—Nearly level to moderately sloping soils that are somewhat droughty.
  - Management group 14.—Moderately light colored, excessively drained, sandy soils.
- Subclass IIIw. Soils that have severe limitations because of excess water.
  - Management group 15.—Poorly drained to very poorly drained bottom-land soils.
  - Management group 16.—Dark-colored, wet or seepy, moderately sloping upland soils that have formed in glacial till.
  - Management group 17.—Light-colored, poorly drained, level soils.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Subclass IVe. Soils that have a very severe risk of erosion if they are cultivated and not protected.
  - Management group 18.—Moderately dark colored, sloping to steep soils that are subject to severe sheet and gully erosion; generally not suitable for cultivation.
  - Management group 19.—Moderately sloping, severely eroded upland soils that are generally not suitable for cultivation.

Class V. Soils that have little or no erosion hazard, but have other limitations that are impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.
- Subclass Vs. Soils generally unsuitable for cultivation because of moisture capacity or tilth.
  - Management group 20.—Shallow, moderately light colored soils that are underlain by coarse gravel, limestone flags, or shale; unsuitable for cultivation.

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation and 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.
  - Management group 21.—Steep, well drained to moderately well drained soils that are subject to severe erosion.
- Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.
  - Management group 22.—Moderately well drained to excessively drained, sandy soils that are low in fertility.

Class VII. Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Management group 23.—Steep, severely eroded soils.
- Subclass VIIs. Soils severely limited by moisture capacity, stones, or other soil features.
  - Management group 24.—Steep to strongly sloping, light-colored, sandy, droughty soils that are subject to sheet, gully, and wind erosion.

Management by groups of soils

Soils in Van Buren County that have similar properties and need similar use and management have been placed in groups. This part of the report describes the management groups of soils in the county and suggests the drainage, fertilization, erosion control practices, and cropping systems that ought to be used for each group.

Table 3, in the subsection "Estimated Yields of Crops," shows the yields of crops that can be expected under a high level of management from the soils in the county. Yields vary with soil types and phases, but they are considered to be average yields if the stated cropping systems and supporting practices have been applied for as much as 5 to 10 years.

MANAGEMENT GROUP 1

Well-drained, nearly level bottom-land and terrace soils

Nodaway silt loam.
Waukegan loam, deep, 0 to 2 percent slopes.

These soils are in capability class I. The Waukegan soil occurs almost entirely on the terraces of the Des Moines River and is seldom flooded. The Nodaway soil is along all the streams in the county and is subject to some overflow. The soils in this management group are the most productive in the county. They tend to be low in available nitrogen and medium in available phosphorus and potassium. They have a high moisture-holding capacity and are friable and easy to work.

Use and management.—These soils are suitable for corn, grain sorghum, soybeans, oats, winter wheat, alfalfa, red clover, bromegrass, and other crops commonly grown in the county.

They do not erode and have no serious problems that limit their use for cultivated crops. They occur in many places in association with other bottom-land soils and are cropped like the surrounding soils. Where overflow is a problem, dikes, diversion terraces, or open-ditch drainage may be needed.

These soils respond well to fertilizer, and they usually need lime. High yields are obtained if fertilizer and lime are applied according to needs determined by soil tests. A cropping system consisting of row crops for 3 years followed by a small grain seeded with a legume for green manure is suitable on these soils if a high level of fertility is maintained.

MANAGEMENT GROUP 2

Dark-colored, moderately well drained to imperfectly drained, highly productive soils on gentle slopes

Olmitz loam, 2 to 5 percent slopes.
Olmitz and Gravity soils, 2 to 5 percent slopes.

These soils are in capability subclass IIe. They are at the bases of slopes between the uplands and bottom lands. They often receive runoff from the bordering slopes and sometimes are slightly wet in the spring because of seepage or overflow. Supplies of organic matter are high; those of available nitrogen are medium to low and those of available phosphorus and potassium are medium. The soils have a high moisture-holding capacity. Surface soils are friable loam or silt loam, and they are easy to work.

Use and management.—These soils are well suited to corn, soybeans, grain sorghum, oats, alfalfa, red clover, bromegrass, and other crops commonly grown in the county.

Diversion terraces may be needed to protect these soils from runoff and to divert runoff and seep water to suitable drainageways or ditches. Tile drains are seldom needed, but they work well if suitable outlets are obtained. These soils are subject to slight sheet erosion if intensively cultivated. Fields in row crops should be tilled on the contour wherever practical.

These soils usually need nitrogen for corn unless the crop follows a good stand of legumes. Lime and fertilizer should be applied according to needs determined by soil tests.

The soils in this group generally occur in small areas and are often cropped like the surrounding soils on adjacent bottom lands. A suitable cropping system consists of row crops 2 years, a small grain 1 year, and meadow.

MANAGEMENT GROUP 3

Light to moderately dark colored, gently sloping soils in which erosion is a problem

Clinton silt loam, bench position, 2 to 5 percent slopes.
Downs silt loam, bench position, 2 to 5 percent slopes.
Givin silt loam, 2 to 6 percent slopes.
Givin silt loam, bench position, 2 to 6 percent slopes.
Keomah silt loam, 2 to 5 percent slopes.
Keomah silt loam, bench position, 2 to 5 percent slopes.
Waukegan loam, deep, 2 to 5 percent slopes.

These soils are in capability subclass IIe. They occur on bench terraces and adjacent upland slopes along the Des Moines River. They range from moderately well drained to imperfectly drained. They are subject to some sheet erosion and wind erosion. Available nitrogen and phosphorus are low, and available potassium is medium. All soils have a high moisture-holding capacity and are friable and easy to work. The subsoils are moderately to moderately slowly permeable silty clay loam.

The Waukegan, Downs, and Givin soils are moderately dark colored and medium in supply of organic matter. The Clinton and Keomah soils are light colored and low in organic matter.

Use and management.—These soils produce moderate to high yields of corn, grain sorghum, soybeans, oats, alfalfa, red clover, bromegrass, and other crops commonly grown in this county. They are well suited to these crops. Fields in row crops should be tilled on the contour and all waterways should be maintained in permanent grass. Areas of these soils on bench terraces may need diversion terraces to control runoff from adjacent steeper upland slopes.

These soils respond well to fertilizers. They should be limed and fertilized according to needs determined by soil tests. Corn usually needs nitrogen if the crop does not follow a good stand of legumes.

If plowed in fall, these soils may be subject to wind erosion. Rough plowing and a litter of trash and stubble on the surface help prevent soil blowing after fall plowing.

A cropping system consisting of row crops for 2 years, oats 1 year, and meadow 1 year is suitable for these soils if tillage is on the contour and fertility is maintained. If fields are terraced and tilled on the contour, a cropping system consisting of row crops for 3 years, oats 1 year, and meadow 1 year can be safely used.

MANAGEMENT GROUP 4

Dark-colored, imperfectly drained, gently sloping upland soils that are subject to sheet and gully erosion

Grundy silty clay loam, 2 to 5 percent slopes.
Grundy silt loam, bench position, 2 to 5 percent slopes.
Pershing silt loam, 2 to 5 percent slopes.
Pershing silt loam, bench position, 2 to 5 percent slopes.
Seymour silt loam, 2 to 5 percent slopes.

These soils are in capability subclass IIe. They are mainly on narrow, upland divides adjacent to broad upland flats. A few small areas are on loess-covered benches. The subsoils are slowly to very slowly permeable silty clay. Supplies of organic matter are medium to high. Available nitrogen and phosphorus are low in supply, and potassium is medium. Moisture-holding capacities are high. The soils are friable and easy to work when moisture conditions are right.

Use and management.—The soils produce moderate to high yields of corn, grain sorghum, oats, soybeans, alfalfa, red clover, bromegrass, and other crops commonly grown in the county, and they are suitable for these crops.

If row crops are grown, these soils should be terraced or tilled on the contour. On contoured areas, a suitable cropping system is row crops 2 years, oats 1 year, and meadow 2 years. On terraced areas, 1 year of meadow can be omitted from this system. Waterways should be kept in grass.

These soils respond well to nitrogen and phosphate fertilizers. They should be limed and fertilized according to needs determined by soil tests. Second-year corn generally needs additional nitrogen.

Some areas of Pershing silt loam, bench position, 2 to 5 percent slopes, may be slightly wet or seepy because of runoff from the adjacent uplands. However, the use of diversion terraces helps reduce wetness.

MANAGEMENT GROUP 5

Moderately dark colored bench-position soils

Dickinson sandy loam, bench position, 0 to 2 percent slopes.
Dickinson sandy loam, bench position, 2 to 5 percent slopes.

These soils are in capability subclass IIs. They are on nearly level and gently sloping bottom lands and low terraces along the Des Moines River. Moisture-holding capacities are moderately high, but the soils are slightly droughty. Supplies of organic matter are medium. Available nitrogen is very low, available phosphorus is low, and available potassium is medium. The soils are very friable and easy to work. Subsoils are moderately rapidly permeable.

Use and management.—These soils produce moderate yields of corn, grain sorghum, oats, soybeans, red clover, bromegrass, and other crops commonly grown in the county. In addition, they are well adapted to specialty crops or truck farming crops, since they can be cultivated readily under a wide range of moisture conditions. Erosion control is generally no problem. These soils, however, are subject to wind erosion when plowed.

A suitable cropping system is row crops 2 years, oats 1 year, and meadow 1 year. Small areas of these soils in a field are generally handled like the surrounding soils.

The response to fertilizer is limited because these soils are slightly droughty. Heavy applications of fertilizer should be avoided, but the response to small amounts should be good.

MANAGEMENT GROUP 6

Dark-colored, poorly drained to very poorly drained soils on upland flats

Haig silty clay loam.
Haig silty clay loam, fine textured.

These soils are in capability subclass IIw. They are north of the Des Moines River. The subsoils are slowly permeable silty clay. Supplies of organic matter are high; those of nitrogen and potassium are medium and those of phosphorus are low. Moisture-holding capacities are high. Drainage is the major problem. In wet seasons, the soils are difficult to work, and they are late in warming up.

Use and management.—These soils are used intensively for row crops and produce moderately high yields. Corn, grain sorghum, soybeans, oats, red clover, alfalfa, and bromegrass are well suited to these soils.

Surface drains are adequate in some areas. However, on the broader flats, suitable outlets are hard to locate. Tile drainage systems are used by some farmers, but there is little evidence that they improve drainage enough to increase yields significantly or to improve the workability of the soils. The advice of the Soil Conservation Service or the County Extension Service should be obtained before installing tile, especially in Haig silty clay loam, fine textured phase.

Fall plowing helps these soils to dry out so they can be worked earlier in the spring. Rough plowing and a litter of trash on the surface help to reduce wind erosion.

A cropping system consisting of row crops 2 years, oats 1 year, and meadow 1 year is suitable for these soils. However, row crops for 3 years with a green-manure catch crop can be used if special attention is given to the control of weeds, diseases, and insects and the maintenance of fertility. These soils respond well to fertilizer and for best yields should be limed and fertilized according to needs determined by soil tests, particularly if corn is grown 2 years or more in succession. Alfalfa is difficult to establish in wet years, so a mixture of alfalfa and red clover is often suggested. Soybeans are grown extensively, especially on Haig silty clay loam, fine textured, because they can be planted later in the year after the soils have dried.

MANAGEMENT GROUP 7

Level to gently sloping bottom-land soils

Chequest silty clay loam.
Colo silty clay loam.
Colo-Gravity-Olmitz complex.
Coppock silt loam, 0 to 2 percent slopes.
Coppock silt loam, 2 to 5 percent slopes.
Gravity silty clay loam, 2 to 5 percent slopes.
Nodaway-Coppock complex.

These soils are in capability subclass IIw. They are mainly on bottom lands and low terraces along the larger streams in the county. However, the Nodaway-Coppock complex and the Colo-Gravity-Olmitz complex occur most extensively along narrow streams and narrow upland drainageways. The soils in this management group generally occur in large areas, but there are also some small areas cut up by meandering stream channels.

Supplies of organic matter are medium to high. Supplies of phosphorus and potasssium are medium and those of nitrogen are low. These soils are subject to occasional overflow from streams and from upland runoff. As a rule, they are wet and slow to warm in spring. The Chequest and Gravity soils are somewhat difficult to work; the other soils in the group are friable and easy to till under the right moisture conditions. Subsoils are moderately to slowly permeable. The soils are imperfectly drained to poorly drained.

Use and management.—These soils should be plowed in the fall when possible. They are well suited to corn, grain sorghum, soybeans, oats, winter wheat, red clover, and alfalfa, and they produce moderately high to high yields of these crops.

They should be protected from overflow where practical by the use of diversion terraces, open-ditch drains, or dikes, or by straightening the stream channels. Drainage can also be improved by the use of tile systems, but suitable outlets are often difficult to find.

A cropping system suitable for these soils consists of row crops 3 years, oats 1 year, and meadow 1 year. Also suitable is a cropping system that consists of row crops 3 years followed by oats seeded with a legume to be used as green manure after the harvest of oats. Some undrained areas, or those with a high water table, are unsuitable for alfalfa. Consequently, red clover should be included in the legume mixture for meadows. These soils usually respond well to nitrogen fertilizer, particularly when it is used on corn that does not follow a good stand of legumes. Fertilizer and lime should be applied in amounts determined by soil tests.

MANAGEMENT GROUP 8

Poorly to very poorly drained, level soils

Belinda silt loam.
Belinda silt loam, bench position.
Chariton silt loam.
Edina silt loam.
Rubio silt loam, bench position.
Rushville silt loam, bench position.

These soils are in capability subclass IIw. The Edina and Belinda soils are on level upland flats; the Rushville, Rubio, and Belinda soils on bench positions occupy bench terraces; and the Chariton soil is on low second bottoms. Some areas of these soils become ponded and stay wet for several days after heavy rainfall. Subsoils are very slowly permeable silty clay or heavy silty clay loam. The light-colored Rushville soil is low in organic matter. The other soils in the group are dark colored and medium in organic matter. All have a high moisture-holding capacity and are friable and easy to work under the right moisture conditions. The surface soil tends to seal during rains, and it becomes hard and crusty on drying.

Use and management.—These soils produce low to moderately high yields of crops. If properly drained, they are suited to corn, grain sorghum, oats, soybeans, red clover, bromegrass, and other crops grown in the county. They are not subject to erosion. On the narrower upland divides and narrow benches, the natural surface drainage of these soils is sometimes adequate, but generally a system of surface drains is needed.

In recent years the practice of land leveling has been used in conjunction with surface drains, and this seems to improve surface drainage. Tile drains do not work well and are not recommended on these soils because of high amount of clay in the subsoil. Little can be done to improve the internal drainage of these soils.

Initial stands of alfalfa may be difficult to establish because these soils are generally wet and cold late in the spring. Established stands tend to heave because of freezing and thawing. Red clover should be mixed with the alfalfa for seedings that are made in a wet spring.

These soils generally need nitrogen, phosphate, and lime, which should be applied in amounts determined by soil tests in order to get satisfactory yields. The response to fertilizer is good. Research at the Southern Iowa Experimental Farm at Bloomfield has shown that good yields can be maintained on Edina soil under intensive row cropping if high fertility is maintained. A cropping system consisting of row crops 2 years, a small grain 1 year, and meadow 1 year is suitable for these soils. However, row crops for 3 years followed by a green-manure crop can be used if special attention is given to maintenance of fertility.

MANAGEMENT GROUP 9

Well-drained, moderately to strongly sloping soils that are subject to sheet and gully erosion

Clinton silt loam, bench position, 5 to 9 percent slopes.
Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded.
Clinton silt loam, bench position, 9 to 14 percent slopes.
Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded.
Clinton silt loam, 5 to 9 percent slopes.
Clinton silt loam, 5 to 9 percent slopes, moderately eroded.
Clinton silt loam, 9 to 14 percent slopes.
Clinton silt loam, 9 to 14 percent slopes, moderately eroded.
Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded.
Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded.

These soils are in capability subclass IIIe. Except for the Waukegan soil, all occupy loess-covered benches and upland slopes. The Waukegan soil, which is minor in extent, occupies the side slopes of low alluvial terraces. All the soils in this group are friable and easy to work. Subsoils are moderately to moderately slowly permeable silty clay loam. The moisture-holding capacities of these soils are moderately high. Supplies of organic matter are medium to low.

Use and management.—These soils produce moderate to high yields of crops. They are suitable for corn, grain sorghum, oats, alfalfa, red clover, bromegrass, and other crops commonly grown in the county. Erosion is a serious problem; consequently, fields in which row crops are grown regularly should be terraced. If terraces are used, a cropping system that consists of row crops 2 years, a small grain 1 year, and meadow 1 year is suitable for fields on slopes of 5 to 9 percent. If these slopes are protected only by contour cultivation, a suitable cropping system is a row crop 1 year, a small grain 1 year, and meadow 2 years.

On slopes of 9 to 14 percent, a cropping system that consists of row crops 2 years, a small grain 1 year, and meadow 2 years is suitable if terraces are used. If not terraced, the land should be in meadow or improved pasture and used for corn or other row crop no more than 1 year every 6 years.

Waterways and terrace outlets should be kept in grass. Terrace outlets should be properly graded, particularly on some of the loess-covered benches because the underlying substratum is extremely erodible and subject to severe gullying.

These soils show an excellent response to fertilizer. They usually need nitrogen, phosphate, and lime. Amounts used should be determined by soil tests. Nitrogen is usually needed on second-year corn for high yields.

MANAGEMENT GROUP 10

Gently sloping soils that are low in fertility

Weller silt loam, 2 to 5 percent slopes.
Weller silt loam, 2 to 5 percent slopes, moderately eroded.
Weller silt loam, bench position, 2 to 5 percent slopes.
Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded.

These soils are in capability subclass IIIe. They occupy loess-covered upland divides and bench terraces. They are low in organic matter and in fertility. Supplies of available nitrogen and phosphorus are low, and supplies of potassium are medium. Subsoils are slowly permeable silty clay. The soils in this group are imperfectly drained and are somewhat slow to dry in some seasons. However, they are easy to till under favorable moisture conditions. The surface soil tends to seal during rains and then becomes hard and crusty on drying.

Use and management.—These soils are suitable for corn, grain sorghum, soybeans, oats, alfalfa, bromegrass, and other crops commonly grown in the county. Average corn yields are low to moderate. In terms of profit, yields of corn and soybeans are near the break-even point. Grain and meadow crops require fertilizer, which should be applied in amounts determined by soil tests.

All tillage should be on the contour to reduce erosion losses. If fields are contoured, a suitable cropping system is corn 1 year, oats 1 year, and meadow 2 years. If fields are terraced and the soil is highly fertile, corn 2 years, oats 1 year, and meadow 1 year can be grown. Alternative uses are long-term hay or pasture.

MANAGEMENT GROUP 11

Moderately sloping soils that are low in fertility and subject to severe sheet and gully erosion

Weller silt loam, 5 to 9 percent slopes.
Weller silt loam, 5 to 9 percent slopes, moderately eroded.
Weller silt loam, bench position, 5 to 9 percent slopes.
Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded.

These soils are in capability subclass IIIe. They occupy loess-covered upland divides and bench terraces. They are low in supply of organic matter and low in fertility. Subsoils are slowly permeable silty clay. The soils are moderately well drained to imperfectly drained. They are friable and easy to till under favorable moisture conditions. The surface soil tends to seal during rains and may become hard and crusty on drying.

Use and management.—These soils are suitable for corn, grain sorghum, soybeans, oats, alfalfa, bromegrass, and other crops commonly grown in the county. Corn and soybeans are not profitable because of very low yields. These soils are probably best suited to hay and pasture.

A cropping system consisting of corn 1 year, oats 1 year, and meadow 4 years is suitable. If terraced and contour farmed and the cost-return ratio of corn is favorable, these soils may be used for corn 2 years, oats 1 year, and meadow 2 years. Vernal alfalfa and other improved varieties of long-lived legumes or of birdsfoot trefoil and bluegrass can be used for long-term meadows. A high fertility level should be maintained by liming and topdressing with phosphate. Farms with a high percentage of soils in this management group should be used for production of livestock. Small acreages of these soils in fields that consist mainly of more productive soils will generally be used for a cropping system based on the better soils. The poorer soils should be given additional manure and fertilizer. All tillage should be on the contour. Fields should be terraced if row crops are grown more often than 1 year in 6.

MANAGEMENT GROUP 12

Moderately sloping soils that are subject to severe sheet and gully erosion

Grundy silty clay loam, 5 to 9 percent slopes.
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded.
Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded.
Pershing silt loam, 5 to 9 percent slopes.
Pershing silt loam, 5 to 9 percent slopes, moderately eroded.
Pershing silt loam, bench position, 5 to 9 percent slopes.
Seymour silt loam, 5 to 9 percent slopes, moderately eroded.

These soils are in capability subclass IIIe. They occupy moderately sloping, loess-covered upland divides and bench terraces. Supplies of organic matter are medium to high. Those of nitrogen and phosphorus are generally low. The moisture-holding capacities of these soils are moderately high. The soils are moderately well drained to imperfectly drained. Subsoils are slowly to very slowly permeable silty clay. The soils are all friable and easy to till if moisture is favorable.

Use and management.—These soils are suitable for corn, soybeans, grain sorghum, oats, alfalfa, bromegrass, and other crops commonly grown in the county. Average yields are moderate to moderately high. Fields should be terraced if row crops are grown. All waterways and terrace outlets should be kept permanently in grass. Generally, cropping systems should include meadow 25 to 50 percent of the time. If fields are terraced, a suitable cropping system is row crops 2 years, a small grain 1 year, and meadow 1 year. If they are contoured, a row crop 1 year, a small grain 1 year, and meadow for 2 or 3 years is necessary to reduce erosion losses to safe limits. These soils respond well to fertilizers. They should be limed and fertilized in amounts determined by soil tests.

MANAGEMENT GROUP 13

Nearly level to moderately sloping soils that are somewhat droughty

Coppock soils, sandy overwash, 0 to 2 percent slopes.
Coppock soils, sandy overwash, 2 to 5 percent slopes.
Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded.
Landes soils.
Waukegan loam, moderately deep, 0 to 3 percent slopes.
Waukegan loam, moderately deep, 3 to 6 percent slopes.

These soils are in capability subclass IIIs. They generally occur as small areas on bottoms and on low terraces. Some large areas of Landes soils, however, occur near Mt. Sterling on the flood plain of the Fox River. Except for Landes soils, this group of soils is not likely to be flooded. The Landes and Coppock soils may be slightly wet in some seasons. The soils in this group are droughty. Subsoils are rapidly permeable to very rapidly permeable. The moisture-holding capacities are low. Supplies of organic matter and nitrogen are low to very low. Those of available phosphorus and potassium are usually medium. The soils are friable and easy to work but are subject to wind erosion.

Use and management.—These soils usually produce low yields. They are generally surrounded by other bottom-land and terrace soils, and, because of this, they are usually farmed like the surrounding soils.

Areas of Landes soils economically suitable for farming should be protected from overflow by dikes or diversion terraces, or by the straightening of stream channels. Winter cover crops and mulch tillage practices are needed on all of these soils to control wind erosion. The Waukegan soils on moderate slopes are subject to sheet erosion, but terraces are generally not practical because these soils occur in small, isolated areas. They should be kept in grasses and legumes as much of the time as possible, however.

A cropping system that consists of row crops 2 years, a small grain 1 year, and meadow 2 years should be used on these soils. Because yields of crops are low, meadow is desirable most of the time. The soils should be limed and fertilized according to soil tests.

MANAGEMENT GROUP 14

Moderately light colored, excessively drained, sandy soils

Perks and Hagener soils, 0 to 2 percent slopes.
Perks and Hagener soils, 2 to 5 percent slopes.

These soils are in capability subclass IIIs. They occur mainly as small areas along the Des Moines River. Supplies of organic matter are low and those of available plant nutrients are very low. The soils are very droughty. The moisture-holding capacities are low. Many areas of these soils are along riverbanks and have not been cleared of timber.

Use and management.—These soils produce low yields of all crops. They should be in permanent grass or legumes whenever practical. Generally, it is more practical to manage these soils like the adjacent soils. Winter cover crops and mulch tillage practices will help to reduce wind erosion on these soils. In areas large enough to be farmed, these soils should be limed and fertilized in amounts determined by soil tests. They usually require more fertilizer than the adjacent soils.

MANAGEMENT GROUP 15

Poorly drained to very poorly drained bottom-land soils

Carlow silty clay loam.
Carlow silty clay loam, overwashed.
Nodaway silt loam, silty clay substratum.
Wabash silty clay loam.
Wabash silty clay loam, overwashed.

These soils are in capability subclass IIIw. They are on level to depressional first bottoms. Nodaway silt loam, silty clay substratum, is along the present stream channels, and it generally has a friable silt loam surface soil. The Wabash and Carlow soils are in low areas that tend to collect surface water during wet seasons or when streams overflow. Surface soils are silt loam or silty clay loam and may be sticky and difficult to work except in a narrow range of moisture conditions. All soils in the group have very slowly permeable silty clay subsoils.

Supplies of organic matter are medium to high. Supplies of available nitrogen are low and those of available potassium and phosphorus are medium. The soils have a high moisture-holding capacity.

Use and management.—These soils are suited to corn, soybeans, small grains, red clover, bromegrass, and most other crops commonly grown in the county. Soybeans and winter wheat are often grown on these soils. Alfalfa may not grow well because of wetness and heaving. Crop yields are moderately high on the Nodaway soil and moderate to low on the Carlow and Wabash soils.

These soils are frequently wet in spring and warm up late. They should be plowed in fall whenever possible. Drainage can be improved to a limited extent by the use of dikes and diversion terraces and by the use of surface drains and open ditches. Tile drainage systems are seldom worth while.

To produce good crop yields, the soils should be given lime and fertilizer in amounts determined by soil tests. A cropping system consisting of row crops for 3 years followed by a small grain and a green-manure catch crop is suitable. Additional green-manure crops help to maintain good tilth and the supply of organic matter. Legume mixtures should contain red clover in place of alfalfa unless the area to be seeded has been adequately drained. Weeds can be a serious problem in wet years.

MANAGEMENT GROUP 16

Dark-colored, wet or seepy, moderately sloping upland soils that have formed in glacial till

Adair and Clarinda soils, 5 to 9 percent slopes.
Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded.

These soils are in capability subclass IIIw. They occupy upland slopes immediately below the loess-covered flats and divides. They are sometimes wet in spring or during rainy periods because of seepage from higher slopes and very slow subsoil permeability. Surface soils are silt loam or silty clay loam, and some areas are slightly sticky and difficult to work when wet. Subsoils are very slowly permeable silty clay or clay. The moisture-holding capacities of these soils are moderately high. Supplies of organic matter and potassium are medium. Supplies of nitrogen are low and those of phosphorus are very low. The soils are low in productivity, especially if eroded.

Use and management.—These soils are suited to corn, oats, red clover, birdsfoot trefoil, orchardgrass, and bromegrass and to most other grasses and legumes commonly grown in the county. Yields of all crops are usually low. The soils are considered to be of marginal value for grain, and generally their best use is for meadow or pasture. However, the darker colored, uneroded soils in this group, which usually occupy gentler slopes, are somewhat more productive than the soils on steeper slopes. If erosion is controlled, these gentler sloping soils can usually be farmed like the adjacent Grundy and Seymour soils.

The use of interceptor tile to control seepage is suggested if wetness seriously delays tilling or harvesting. The soils are subject to severe sheet and gully erosion; consequently, fields used frequently for row crops should be terraced and outlets and waterways kept permanently in grass. All tillage should be on the contour. Because of low yields, most of these soils should be in meadow or improved pasture and used for row crops no more than 1 year in 6 years.

MANAGEMENT GROUP 17

Light-colored, poorly drained, level soils

Beckwith silt loam.
Beckwith silt loam, bench position.

These soils are in capability subclass IIIw. They occupy nearly level to level upland flats and divides or level bench terraces. They are low in organic matter.

Supplies of phosphorus are low, those of nitrogen are very low, and those of potassium are medium. Surface soils are friable and easy to work when moisture is right. They tend to seal during rains and crust on drying. Subsoils are very slowly permeable silty clay. The soils of this group have a high moisture-holding capacity. They are generally slow to dry in spring. They are strongly acid.

Use and management.—These soils are used for corn, soybeans, oats, alfalfa, red clover, bromegrass, and other crops commonly grown in the county. Yields of grain are moderate to low. The soils are best suited to hay and pasture. Surface drainage is needed. The soils on bench terraces should be protected from upland runoff by diversion terraces. Tile drains are unsuitable because of the very slowly permeable subsoil.

Alfalfa may be difficult to establish in wet years, and it may winterkill if surface drainage is poor. Seeded legumes should include red clover in the mixture. A cropping system consisting of row crops 2 years, a small grain 1 year, and meadow 1 year is suitable. However, 2 years of meadow will add more organic matter to the soil. Lime and fertilizer should be applied in amounts determined by soil tests.

MANAGEMENT GROUP 18

Moderately dark colored, sloping to steep soils that are subject to severe sheet and gully erosion; generally not suitable for cultivation

Adair and Clarinda soils, 9 to 14 percent slopes.
Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded.
Shelby loam, 14 to 18 percent slopes, moderately eroded.

These soils are in capability subclass IVe. They are on slightly to moderately eroded slopes and are subject to severe sheet and gully erosion. Supplies of organic matter are medium to low. Those of phosphorus and lime are low. The moisture-holding capacities are moderately high. Permeability of the subsoils is moderately slow to slow. The soils in this group are generally moderately well drained, but they may be somewhat wet in wet seasons.

Use and management.—The steep and irregular slopes of these soils and their low yields make them generally unsuited to row crops. However, corn is grown occasionally in order to reestablish or to improve pastures through seeding. The soils are suited to alfalfa, birdsfoot trefoil, bromegrass and orchardgrass and to other legumes and grasses commonly grown in the county. Pastures in alfalfa and bromegrass mixtures probably will need renovation and reseeding every 4 to 6 years. If management is good, birdsfoot trefoil and bluegrass can be expected to thrive for many years.

Many areas of these soils are producing only poor pasture or second-growth timber and buckbrush. These areas are capable of producing 1½ to 2 tons per acre of hay, or an equivalent amount of high-quality forage if they are limed, fertilized, and reseeded to a mixture of long-lived legumes and grasses. Lime and fertilizer should be applied in amounts determined by soil tests.

Waterways and terrace outlets should be permanently in grass. Some eroded areas of these soils make ideal wildlife shelters if planted to suitable shrubs and coniferous trees.

MANAGEMENT GROUP 19

Moderately sloping, severely eroded upland soils that are generally not suitable for cultivation

Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded.
Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded.
Pershing soils, 5 to 9 percent slopes, severely eroded.
Seymour soils, 5 to 9 percent slopes, severely eroded.
Weller soils, 5 to 9 percent slopes, severely eroded.
Weller soils, bench position, 5 to 9 percent slopes, severely eroded.

These soils are in capability subclass IVe. They occupy small areas on upland slopes and divides that have been severely damaged by sheet erosion. They have little or no surface soil. Some areas are severely gullied. The surface layers of all members of this group are sticky, clayey, and difficult to work.

Supplies of organic matter and plant nutrients are low. Moisture-holding capacities are moderately high. Subsoils are very slowly permeable silty clay. The Adair and Clarinda soils are subject to wetness because they occur below sidehill seep areas.

Use and management.—In many places, these eroded soils occur in close relationship with larger areas of the same soil types that are not so severely eroded and which are more suitable for crops. In such areas, these soils are usually terraced and contoured and are farmed under the same cropping systems as the less eroded soils. However, they should be given larger applications of manure and fertilizer and used more frequently for meadow crops.

These soils are poorly suited to row crops because yields are generally low. When possible they should be used, alone or with steeper soils, for hay and pasture. Suitable forage plants are alfalfa, red clover, birdsfoot trefoil, bluegrass, orchardgrass, bromegrass, and other legumes and grasses.

Alfalfa and bromegrass meadows need renovation and reseeding every 4 to 6 years. Birdsfoot trefoil and bluegrass are suited to the more permanent type of meadow. Good seedbeds are difficult to establish and good stands of grasses and legumes are extremely difficult to establish on these soils because of the clayey surface soil. Forage yields, on the average, can be expected to be poor. Lime and fertilizer should be applied in amounts determined by soil tests. Woodland is an alternative use.

MANAGEMENT GROUP 20

Shallow, moderately light colored soils that are underlain by coarse gravel, limestone flags, or shale; unsuitable for cultivation

Nodaway-Coppock complex, flaggy.

These soils are in capability subclass Vs. They are along the smaller streams that flow through areas of residual shale and limestone. They are medium in supply of organic matter. They are imperfectly to moderately well drained.

Use and management.—These soils are generally not tillable. They are used like the surrounding Sogn, Gosport, and Lindley soils, which are usually forested.

MANAGEMENT GROUP 21

Steep, well drained to moderately well drained soils that are subject to severe erosion

Gosport silt loam, 9 to 14 percent slopes, moderately eroded.
Lindley loam, 14 to 18 percent slopes, moderately eroded.
Shelby loam, 18 to 25 percent slopes, moderately eroded.
Shelby soils, 14 to 18 percent slopes, severely eroded.

These soils are in capability subclass VIe. They are on steep slopes adjacent to streams and upland drainageways. Organic matter is medium to low in supply. The moisture-holding capacity of these soils is moderately high. The soils are friable and easy to work.

Use and management.—These soils are not suitable for cultivation because of steep slopes, low yields, and the hazard of severe erosion. They are best suited to pasture and meadow. Birdsfoot trefoil, lespedeza, orchardgrass, bromegrass, and bluegrass are good forage plants. Birdsfoot trefoil is a long-lived perennial and, once established, can be expected to thrive for many years if management is good. Improved pastures require periodic applications of phosphate and lime to maintain forage growth. Control of brush, weeds, and grazing should be a part of management. A few areas of these soils that contain numerous waterways or complex slopes may not be suitable for pasture renovation and should be used for forestry and wildlife cover.

MANAGEMENT GROUP 22

Moderately well drained to excessively drained, sandy soils that are low in fertility

Douds soils and Terrace escarpments.
Downs and Lamont soils, bench position, 9 to 14 percent slopes.

Most areas of these soils are in capability subclass VIs, but some in subclasses IVs and VIIs are included. These soils occupy terrace escarpments or bench positions along the larger streams. They are low in organic matter. Permeability of the subsoil may be moderately rapid, moderate, or slow. Many areas of these soils are droughty. Surface textures are sandy in many places.

Use and management.—These soils are generally not suitable for cultivation. However, a few areas are occasionally used for small grains or hay. Permanent pasture or woodland is a more common use. The less steep slopes of these soils are good for grass or grass-legume meadow or hay. Yields range from low on Douds soils and Terrace escarpments to fair on the Downs and Lamont soils. Alfalfa, red clover, bromegrass, orchardgrass, and bluegrass are suitable where pastures on these soils can be improved by reseeding. Some slopes are too steep and irregular to be worked with normal farm machinery. Woodland is an alternative use.

MANAGEMENT GROUP 23

Steep, severely eroded soils

Gosport silt loam, 14 to 18 percent slopes, moderately eroded.
Gosport silt loam, 18 to 40 percent slopes, moderately eroded.
Gosport soils, 9 to 14 percent slopes, severely eroded.
Gosport soils, 14 to 18 percent slopes, severely eroded.
Lindley loam, 18 to 25 percent slopes, moderately eroded.
Lindley loam, 25 to 40 percent slopes, moderately eroded.
Lindley soils, 14 to 18 percent slopes, severely eroded.
Lindley soils, 18 to 25 percent slopes, severely eroded.
Shelby soils, 18 to 25 percent slopes, severely eroded.
Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes.

These soils are in capability subclass VIIe. They are moderately well drained to well drained. Subsoils are slowly permeable. Supplies of organic matter are low. These soils have a moderately high moisture-holding capacity. They are subject to severe sheet and gully erosion. They are in timber, timbered pasture, brushy pasture, or improved pasture.

Use and management.—Timber and steep slopes on these soils make the establishment and improvement of pasture difficult or impossible. Where improved pastures can be established, the seeding of long-lived perennial legumes and grasses is suggested. A mixture of birdsfoot trefoil and orchardgrass or bluegrass is suitable for these soils. Timbered soils should be protected from overgrazing, fire, and overcutting.

More detailed information about woodland is provided in the subsection "Woodland Use of the Soils."

MANAGEMENT GROUP 24

Steep to strongly sloping, light-colored, sandy, droughty soils that are subject to sheet, gully, and wind erosion

Steep sandy land.

This land type is in capability class VIIs. It occurs on upland slopes of 9 to 40 percent that are adjacent to the Des Moines River. The supply of organic matter is low. The soil is sandy, excessively drained, and droughty.

Use and management.—The soil in this group is not suitable for cultivation or rotation pasture. Areas that are not in permanent pasture should be protected from overgrazing and, if necessary, improved without excessive cultivation. An alternative use is woodland.

Estimated Yields of Crops

The estimated average yields that can be expected from the principal crops when grown under improved management on the soils of Van Buren County are shown in table 3. This table also shows the capability subclass and management group to which each soil belongs, the main soil problems, and the suggested management for safe use and improvement of the soils.

The estimated yields assume that wet soils have been drained, and flooding has been controlled; that lime and fertilizer have been applied in adequate amounts according to soil tests made by the soil testing laboratory, Iowa State University; that suitable crop varieties are used, are grown in the suggested cropping system with specified supporting practices, and are seeded at appropriate rates per acre; that weeds and insects are controlled; that tillage and other cultural practices are timely and above average in quality; and that a high level of management has been used on the soil for 5 to 10 years.

Yields of hay are those obtained from first-year meadow. The crop is assumed to be alfalfa and bromegrass, where these plants are adapted. On some poorly drained soils, red clover may be mixed with alfalfa and bromegrass, or red clover and timothy may be used. Yields from second-year meadows may be higher than from first-year meadows.

Pasture production is expressed in terms of the average gain to be expected from yearling steers or heifers grazing for one season on established meadow or alfalfa and bromegrass, where such plants are adapted, or on a mixture of birdsfoot trefoil and bluegrass. Grazing animals receive no supplemental feed.

The estimated yields in table 3 are thought to be fairly reliable. Nevertheless, year-to-year fluctuations are normal and to be expected. A few farmers using the best techniques of management known today can be expected to exceed these estimated yields by as much as 10 to 15 percent. New or improved crop varieties, better fertilizer practices, improved farming methods, and other changes may make it necessary to revise the average yields in the future.

The availability of nitrogen, phosphorus, and potassium in the soils is indicated in table 3 by the words "very low,"

"low," and "medium." These levels are established on the basis of tests made by the soil testing laboratory at Iowa State University and on response of crops to fertilizer in field trials.

The suggested cropping systems in table 3 are those to be used to obtain the average yields shown. In these systems, some other row crop may be substituted for corn or soybeans. Corn or soybeans may also be used interchangeably. It is assumed that the stated supporting practices are used with the suggested cropping systems.

Pasture improvement, one of the supporting practices, means fertilizing the soil; seeding improved types of grasses and legumes; and controlling weeds, brush, and grazing. Woodland management, suggested for those soils not suited to cropping, means the improvement of existing stands through planting or through removal of poor trees or undesirable kinds of trees: protecting the trees from fire and grazing; and selective cutting and marketing of merchantable timber.

Woodland Use of the Soils

More than half of Van Buren County was forested at the time of settlement (fig. 6). The rest was prairie. Most of the native trees on uplands were hardwoods—white, red, and black oaks, elm, shagbark hickory, and green ash. On the bottom lands were soft maple, walnut, green ash, and cottonwood.

Most of the original timber has been cut over or cleared so that the soils could be used for crops and pasture. However, there are still scattered tracts of woodlands, mainly in small acreages. Most of the existing woodland is on the Lindley, Gosport, and Sogn soils, on the Douds soils and Terrace escarpments, and on Steep sandy land in general soil areas 3 and 7.

About 20 percent of the county is now woodland, but the sale of wood products is not a major source of farm income. Woodlands need improved management. They are grazed, but little forage is obtained. Grazing is detrimental to woodlands because it damages trees and compacts the soil.

Soil characteristics and tree growth

Soils vary in their suitability for trees. In general, the deep, well drained or moderately well drained, medium to highly fertile soils are best suited to trees. Subsoils should have moderate to moderately slow permeability. Trees vary in their ability to grow and develop under various soil and climatic conditions. Table 4 is a guide that can help farmers select the most suitable kinds of trees and shrubs for the soil and site.

The development of tree roots is related to subsoil permeability. Tree roots growing in a slowly to very slowly permeable, plastic subsoil are often poorly developed. Underdeveloped roots caused by poor aeration and poor drainage do not allow trees to develop normally above the ground. Some of the soils with slowly to very slowly permeable subsoils (table 4) are the Beckwith, Belinda, Carlow, Edina, Gosport, and Weller.

The very sandy soils or those underlain by sand or gravel are generally rapidly to very rapidly permeable. Aeration and drainage in these soils tend to be excessive, causing them to be droughty. This condition also limits the growth of trees. Soils in this group are the Lamont, Dickinson, Perks and Hagener, Sogn, and Waukegan.

Native hardwoods generally are not suited to soils that have been in cultivation or to those that are moderately or severely eroded. Hardwoods apparently require a site of better quality and grow more satisfactorily if planted on uncultivated soils. Pines are better suited than hardwoods on eroded or formerly cultivated soils.

Tree plantings in southeastern Iowa

Several high-quality evergreen plantations have been established by the State Conservation Commission, the U.S. Forest Service, and private landowners. Growth of trees on some soils has been excellent, particularly of Austrian pine, red pine, eastern white pine, Virginia pine (fig. 7), and Scotch pine. Ponderosa (western yellow) pine is not suited to southeastern Iowa.

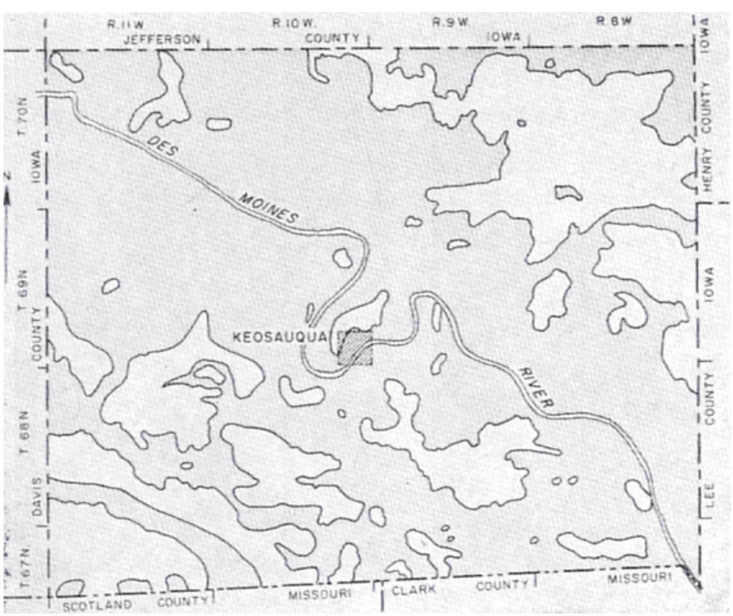

***Figure 6.*—Original forest cover in Van Buren County. Lighter part was prairie.**

***Figure 7.*—Virginia pine plantation, 20 years old, in the Farmington Unit of Shimek State Forest.**

TABLE 3.—*Problems, suggested management, and*

[Yields are those expected under improved management. Absence information regarding data in columns on available plant

Soil	Management group and capability subclass	Management problems			
		Available nitrogen	Available phosphorus	Available potassium	Other
Adair and Clarinda soils, 5 to 9 percent slopes	16(IIIw)	Low	Very low	Medium	Erosion and wetness
Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded.	16(IIIw)	Low	Very low	Medium	Erosion and wetness
Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded.	19(IVe)	Very low	Very low	Medium	Erosion and wetness
Adair and Clarinda soils, 9 to 14 percent slopes	18(IVe)	Low	Very low	Medium	Erosion
Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded.	18(IVe)	Very low	Very low	Medium	Erosion
Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded.	19(IVe)	Very low	Very low	Medium	Erosion
Beckwith silt loam	17(IIIw)	Very low	Low	Medium	Wetness
Beckwith silt loam, bench position	17(IIIw)	Very low	Low	Medium	Wetness
Belinda silt loam	8(IIw)	Low	Low	Medium	Wetness
Belinda silt loam, bench position	8(IIw)	Low	Low	Medium	Wetness
Carlow silty clay loam	15(IIIw)	Low	Medium	Medium	Wetness due to flooding
Carlow silty clay loam, overwashed	15(IIIw)	Low	Medium	Medium	Wetness due to flooding.
Chariton silt loam	8(IIw)	Low	Low	Medium	Wetness
Chequest silty clay loam	7(IIw)	Low	Medium	Medium	Wetness due to flooding.
Clinton silt loam, bench position, 2 to 5 percent slopes	3(IIe)	Low	Low	Medium	Runoff from adjacent uplands.
Clinton silt loam, bench position, 5 to 9 percent slopes	9(IIIe)	Low	Low	Medium	Erosion
Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	9(IIIe)	Very low	Low	Medium	Erosion
Clinton silt loam, bench position, 9 to 14 percent slopes	9(IIIe)	Low	Low	Medium	Erosion
Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded.	9(IIIe)	Very low	Low	Medium	Erosion
Clinton silt loam, 5 to 9 percent slopes	9(IIIe)	Low	Low	Medium	Erosion
Clinton silt loam, 5 to 9 percent slopes, moderately eroded.	9(IIIe)	Very low	Low	Medium	Erosion
Clinton silt loam, 9 to 14 percent slopes	9(IIIe)	Low	Low	Medium	Erosion
Clinton silt loam, 9 to 14 percent slopes, moderately eroded.	9(IIIe)	Very low	Low	Medium	Erosion
Colo silty clay loam	7(IIw)	Medium	Medium	Medium	Wetness due to overflow.
Colo-Gravity-Olmitz complex	7(IIw)	Medium	Medium	Medium	Wetness due to overflow.
Coppock silt loam, 0 to 2 percent slopes	7(IIw)	Low	Medium	Medium	Wetness due to overflow.
Coppock silt loam, 2 to 5 percent slopes	7(IIw)	Low	Medium	Medium	Wetness due to overflow.
Coppock soils, sandy overwash, 0 to 2 percent slopes	13(IIIs)	Very low	Medium	Medium	Slight wetness due to overflow.
Coppock soils, sandy overwash, 2 to 5 percent slopes	13(IIIs)	Very low	Medium	Medium	Slight wetness due to overflow.
Dickinson sandy loam, bench position, 0 to 2 percent slopes.	5(IIs)	Very low	Low	Medium	Slight droughtiness
Dickinson sandy loam, bench position, 2 to 5 percent slopes.	5(IIs)	Very low	Low	Medium	Slight droughtiness
Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded.	13(IIIs)	Very low	Low	Medium	Erosion and droughtiness.
Douds soils and Terrace escarpments	22(VIs)	Very low	Very low	Low	Erosion and severe gullying.
Downs silt loam, bench position, 2 to 5 percent slopes	3(IIe)	Low	Low	Medium	Erosion
Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	9(IIIe)	Low	Low	Medium	Erosion
Downs and Lamont soils, bench position, 9 to 14 percent slopes.	22(VIs)	Very low	Low	Medium	Erosion

See footnotes at end of table.

expected crop yields of Van Buren County soils

of yield indicates crop is seldom, if ever, grown. See text for additional nutrients, suggested management, and expected yields per acre]

Suggested management		Expected yields per acre				
Cropping system	Supporting practices	Corn	Soybeans	Oats	Hay	Pasture
		Bu.	Bu.	Bu.	Tons	Lbs. beef
(1)	(1)	34	18	25	1. 5	
(1)	(1)	30	12	20	1. 4	
Hay and pasture	Pasture improvement	18	8	12	. 8	100
Hay and pasture	Pasture improvement	28	11	20	1. 4	170
Hay and pasture	Pasture improvement	26	10	18	1. 0	120
Hay and pasture, woodland	Pasture improvement and woodland management.	16	7	11	. 6	100
Corn, soybeans, oats, meadow	Surface drainage	40	16	20	1. 1	
Corn, soybeans, oats, meadow	Surface drainage	45	18	30	1. 3	
Corn, corn, oats, meadow [2]	Surface drainage	50	22	36	1. 6	
Corn, corn, oats, meadow [2]	Surface drainage	50	20	36	1. 6	
Corn, soybeans, corn, oats with a legume for green manure.	Overflow protection and open-ditch drainage.	39	19	26	1. 4	
Corn, soybeans, corn, oats with a legume for green manure.	Overflow protection and open-ditch drainage.	45	22	30	1. 6	
Corn, corn, oats, meadow	Surface drainage	50	24	28	1. 6	
Corn, soybeans, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Overflow protection, tiling, and open-ditch drainage.	58	25	40	2. 4	
Corn, corn, oats, meadow [2]	Contouring and diversion terraces	65	26	45	3. 2	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	63	24	42	3. 2	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	60	22	40	3. 0	
Corn, corn, oats, meadow, meadow	Terracing	56	21	40	2. 8	
Corn, corn, oats, meadow, meadow	Terracing	52	20	37	2. 6	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	63	24	42	3. 2	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	60	22	40	3. 0	
Corn, corn, oats, meadow, meadow	Terracing	56	21	40	2. 8	
Corn, corn, oats, meadow, meadow	Terracing	52	20	37	2. 6	
Corn, soybeans, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Overflow protection, tiling, and open-ditch drainage.	70	29	52	3. 0	
Corn, soybeans, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Diversion terraces	65	28	50	2. 8	
Corn, soybeans, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Tiling and diversion terraces	65	24	46	2. 8	
Corn, soybeans, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Tiling and diversion terraces	65	24	46	2. 8	
Corn, corn, oats, meadow, meadow	Diversion terraces	45	16	34	2. 0	
Corn, corn, oats, meadow, meadow	Diversion terraces	40	14	28	1. 9	
Corn, corn, oats, meadow	None	48	18	36	2. 0	
Corn, corn, oats, meadow	None	48	18	36	2. 0	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	38	15	28	1. 7	
Woodland	Gully control and woodland management.					80
{Corn, corn, oats, meadow {Corn, soybeans, corn, oats, meadow	Contouring Terracing	78	29	50	3. 5	
{Corn, corn, oats, meadow {Corn, oats, meadow, meadow	Terracing Contouring	75	27	46	3. 2	
Pasture	Pasture improvement					200

TABLE 3.—*Problems, suggested management, and expected*

Soil	Management group and capability subclass	Management problems			
		Available nitrogen	Available phosphorus	Available potassium	Other
Edina silt loam	8(IIw)	Low	Low	Medium	Wetness
Givin silt loam, bench position, 2 to 6 percent slopes	3(IIe)	Low	Low	Medium	Erosion
Givin silt loam, 2 to 6 percent slopes	3(IIe)	Low	Low	Medium	Erosion
Gosport silt loam, 9 to 14 percent slopes, moderately eroded.	21(VIe)	Very low	Very low	Low	Erosion
Gosport silt loam, 14 to 18 percent slopes, moderately eroded.	23(VIIe)	Very low	Very low	Low	Erosion
Gosport silt loam, 18 to 40 percent slopes, moderately eroded.	23(VIIe)	Very low	Very low	Low	Erosion
Gosport soils, 9 to 14 percent slopes, severely eroded	23(VIIe)	Very low	Very low	Low	Erosion and fertility maintenance.
Gosport soils, 14 to 18 percent slopes, severely eroded	23(VIIe)	Very low	Very low	Low	Erosion and fertility maintenance.
Gravity silty clay loam, 2 to 5 percent slopes	7(IIw)	Medium	Medium	Medium	Wetness due to overflow from uplands.
Grundy silty clay loam, 2 to 5 percent slopes	4(IIe)	Low	Low	Medium	Erosion
Grundy silty clay loam, 5 to 9 percent slopes	12(IIIe)	Low	Low	Medium	Erosion
Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded.	12(IIIe)	Low	Low	Medium	Erosion
Grundy silt loam, bench position, 2 to 5 percent slopes	4(IIe)	Low	Low	Medium	Erosion
Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	12(IIIe)	Low	Low	Medium	Erosion
Haig silty clay loam	6(IIw)	Medium	Low	Medium	Wetness
Haig silty clay loam, fine textured	6(IIw)	Medium	Low	Medium	Wetness
Keomah silt loam, 2 to 5 percent slopes	3(IIe)	Low	Low	Medium	Slight wetness
Keomah silt loam, bench position, 2 to 5 percent slopes	3(IIe)	Low	Low	Medium	Slight wetness
Landes soils	13(IIIs)	Low	Medium	Medium	Droughtiness, wetness, flooding.
Lindley loam, 14 to 18 percent slopes, moderately eroded.	21(VIe)	Very low	Very low	Medium	Erosion
Lindley loam, 18 to 25 percent slopes, moderately eroded.	23(VIIe)	Very low	Very low	Medium	Erosion
Lindley loam, 25 to 40 percent slopes, moderately eroded.	23(VIIe)	Very low	Very low	Medium	Erosion
Lindley soils, 14 to 18 percent slopes, severely eroded	23(VIIe)	Very low	Very low	Medium	Erosion and fertility maintenance.
Lindley soils, 18 to 25 percent slopes, severely eroded	23(VIIe)	Very low	Very low	Medium	Erosion and fertility maintenance.
Nodaway-Coppock complex	7(IIw)	Low	Medium	Medium	Wetness due to overflow.
Nodaway-Coppock complex, flaggy	20(Vs)	Low	Medium	Medium	Stoniness
Nodaway silt loam	1(I)	Low	Medium	Medium	Infrequent overflow
Nodaway silt loam, silty clay substratum	15(IIIw)	Low	Medium	Medium	Wetness, flooding
Olmitz loam, 2 to 5 percent slopes	2(IIe)	Low	Medium	Medium	Slight overflow from uplands.
Olmitz and Gravity soils, 2 to 5 percent slopes	2(IIe)	Medium	Medium	Medium	Slight wetness due to overflow from uplands.
Perks and Hagener soils, 0 to 2 percent slopes	14(IIIs)	Very low	Very low	Low	Wind erosion and droughtiness.
Perks and Hagener soils, 2 to 5 percent slopes	14(IIIs)	Very low	Very low	Low	Wind erosion and droughtiness.
Pershing silt loam, 2 to 5 percent slopes	4(IIe)	Low	Low	Medium	Erosion

See footnotes at end of table.

crop yields of Van Buren County soils—Continued

Suggested management		Expected yields per acre				
Cropping system	Supporting practices	Corn	Soybeans	Oats	Hay	Pasture
		Bu.	*Bu.*	*Bu.*	*Tons*	*Lbs. beef*
Corn, corn, oats, meadow [2]	Surface drains	62	26	38	1.6	
Corn, corn, oats, meadow Corn, soybeans, corn, oats, meadow	Contouring Terracing	68	27	42	3.2	
Corn, corn, oats, meadow Corn, soybeans, corn, oats, meadow	Contouring Terracing	68	27	42	3.2	
Hay and pasture; woodland	Pasture improvement and woodland management.					120
Pasture and woodland	Pasture improvement and woodland management.					(3)
Woodland	Woodland management					(3)
Woodland	Woodland management					(3)
Woodland	Woodland management					(3)
Corn, soybeans, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Tiling and diversion terraces	65	28	50	2.8	
Corn, corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	66	28	42	3.0	
Corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	60	26	40	2.9	
Corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	55	23	35	2.8	
Corn, corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	66	28	42	3.0	
Corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	55	23	35	2.8	
Corn, corn, oats, meadow,[2] or corn, soybeans, corn, oats, meadow.	Surface drains	65	28	42	2.0	
Corn, corn, oats, meadow,[2] or corn, soybeans, corn, oats, meadow.	Surface drains	62	26	38	1.6	
Corn, corn, oats, meadow Corn, soybeans, corn, oats, meadow	Contouring Terracing	58	22	43	2.8	
Corn, corn, oats, meadow Corn, soybeans, corn, oats, meadow	Contouring Terracing	58	22	43	2.8	
Corn, corn, oats, meadow, meadow	Overflow protection	40	15	28	1.6	
Pasture and woodland	Pasture improvement or woodland management.					170
Pasture and woodland	Pasture improvement or woodland management.					(3)
Woodland	Woodland management					(3)
Woodland	Woodland management					(3)
Woodland	Woodland management					(3)
Corn, corn, corn, oats with a legume for green manure, or corn, soybeans, corn, oats, meadow.	Diversion terraces	60	24	41	3.0	
Pasture or woodland	Pasture improvement and woodland management.					
Corn, corn, corn, oats with a legume for green manure.	None	75	27	55	3.2	
Corn, soybeans, corn, oats with a legume for green manure.	Overflow protection, open-ditch drainage.	60	24	45	2.8	
Corn, corn, oats, meadow	Diversion terraces	74	30	52	3.2	
Corn, corn, oats, meadow	Diversion terraces	70	30	50	3.0	
Same as surrounding areas	Mulch tillage	15	8	14	1.0	
Same as surrounding areas	Mulch tillage	15	8	14	1.0	
Corn, corn, oats, meadow, meadow Corn, corn, oats, meadow	Contouring Terracing	54	20	36	2.8	

TABLE 3.—*Problems, suggested management, and expected*

Soil	Management group and capability subclass	Management problems			
		Available nitrogen	Available phosphorus	Available potassium	Other
Pershing silt loam, 5 to 9 percent slopes	12(IIIe)	Low	Low	Medium	Erosion
Pershing silt loam, 5 to 9 percent slopes, moderately eroded.	12(IIIe)	Very low	Low	Medium	Erosion
Pershing soils, 5 to 9 percent slopes, severely eroded	19(IVe)	Very low	Low	Medium	Erosion and fertility maintenance.
Pershing silt loam, bench position, 2 to 5 percent slopes.	4(IIe)	Low	Low	Medium	Erosion
Pershing silt loam, bench position, 5 to 9 percent slopes.	12(IIIe)	Low	Low	Medium	Erosion
Rubio silt loam, bench position	8(IIw)	Low	Low	Medium	Wetness
Rushville silt loam, bench position	8(IIw)	Very low	Low	Medium	Wetness
Seymour silt loam, 2 to 5 percent slopes	4(IIe)	Low	Low	Medium	Erosion
Seymour silt loam, 5 to 9 percent slopes, moderately eroded.	12(IIIe)	Low	Low	Medium	Erosion
Seymour soils, 5 to 9 percent slopes, severely eroded	19(IVe)	Very low	Low	Medium	Erosion
Shelby loam, 14 to 18 percent slopes, moderately eroded.	18(IVe)	Low	Very low	Medium	Erosion
Shelby loam, 18 to 25 percent slopes, moderately eroded.	21(VIe)	Low	Very low	Medium	Erosion
Shelby soils, 14 to 18 percent slopes, severely eroded	21(VIe)	Very low	Very low	Medium	Erosion and fertility maintenance.
Shelby soils, 18 to 25 percent slopes, severely eroded	23(VIIe)	Very low	Very low	Medium	Erosion and fertility maintenance.
Steep sandy land	24(VIIs)	Very low	Very low	Low	Erosion and droughtiness.
Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes.	23(VIIe)	Very low	Very low	Medium	Erosion
Wabash silty clay loam	15(IIIw)	Low	Medium	Medium	Wetness due to flooding.
Wabash silty clay loam, overwashed	15(IIIw)	Low	Medium	Medium	Wetness due to flooding
Waukegan loam, deep, 0 to 2 percent slopes	1(I)	Low	Medium	Medium	None
Waukegan loam, deep, 2 to 5 percent slopes	3(IIe)	Low	Medium	Medium	None to slight erosion
Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded.	9(IIIe)	Low	Medium	Medium	Erosion
Waukegan loam, moderately deep, 0 to 3 percent slopes.	13(IIIs)	Low	Medium	Medium	Droughtiness
Waukegan loam, moderately deep, 3 to 6 percent slopes.	13(IIIs)	Low	Medium	Medium	Droughtiness and erosion.
Weller silt loam 2 to 5 percent slopes	10(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, 2 to 5 percent slopes, moderately eroded.	10(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, 5 to 9 percent slopes	11(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, 5 to 9 percent slopes, moderately eroded.	11(IIIe)	Very low	Low	Medium	Erosion
Weller soils, 5 to 9 percent slopes, severely eroded	19(IVe)	Very low	Low	Medium	Erosion and fertility maintenance.
Weller silt loam, bench position, 2 to 5 percent slopes	10(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded.	10(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, bench position, 5 to 9 percent slopes	11(IIIe)	Low	Low	Medium	Erosion
Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded.	11(IIIe)	Very low	Low	Medium	Erosion
Weller soils, bench position, 5 to 9 percent slopes, severely eroded.	19(IVe)	Very low	Low	Medium	Erosion and fertility maintenance.

[1] These soils are of marginal value for grain because yields are low, even though erosion can be controlled by contouring and terracing. Hay and pasture are suitable, and, under some economic conditions, cropping systems can be used. If the cost-return ratio for corn is favorable and the soils are terraced, a suitable cropping system is corn for 2 years, oats for 1 year, and meadow for 2 years. A cropping system consisting of corn for 1 year, oats for 1 year, and meadow for 4 years is probably best for long-time use on these soils.

[2] If management is exceptionally good and the fertility level is very high, these soils can be used in a cropping system made up of row crops for 3 years and oats seeded with a legume for green

crop yields of Van Buren County soils—Continued

Suggested management		Expected yields per acre				
Cropping system	Supporting practices	Corn	Soybeans	Oats	Hay	Pasture
		Bu.	*Bu.*	*Bu.*	*Tons*	*Lbs. beef*
{Corn, corn, oats meadow	Terracing }	49	18	32	2. 7	
{Corn, oats, meadow, meadow, meadow	Contouring }					
{Corn, oats, meadow, meadow	Terracing }	44	14	26	2. 6	
{Corn, oats, meadow, meadow, meadow	Contouring }					
Hay and pasture	Pasture improvement	26	10	17	1. 6	200
{Corn, corn, oats, meadow, meadow	Contouring }	50	20	36	2. 8	
{Corn, corn, oats, meadow	Terracing }					
{Corn, corn, oats, meadow	Terracing }	46	18	32	2. 7	
{Corn, oats, meadow, meadow, meadow	Contouring }					
Corn, corn, oats, meadow [2]	Surface drains	60	24	42	2. 0	
Corn, corn, oats, meadow [2]	Surface drains	45	22	36	1. 5	
{Corn, corn, oats, meadow	Terracing }	60	26	40	2. 6	
{Corn, corn, oats, meadow, meadow	Contouring }					
{Corn, corn, oats, meadow	Terracing }	45	17	27	2. 4	
{Corn, oats, meadow, meadow, meadow	Contouring }					
Hay and pasture	Pasture improvement	26	10	17	1. 4	180
Hay or pasture	Pasture improvement	35		28	1. 6	200
Pasture or woodland	Pasture improvement					170
Hay or pasture	Pasture improvement and woodland management.					150
Pasture or woodland	Pasture improvement and woodland management.					(3)
Woodland	Woodland management					(3)
Woodland	Woodland management					(3)
Corn, soybeans, corn, oats with a legume for green manure.	Overflow protection and open-ditch drainage.	45	22	30	1. 6	
Corn, soybeans, corn, oats with a legume for green manure.	Overflow protection and open-ditch drainage.	48	25	35	1. 8	
Corn, corn, corn, oats with a legume for green manure.	None	78	30	55	3. 2	
Corn, corn, oats, meadow	None	75	30	55	3. 2	
Corn, corn, oats, meadow	Terracing	65	27	52	3. 0	
Corn, corn, oats, meadow, meadow	None	40	18	36	2. 0	
Corn, corn, oats, meadow, meadow	Terracing	38	16	32	1. 8	
{Corn, corn, oats, meadow, meadow	Contouring }	42	16	32	2. 5	
{Corn, corn, oats, meadow	Terracing }					
{Corn, corn, oats, meadow, meadow	Contouring }	38	14	28	2. 4	
{Corn, corn, oats, meadow	Terracing }					
(1)	(1)	37	14	27	2. 4	
(1)	(1)	32	12	22	2. 2	
Hay and pasture; woodland	Pasture improvement and woodland management.	20	9	15	1. 4	180
{Corn, corn, oats, meadow, meadow	Contouring }	45	18	34	2. 5	
{Corn, corn, oats, meadow	Terracing }					
{Corn, corn, oats, meadow, meadow	Contouring }	40	16	30	2. 4	
{Corn, corn, oats, meadow	Terracing }					
(1)	(1)	39	16	29	2. 4	
(1)	(1)	34	14	24	2. 2	
Hay and pasture; woodland	Pasture improvement and woodland management.	23	11	17	1. 4	180

manure for 1 year. Under this system, however, soil structure may be reduced below the desired level. If this occurs, it can be corrected by growing a grass-legume crop for 1 or 2 years. Insects, diseases, and weeds may become serious problems. Lime, large quantities of fertilizer, and crop residue must be used.

[3] Soils in capability class VII are not well suited to pasture renovation because they are on steep, irregular topography. Bluegrass is dominant in nontimbered areas. The production of beef depends mainly on absence of weeds, brush, and trees in pastures. A bluegrass pasture free of weeds, brush, and trees will produce 80 to 100 pounds of beef per year. An average weedy and brushy pasture produces 50 pounds or less per year.

TABLE 4.—*Guide for the planting of trees and shrubs on stated soils, slopes, and exposures*

Soils	All slopes as much as 14 percent and any exposure on uplands, coves, benches, and second bottoms; and slopes of 14 percent or more facing north and east		Slopes of 14 percent or more facing south and west	
	For windbreaks and field plantings	For wildlife plantings	For windbreaks and field plantings	For wildlife plantings
Shallow or droughty soils: Dickinson Douds soils and Terrace escarpments Lamont Landes Nodaway-Coppock complex, flaggy Perks and Hagener Steep sandy land Sogn [2] Waukegan loam, moderately deep	Sites not subject to overflow: Austrian pine [1] Eastern white pine Jack pine Scotch pine Virginia pine Sites subject to repeated and heavy overflow: Cottonwood	Eastern redcedar Russian-olive	Eastern redcedar Jack pine Virginia pine	Eastern redcedar Russian-olive
Deep, well-drained to imperfectly drained soils that are moderately to moderately slowly permeable: Clinton Downs Givin Keomah Nodaway Olmitz Shelby Waukegan loam, deep	Sites not subject to overflow: Aspen-poplar hybrid (Shimek or Sherrill) Austrian pine [1] Black walnut Cottonwood Eastern white pine European larch Green ash Jack pine Norway spruce Osage-orange Red pine Soft maple Virginia pine Sites subject to repeated and heavy overflow: Cottonwood Green ash Soft maple Sycamore	Sites not subject to overflow: Aromatic sumac Eastern redcedar Honeysuckle Multiflora rose Ninebark Russian-olive Sericea lespedeza Sites subject to repeated and heavy overflow: Purple willow	Aspen-poplar hybrid (Shimek or Sherrill) Austrian pine [1] Eastern redcedar European larch Jack pine Virginia pine	Aromatic sumac Eastern redcedar Ninebark Russian-olive
Slowly to very slowly permeable soils or soils with poor drainage: Adair and Clarinda Beckwith Belinda Carlow Chariton Chequest Colo Coppock Edina Gosport Gravity Grundy Haig Lindley Nodaway silt loam, silty clay substratum Pershing Rubio Rushville Seymour Wabash Weller	Sites not subject to overflow: Aspen-poplar hybrid (Shimek or Sherrill) Austrian pine [1] Black walnut Cottonwood Eastern redcedar Eastern white pine European larch Norway spruce Soft maple Virginia pine Sites subject to repeated and heavy overflow: Cottonwood Soft maple	Sites not subject to overflow: Eastern redcedar Purple willow Sericea lespedeza Sites subject to repeated and heavy overflow: Purple willow	Aspen-poplar hybrid (Shimek or Sherrill) Eastern redcedar Jack pine Virginia pine	Eastern redcedar

[1] Austrian pine has been affected by a needle rust, which is similar to or the same as that on ponderosa pine. This rust has not generally been as severe on Austrian pine, but if observations indicate that Austrian pine is being seriously damaged by the rust, some of the other tree species should be substituted. The rust makes ponderosa pine unsuited to Van Buren County.

[2] Austrian pine, Scotch pine, and eastern redcedar are normally recommended for the Sogn soil because of the calcareous (high in lime) material it contains at fairly shallow depths.

Trees planted on formerly cultivated sites of Beckwith, Weller, and Lindley soils made the following height growth in the 20-year period, 1939–59:

	Feet
Red pine	30 to 35
Eastern white pine	30 to 35
Virginia pine	30 to 35
Jack pine	20 to 25
Eastern redcedar	15 to 16
Ponderosa pine	15 to 20

The breast-high diameter to which red, white, and Virginia pines had grown in 20 years averaged 5 to 6 inches. Occasional trees measured as much as 10 inches in diameter. Other species that also have grown well are Austrian pine and Scotch pine. Ponderosa pine is seriously affected by a needle rust, which in some cases has killed or nearly killed most of these trees. Needle rust also affects Austrian pine, but the damage so far has not been serious.

A hybrid aspen-poplar (Shimek) plantation in Shimek State Forest is 90 feet tall. Many trees are as much as 16 inches in diameter, breast high, at 30 years of age. For the most part, however, hardwoods do very poorly where planted on formerly cultivated soils. A study of plantations 20 years of age consisting of Osage-orange, green ash, black locust, Chinese elm, American elm, hard maple, red oak, wild black cherry, and walnut showed that the growth ran from poor to very poor when these species were planted in old cultivated and eroded fields. Cottonwood, soft maple, and walnut, when planted in well-drained bottom-land soils, made fairly good growth.

Selecting soils for woodland planting

In selecting soils for woodland, the alternative uses should be considered. The probable returns from grain or pasture should be weighed against those expected from woodland—wood products, habitats for wildlife, recreation, and protection of watersheds.

Most soils suitable for trees also produce good yields of grain. The Clinton, Downs, and other good timber soils have been cleared and are cultivated for crops. Although well suited to timber, these soils are not normally suggested for trees because cultivated crops produce more income for the owner.

The Lindley and Gosport soils, Steep sandy land, Douds soils and Terrace escarpments, and the undifferentiated Sogn, Gosport, and Lindley soils were originally forested. Although poorly suited to grain, some of these soils have been cleared for cultivation. However, many cleared areas have reverted to brushy pasture or to inferior trees. The returns from well-managed woodlands on these less productive soils may compare favorably with those from pasture. The production of timber from these soils is lower than from the Clinton, Downs, and similar soils.

The Weller, Pershing, Shelby, Seymour, and Adair and Clarinda soils are more suitable for grain or pasture when uneroded or only moderately eroded. The severely eroded phases of these soils should be considered for woodland.

The soils in management groups 21, 22, 23, and 24 are not suitable for cultivated crops, but they are suitable for woodland or pasture. Areas of these soils that are not economically suitable for pasture can be used for trees for the production of wood, for protection of watersheds, for wildlife habitats, or for outdoor recreation. Woodlands should not be pastured.

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Woodland management

Local practices commonly used in the native woodlands have resulted in gradual deterioration of the quality of trees. The early settlers prized the woodlands as sources of fuel, posts, and poles and material for houses, barns, and the repair of implements. They harvested the best trees and left the less desirable in form and species. Gradually, the less desirable trees dominated the woodlands and reduced their economic value. As a result, the woodlands became liabilities instead of assets to many farmowners. Most woodlands are used as pasture and are seriously overgrazed. Grazing always reduces the possibility of improving the woodlands.

Native woodlands still in existence can yield a fair quantity of wood products if management is good. Table 5 shows the approximate annual growth that can be expected from well-managed stands of native hardwood sawtimber on stated soils in Van Buren County. The droughty, sandy soils now in hardwood trees should be converted to pine if wood is to be their future crop.

Basic management should consist of protecting woodlands from grazing and fire, gradually improving the composition of the woodland, and eventually regulating the cut or harvest to balance the growth. Management is started by going through a woodland and selecting the trees suitable for crop trees and allowing them to grow. The next step is to remove as many of the inferior trees as possible to eliminate competition with the crop trees. The maturing crop trees are harvested selectively, and other crop trees are designated to take their place for the next crop or cutting cycle (fig. 8).

Landowners can get help from the soil conservation district in judging the best use of their land. Help in managing woodlands is available from farm foresters in the employ of the State Conservation Commission.

Some woodlands may be of such poor quality that the best procedure is to convert them from hardwoods to

Figure 8.—**Well-managed woodland in the Shimek State Forest north of Farmington.**

TABLE 5.—*Approximate annual growth per acre of well-managed native sawtimber on some soils of Van Buren County*

Soil	Cool sites [1]			Warm sites [1]		
	Dense stand	Medium stand	Open stand	Dense stand	Medium stand	Open stand
	Bd. ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
Clinton	250	185	125 or less			
Keomah	250	185	125 or less			
Givin	250	185	125 or less			
Weller	200	150	100 or less			
Pershing	200	150	100 or less			
Sogn, Gosport, and Lindley [2]	100–200			0–125		
Lindley	150	110	75 or less	75	55	35 or less
Rushville	125	90	60 or less			
Rubio	125	90	60 or less			
Belinda	125	90	60 or less			
Beckwith	100	75	50 or less			
Steep sandy land	100	75	50 or less			
Bottom-land soils (not droughty) [3]	300–700+	225–525	150–350 or less			

[1] Cool sites are those on eastern, southeastern, northern, northeastern, and northwestern exposures, and all exposures on slopes of less than 14 percent in coves and on lower slopes. Warm sites are those on western, southwestern, and southern exposures on slopes more than 13 percent, and those on ridgetops and upper parts of slopes.

[2] Production of wood is variable depending on the percentage of fine soil mixed with the rock. Existing timber is the best indicator of site. Tall, straight, clean-stemmed trees indicate good site; short, scattered, limby trees indicate poor site.

[3] Production of wood is variable depending on tree species. Maximum growth is obtained in stands that are mainly cottonwood; the lowest, in stands of elm, ash, and soft maple.

the relatively valuable evergreen-type of woodland. Before such conversion, competition from inferior species of trees and shrubs must be eliminated by mowing or by spraying them with some type of chemical brush-killer.

Uses and markets for woodland products

Pulpwood, Christmas trees, fenceposts, poles, lumber, veneer, barrel staves, and railroad ties are the most common woodland products. Some species are mentioned or discussed here but are not listed in the planting guide, (table 4). This is because they are not recommended for planting, although they occur in native woodlands or were formerly planted.

Pulpwood.—There is a market for pulpwood in Fort Madison, Iowa. Most of Van Buren County is in the pulpwood purchasing area of this plant. In the past, it has been difficult for farmers to start managing the woodlands because markets were lacking for inferior species and poorly formed trees. Now, however, inferior species and poorly formed trees can be utilized for pulpwood. At the present time, farmers who practice good woodland management are paid a premium price for the pulpwood they harvest. This incentive should result in a gradual improvement in the management of woodlands in Van Buren County.

All the local native hardwoods are bought for pulpwood except black locust, walnut, Osage-orange, and hickory. All of the locally planted pines and spruce are also good pulpwood, but inadequate supplies have limited their use. Woodland owners should acquaint themselves with the pulpwood specifications before cutting their trees. Pulpwood buyers can supply this information.

Christmas trees.—Most of the Christmas trees sold in Iowa are shipped from other States. Some of the soils in Van Buren County are suitable for Christmas-tree production, according to the planting guide in table 4. Christmas trees may be harvested when thinning field plantings of evergreens. They may also be grown commercially as a special enterprise.

The business of raising and selling Christmas trees for income is a highly developed and specialized field. The grower should have knowledge of the suitability of species, of the techniques of planting, spacing, and shaping, of layout of fields, of protection from insects and rodents, and of harvesting and marketing. The production of large numbers of Christmas trees requires that markets be located well ahead of harvesttime. If this is not done, there will be little chance of making a satisfactory sale. Usually these markets are at some distance from the source of production and may be in or near large centers of population. A comparatively small acreage planted to Christmas trees would probably be enough to satisfy the local demand.

Branches and twigs may also be harvested from Christmas tree plantings to provide extra income. Boughs of jack pine and Scotch pine have value for Christmas greens because of the persistent cones.

Scotch pine is the most widely used species for commercial Christmas-tree production in the Midwest. Other species in the approximate order of preference are: Norway spruce, white pine, red pine, Austrian pine, Virginia pine, jack pine, and the local native redcedar. All of the pines just mentioned should be shaped or pruned at intervals during the growing years.

Fenceposts and poles.—Fenceposts and poles are in fairly constant local demand. Many farm operators harvest posts and poles from their own woodlands and save the money they would otherwise have to spend on these materials.

Osage-orange, mulberry, and black locust are very durable woods in contact with the soil, and they do not need treatment with preservatives. Bur oak, white oak, and eastern redcedar do not need treatment when used in the form of large round or split posts. Used as small round posts, these species should be treated with wood preservatives because of the high percentage of sapwood. Pressure treatment with creosote or pentachlorophenol is more effective than cold-soaking or dipping posts in these preservatives. Black oak, elm, larch, pin oak, red oak, shingle oak, maple, aspen, sycamore, and cottonwood should all be treated to make durable posts.

As a general rule, pines produce the straightest and most desirable poles, but this is not always the case. Poles are widely used in the construction of farm buildings, especially in barns, sheds, and similar structures.

Lumber.—Lumber has been milled from logs cut from native trees since pioneer days. Most of this lumber is produced by small sawmills in the form of rough boards and dimension stock. Walnut, wild black cherry, and hard maple have been used for rough lumber, but usually these species are much more valuable for furniture, paneling, and trim. Oaks have also been used for paneling, trim, and flooring, in addition to rough lumber. All of the oaks, ashes, and elms make good rough lumber, especially where extra strength is desired; they also make good finished lumber.

Cottonwood, elm, soft maple, and basswood are suitable as rough boards, sheathing, barnboards, and similar uses in farm construction. Warping and checking, caused by improper seasoning methods, are problems in the use of locally sawed lumber. However, fairly high quality native lumber can be produced if it is piled properly and thoroughly air-dried before use.

Veneer.—Veneer can be made from most of the local native hardwoods if the required specifications for veneer logs are met. In general, the log must be straight and 16 to 18 inches in diameter at the small end and at least 6 to 8 feet and sometimes 10 to 12 feet or more in length. Local markets may have their own specification requirements. The log must be straight because it is either sliced into thin sheets or rotated against a knife to make the veneer.

Veneer logs usually can be sold for higher prices than ordinary logs. Those of black walnut, hard and soft maples, basswood, cherry, and red and white oaks are usually in good demand. Cottonwood is also cut into veneer for use in egg crates and similar items.

Barrel staves.—Good, high-quality white oak is in fairly constant demand at good prices for staves that are used in the cooperage industry. The staves are generally sawed from straight bolts of white oak, 36 to 39 inches long. Oak trees must be 16 inches or more in diameter and free of knots to be suitable for staves.

Railroad ties.—There is a fluctuating market for railroad ties, and most of the straight, native hardwoods can be used for this purpose. Trees of the white oak group, because of their durability and hardness, are desirable for railroad ties, but red oak, pine, maple, ash, and red elm can all be used. Any of these that are not naturally durable in contact with the ground must be treated with wood preservative.

General Information About Van Buren County

This section contains information about the climate, native vegetation, water supply, geology, history and development, transportation, industries and markets, and agriculture of Van Buren County.

Climate[2]

Van Buren County is in the southeastern part of Iowa. The Des Moines River flows through it from the northwestern corner to the southeastern corner. Keosauqua, the county seat, is in the central part of the county. Topographical variations in Van Buren County are not great; consequently, the climatological summary of the Keosauqua station can be applied generally to the whole county (table 6). Among the meteorological elements measured at the Keosauqua station, however, minimum temperatures and shower activity generally will be most variable throughout the county. On calm, clear nights minimum temperatures in the valleys and on lowlands generally will be a few degrees lower than those in the uplands. Showers, falling mostly in the summer, vary in amount and intensity within comparatively short distances, but seasonal totals are about the same for all parts of Van Buren County.

The climate is typically continental; the weather changes frequently, and often rapidly, in all seasons of the year. The summers are warm, and the winters are fairly cold. Intense cold or prolonged heat waves are comparatively rare. The proximity of the two major midwest storm tracks, one from the northwest and the other from the southwest, account for most of the pronounced and sometimes violent changes of weather.

Summer precipitation comes mainly in the form of thunderstorms and showers, which are occasionally associated with high winds and hail and, at times, a tornado. In southeastern Iowa, an area the size of Van Buren County can expect to have about one tornado per year, most likely in May or June. The heaviest rainfalls are recorded in June, July, and September. The greatest amount falling per observational day is 11.23 inches, which was recorded on June 11, 1905.

Rainfall intensities of 2.90 inches or more in 24 hours and 1.50 inches in 1 hour, or both, can be expected about once in 2 years. Those of 5.75 inches or more of rain in 24 hours and 2.40 inches or more in 1 hour, or both, can be expected about once in 50 years. These probabilities are based on Keokuk, Iowa, rainfall frequency data. Usually June has the most thunderstorms and precipitation of any month in the year. It has an average of 10 thunderstorms and a rainfall of 5.52 inches.

Flooding of the Des Moines River usually occurs about once or twice a year—late in March, or early in April, or in June. The biggest flood in recent years occurred in June of 1947 at which time the crest was 25.2 feet at the Keosauqua gage.

About two-thirds of the annual precipitation falls during the growing season—April through September. An inch or more of rain per week in May and June, about what growing corn should have, occurs in about 2 weeks out of 5 weeks. The chance diminishes to about 1 week out of 3 late in summer and then to 1 week out of 7 weeks through the harvest season.

The hazard of drought is least in May and June, but, thereafter, it increases. In March and April, the chance of a week without measurable rain is about 1 in 6; in May and June, 1 in 10; and then about 1 in 5 in the latter part of the growing season. Two consecutive rainless weeks during the crop growing season occur about once

[2] Prepared by PAUL J. WAITE, State climatologist, U.S. Weather Bureau.

TABLE 6.—*Temperature and precipitation at*

[Means and extremes for period 1929–58. Where

Month	Temperature							Mean degree days [1] [2]	Total precipitation		
	Mean			Extreme					Mean	Greatest daily	Year
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year				
	°F.	°F.	°F.	°F.		°F.			Inches	Inches	
January	35.0	15.5	25.3	69	1957	−36	1930	1,230	1.54	1.86	1955
February	39.2	19.4	29.3	78	1930	−27	1936	946	1.15	1.30	1948
March	50.1	28.5	39.3	89	1938	−8	1934	834	2.51	3.35	1935
April	63.8	40.4	52.1	92	1930	13	1936	387	3.38	3.01	1929
May	74.2	50.7	62.5	103	1934	27	1931	133	3.76	2.90	1951
June	83.2	60.9	72.1	107	1934	40	[3] 1956	17	5.52	6.33	1946
July	89.0	64.9	77.0	115	1936	46	[3] 1950	0	3.52	5.50	1931
August	87.0	63.1	75.1	115	1934	38	1934	3	3.73	2.98	1944
September	79.8	54.2	67.0	102	[3] 1947	26	1942	65	3.46	5.37	1947
October	68.8	43.4	56.1	95	[3] 1953	15	1952	299	2.70	2.63	1932
November	51.4	30.3	40.9	83	1938	−4	1929	711	2.07	2.06	1938
December	38.8	20.7	29.8	68	[3] 1946	−19	1932	1,071	1.53	2.81	1942
Year	63.4	41.0	52.2	115	[3] 1936	−36	1930	5,696	34.87	6.33	1946

[1] Average length of record is 8 years. [2] Base is 65° F.

every other season, and three successive weeks without measurable rain occur about once every 6 years.

The monthly mean temperature ranges from 77° F. in July to about 25° in January. The extreme temperatures on record are −36° reported on January 22, 1930, and 115°, recorded on August 9, 1934, and July 15, 1936. Temperatures above 90°, which is above the optimum for growth of most plants, occur about 37 days per year. The average freeze-free season is 173 days, a period extending from the average last freeze in spring, on April 24, to the average first freeze in fall, on October 14. In the 60 years, 1899–1958, the latest freeze in spring occurred on May 25, 1925; and the earliest freeze in fall, on September 13, 1902.

Native Vegetation

Van Buren County is in the region of prairie vegetation that extends from western Indiana westward into Nebraska. At the time of settlement, about half of the county was covered with luxuriant, tall, native grasses. These grasses were dominated (*4*) by big bluestem (*Andropogon gerardi*). Other grasses on the better drained uplands were little bluestem (*A. scoparius*) and side-oats grama (*Bouteloua curtipendula*), the latter on drier sites. On droughty south-facing slopes and on sandier and shallow soils of the dry prairie were sand dropseed (*Sporobolus cryptandrus*), porcupinegrass (*Stipa spartea*), Junegrass (*Koeleria cristata*), prairie cordgrass (*Spartina pectinata*), and prairie three-awn (*Aristida* sp.). In the lower, more poorly drained parts, the dominant plants were sedge (*Carex* sp.), common reed (*Phragmites communis*), common cattail (*Typa latifolia*), and boggrass. There were occasional clumps of willow (*Salix* sp.) and alder (*Alnus rugosa*).

Undisturbed prairie on the better drained soils now can be found in only a few places in the county. Nearly all the prairie sod has been turned under, and the small areas that have escaped the plow have been altered. Grazing has practically eliminated the tall prairie grass (bluestem) in the few natural pastures and meadows that remain in the county. Bluegrass now dominates in these forage areas.

Native timber originally grew on the bottom land of tributary creeks, along the steep bluffs bordering the Des Moines River, and on uplands bordering the small tributaries of the Des Moines River. White, red, and black oaks, white and red elms, shagbark hickory, and green ash were the principal hardwood trees.

All native timber has been cutover. Most of the present woodlands have to compete with livestock for existence. Few woodlands are fenced to keep out livestock.

Water Supply

Much of the water for farm homes and livestock is supplied by wells 40 to 100 feet deep. From these depths, the supply is sometimes inadequate, and in long dry periods, additional water is obtained from farm ponds or hauled in from the towns. Ample water may be obtained in wells drilled to depths of 300 to 600 feet.

Many operators have constructed farm ponds (fig. 9) as a source of supplemental water and as a reserve supply for livestock in dry seasons. Farm ponds also provide water for fire protection. Other uses of farm ponds are fishing, swimming, and habitat for wildlife.

The towns along the Des Moines River obtain water from wells in the bottom lands or on terraces along the river. Abundant water is usually available a few feet

Keosauqua weather station, Van Buren County, Iowa

there is no entry in a column, data are not available.]

Total precipitation—Continued					Mean number of days				
Snow and sleet					Precipitation of 0.10 or more	Temperatures			
						Maximum		Minimum	
Mean	Maximum monthly	Year	Greatest daily	Year		90° F. and above	32° F. and below	32° F. and below	0° F. and below
Inches	*Inches*		*Inches*						
6.9	26.0	1936	10.0	[3] 1958	4	----	13	29	5
4.6	10.0	1944	8.0	1933	4	----	7	25	3
4.4	18.0	1951	8.0	1946	5	----	2	21	----
.5	4.0	1936	4.0	1936	7	----	----	1	----
([4])	([4])	[3] 1954	([4])	[3] 1957	7	1	----	----	----
----	----	----	----	----	7	7	----	----	----
----	----	----	----	----	5	13	----	----	----
----	----	----	----	----	6	11	----	----	----
([4])	([4])	[3] 1949	([4])	[3] 1949	5	5	----	----	----
([4])	([4])	[3] 1958	([4])	[3] 1958	4	----	----	4	----
1.2	6.5	1937	6.0	1934	4	----	2	18	----
5.4	16.2	1944	10.0	1944	4	----	9	26	2
23.0	26.0	1936	10.0	[3] 1958	62	37	33	130	10

[3] Also on earlier dates, months, or years. [4] Trace, an amount too small to measure.

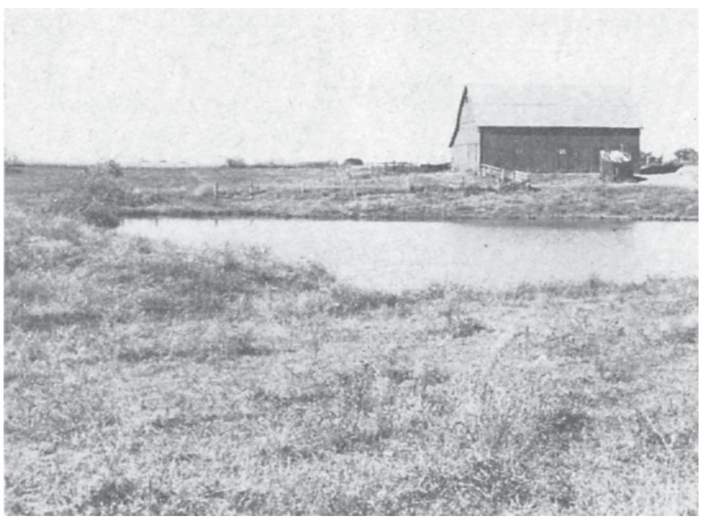

***Figure 9.*—Farm ponds can provide many needed benefits to the owner. Maximum usefulness is obtained through fencing impounded areas.**

below the riverbed. Milton gets its water from the bottom land along the Fox River. The Cantril, Stockport, Douds, and Birmingham communities get their water from dug wells.

Most of the streams have little gradient and are not used for power. In early days, however, water-powered grain mills were located on the Des Moines River. These mills have been abandoned a long time.

There are no natural lakes in Van Buren County. One artificial lake has been built for recreation in the Lacey-Keosauqua State Park. A smaller artificial lake is at Farmington.

Geology

Loess, glacial till, stream-laid deposits, local loess and eolian sands, and shale and limestone bedrock are the principal geologic deposits in Van Buren County (fig. 10).

Loess

Loess is a silty, wind-deposited material that occurs on upland flats, divides, and upper slopes. It is smooth to the touch, and in contrast to glacial till, contains no stones or gravel. Deposits of loess on upland flats are 6 to 10 feet thick and on gently sloping ridgetops, 3 to 5 feet thick. Probable sources of the loess were the Missouri River bottoms of western Iowa and the Wisconsin glacial till plain of north-central Iowa prior to the time it was covered by vegetation. The loess was probably deposited in the Middle to Early Wisconsin glacial age, and likely covered the whole county. Geological erosion has removed it from the steeper slopes, however, and reexposed the underlying bedrock or glacial material. Some of the loess, especially that on bench terraces or on slopes adjacent to the Des Moines River, contains a higher percentage of sand than upland loess. Some of the loess may be of local origin. A few areas of wind-deposited sand occur on bench terraces and the adjacent uplands.

Glacial till

Glacial till is an unstratified, unconsolidated, heterogeneous mixture of clay, silt, sand, gravel, and sometimes boulders, all deposited directly by glacial ice. Little or none of it was transported by water.

Glaciers have moved across Iowa and covered all of Van Buren County twice. The Nebraskan glacier covered the county about 750,000 years ago (*9*). It was followed by the Kansan glacier about 500,000 years ago (*9*).

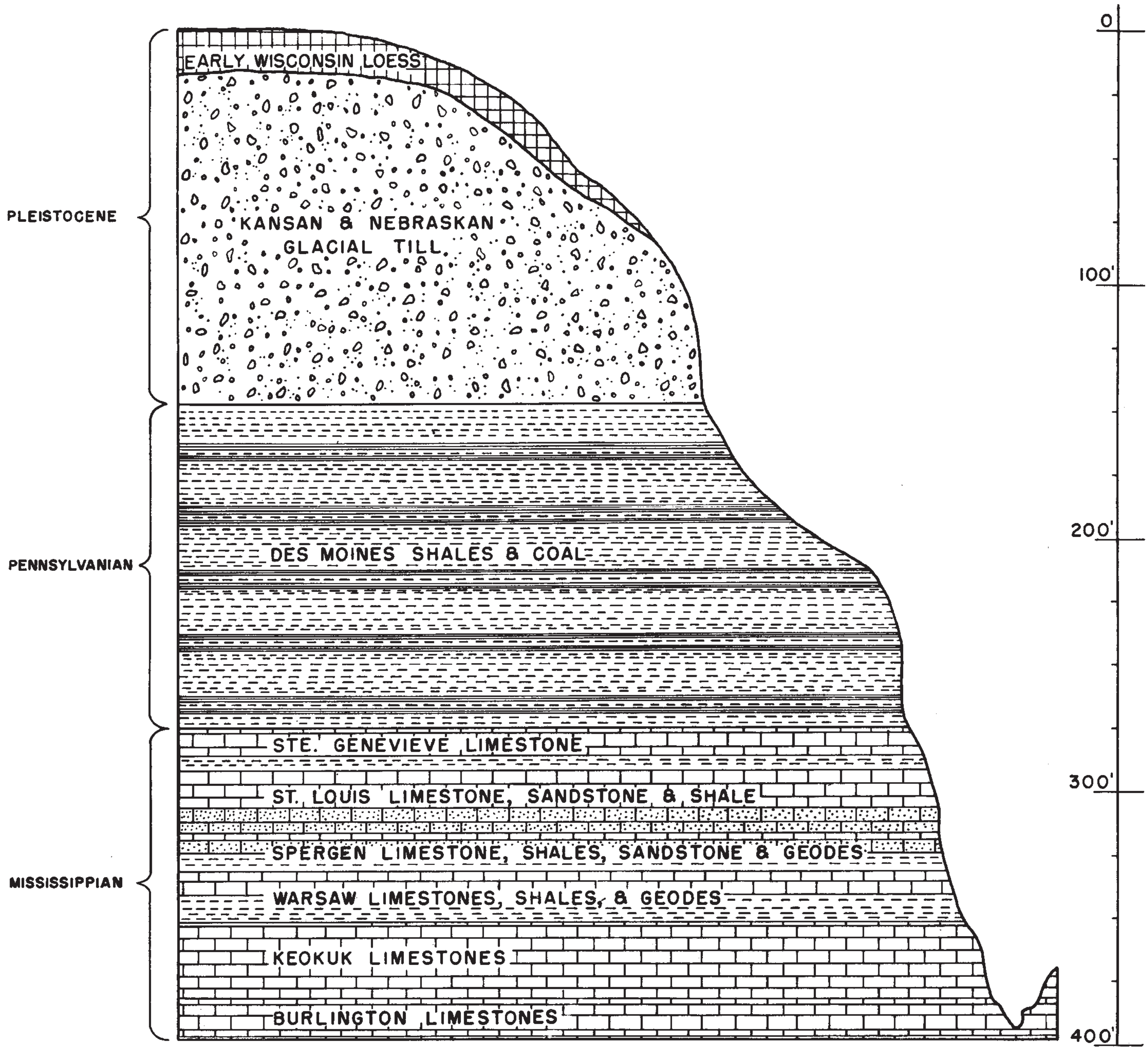

Figure 10.—**Schematic cross section of the valley of the Des Moines River showing geologic formations.**

The original deposits of till were calcareous clay loam, 50 to 200 feet thick. They were thickest in the southwestern corner of the county. Erosion has removed the glacial material from some of the steepest slopes and re-exposed the underlying bedrock.

Stream-laid deposits

Stream-laid materials have been transported and deposited by water. They are known as alluvium and range in texture from sand or gravel to clay or silty clay. Alluvium is on the bottom lands, low terraces or second bottoms, and high bench terraces adjacent to the streams of Van Buren County. High bench terraces were deposited in the early stages of the stream development. They are as much as 140 feet above the low-water level of the present streams (*3*).

Shale and limestone bedrock

Limestone bedrock is exposed along the major drainage systems in the county. It has had very little influence on the development of soils in the county, as only one series is directly related to limestone bedrock. Most of the limestone bedrock is of the Mississippian period (*26*) and can be further subdivided into the following stages (see figure 10):

St. Genevieve limestone.
St. Louis limestone (limestone, sandstone, shale).
Spergen limestone (limestone, shale, geodes).
Warsaw shale (limestone, shale, geodes).
Keokuk limestone.
Burlington limestone.

The shale bedrock is mainly part of the Des Moines series (*26*). It overlies the Mississippian limestone and is several million years old, having been deposited during the Pennsylvanian period (*26*).

The Des Moines shales contain thin seams of limestone, sandstone, clay, and coal. Only 2 to 3 percent of the soils of the county have been developed from shale bedrock. Most of the shale bedrock has an overburden, several feet thick, of glacial till and loess.

History and Development

White men came to Van Buren County long before the county was organized. In 1832 Capt. William Phelps, Peter Avery, and others arrived and spent the winter of 1832–33 opposite the site of Kilbourn at the mouth of Lick Creek.

The area that became Van Buren County was originally part of the Louisiana Purchase. Van Buren County was formed in 1836, and Farmington became the county seat. The west boundary of the county extended to the limits of the territory possessed by the United States. In 1839 the State Legislature designated Keosauqua as the county seat.

The first settlement for purposes of actual improvement was started by Abel Galland and William Jordan in 1833 near the site of Farmington. The first settler on the site of the present town of Keosauqua was John Silvers, who built a log hut in the winter of 1835–36 on the bank of the Des Moines River near the site of the hotel.

The town of Keosauqua was laid out in April 1839 by John Carnes, James Hall, James and Edwin Manning, John J. Fairman, and Robert Taylor. These men comprised the "Van Buren Company." A general act of the legislature incorporated the town on February 17, 1842.

The first bridge across the Des Moines River at Keosauqua was built in 1873.

The name "Keosauqua" is of Indian origin. It means "the river of monks" and was applied by the Indians to a place along the river inhabited by monks.

Transportation

Two railroads are in the county. The Chicago, Burlington, and Quincy Railroad has one branch line in the northeastern part of the county that connects Birmingham with Fort Madison. It has another line in the southern part that connects Fort Madison, Iowa, with Kansas City, Missouri. The Chicago, Rock Island, and Pacific Railroad runs from the northwestern corner of the county to the southeastern. It connects Keokuk, Ottumwa, and Keosauqua and serves the central part of the county. Several truck and bus lines also serve the county.

State Highway No. 2 crosses the southern part of the county from east to west. State Highway No. 1 crosses near the center of the county from north to south. State Highway No. 16 crosses the northern part of the county. These major highways are supplemented by many hard-surfaced county roads. Few farms are more than one-half mile from an all-weather road that connects the producer with market and trading centers.

Industries and Markets

When ready for slaughter, beef cattle, hogs, and sheep are sometimes trucked to packing plants in Ottumwa or to other Iowa and Missouri markets. Fat cattle and feeder stock are marketed through community sale barns in Keosauqua and Bonaparte.

Corn and other grains are bought and sold through local grain dealers in the county. Cooperative creameries are located at Keosauqua and Farmington. Forest products are processed in local sawmills or stave mills. Pulpwood is marketed at a processing plant at Fort Madison.

Manufacturing is not a major industry, but a few small plants are in towns throughout the county. A number of farmers supplement their income by working in industrial plants outside of the county.

Agriculture

Van Buren County is in the southern pasture area of Iowa. Farming is based on the production of grains, hay, and pasture and supplemented by raising of livestock. Corn is the leading grain crop. Few soybeans were grown until 1940, but since then the acreage has tripled. According to the State of Iowa Annual Farm Census, land in farms totaled 299,687 acres in 1955. There were 1,545 farms in Van Buren County, and the average size was 194 acres. Farm operators owned 71.7 percent of the land they farmed; the rest they rented.

Crops

Acreages of the principal crops in 1955, according to the State of Iowa Annual Farm Census, were as follows:

Corn, all purposes	44, 903
For grain	43, 748
Other purposes	1, 155
Oats	23, 320
Soybeans	22, 799
Wheat	2, 890
Rye	164
Barley	77
Hay, all kinds	26, 741
Clover, timothy, and mixtures of these	17, 383
Alfalfa and alfalfa mixtures	8, 771
Soybean	106
Small grains	398
Other (tame and wild hay not otherwise enumerated)	83
Other crops	101
Timothy seed	702
Red clover seed	1, 332
Pasture	152, 586
Cropland not harvested or pastured (includes idle, fallow, failure, etc.)	261
Land in lots, roads, buildings, woods, waste, etc	25, 143

Corn is usually planted in power-checked or drilled rows between May 10 and May 20. Some farmers still plant corn in rows that run uphill and downhill parallel with the fences; some plant on the contour. The crop is cultivated from one to three times. Weather, quantity and kinds of weeds, and the press of other urgent farm operations determine the number of cultivations corn gets.

Only hybrid corn is planted. Most commonly used are the varieties having a 110- to 120-day maturity rating.

Row-crop tractors are used for cultivation. Harvesting is done by mechanical pickers. Most of the corn is fed to livestock on the farm; some corn is sold.

Soybeans, the most important cash grain crop, rank third in acreage. Soybeans are drill-planted in May in about the same manner as corn. Rows are cultivated by use of corn cultivators, and the crop is harvested by use of combines. The soybeans are sold at elevators and shipped to markets in Iowa and Missouri.

Oats is the most extensive small grain. It is grown mainly for feed on farms and as a companion crop for legumes. Oat varieties have changed rapidly during the past years. Oats are planted the last of March or as early as possible in April to assure early maturity and to avoid the yield-decreasing summer heat. The crop is harvested early in July.

Other small grains are wheat, rye, and barley. Rye and barley never have been important crops in the county. The acreage in wheat is increasing slightly.

Until 1950 timothy and red clover were important seed crops. The introduction and use of orchardgrass and bromegrass with alfalfa in cropping systems has decreased the acreage used to produce timothy and red clover seed. In 1955 about 2,000 acres of timothy and red clover seed was harvested, as compared to about 11,000 acres in 1950.

Hay and forage crops are grown almost entirely for consumption on the farm. Clover and timothy mixtures are still the most important hay crops, but the acreage has steadily decreased since 1940. Alfalfa mixtures have increased from 3,840 acres in 1940 to 8,771 acres in 1955. Alfalfa is commonly grown in a mixture with bromegrass or orchardgrass, and seeded with oats as a companion crop. It is used for 1 to 5 years in the cropping system. Three cuttings are usually made each year for hay.

Soybean hay, small-grain hay, and unspecified hay are minor hay crops, which generally are used to supplement the supply of other hay in years of failure, dry weather, or when additional forage is needed for greater numbers of livestock. Small grains that have lodged badly by wind and rain may be salvaged as hay.

Pasture

Pastures occur throughout the county, but the largest acreage is parallel to the Des Moines River and its tributaries in general soil area 3. On uplands, the better unimproved pastures consist mainly of Kentucky bluegrass mixed with clover and lespedeza. However, many unimproved pastures have been overgrazed and allowed to decline in fertility, and under these conditions, Kentucky bluegrass has been replaced by Canada bluegrass and by prairie three-awn (*Aristida*), commonly called povertygrass. Many pastures are brushy or are in cutover timber.

Improved pastures consist mainly of orchardgrass or bromegrass mixed with lespedeza, alfalfa, and red clover. Kentucky bluegrass pasture is improved by the addition of birdsfoot trefoil as the legume.

Livestock and Livestock Products

Many farmers throughout the county keep from 7 to 12 beef cows and sell the calves in the fall for feeder stock. One or more of the cows may be milked to supply milk for the family. Beef cattle are largely of the Hereford, Shorthorn, and Aberdeen-Angus breeds. There are several purebred herds of these breeds, and some herds are mixed breeds. Holstein and Guernsey are the principal breeds of dairy stock. Dairy products are marketed through local creameries. Beef cattle are sold in community sale barns or are trucked to nearby packing centers.

Hogs are raised throughout the county but are most numerous in areas of greatest corn production. Most farms in the county keep only enough hogs to consume the corn harvested. The principal breeds of hogs are Duroc-Jersey, Hampshire, Poland China, and Chester White. There are several purebred herds of these breeds, as well as several herds of hybrids and crossbreds. Hogs are marketed in the same places as beef cattle.

Sheep decreased in the number born from 29,309 in 1940 to 22,414 in 1955. Most farmers who keep beef cows also keep 10 to 20 ewes. The principal breeds of sheep are Shropshire, Hampshire, and Corriedale. There are some purebred flocks of these breeds.

The production of poultry is another important farm enterprise. Chickens have decreased in number since 1945. However, the numbers of turkeys and of turkey growers have increased. A few ducks and geese are raised.

The principal kinds of livestock on farms in Van Buren County in 1955, according to the State of Iowa Annual Farm Census, were as follows:

	Number
Grain-fed cattle marketed	1, 495
Grain-fed sheep and lambs marketed	3, 866
Calves born	13, 593
Lambs born	22, 414
Sows farrowing, fall	[1] 4, 330
Sows farrowing, spring	[2] 6, 364
Milk cows	[3] 5, 148
Beef cows	[4] 9, 365
Hens and pullets of laying age	120, 534
Chickens raised	147, 878
Turkeys raised	6, 502

[1] Sows farrowed between June 1 and December 1, 1955.

[2] Sows bred to farrow between the previous December 1 and June 1, 1956.

[3] Includes all cows and heifers 2 years old and older, fresh, dry, or to freshen, kept for milk production.

[4] All cows and heifers 2 years old and older not reported as "milk cows."

Genesis, Morphology, and Classification of the Soils

This section is written primarily for specialists in soils and agriculture. It is of a technical nature and is intended to provide a better understanding of Van Buren County soils. Discussions of soil genesis, morphology, and classification, as well as available laboratory data, are included.

Genesis

Several factors have influenced the development of the Van Buren County soils (*7*). The interaction of these factors account for the wide range of soil types. The factors involved are parent material, length of time the soils have weathered, climate, vegetation, topography, and living organisms, and man. A brief discussion of these factors of soil formation is given in this section.

Parent material

The soils of Van Buren County have developed from limestone and shale, glacial till, loess, and stream-laid deposits. The stratigraphic relationship of these parent materials are shown in figure 10.

Limestone bedrock.—Bedrock of Mississippian age (*26*) underlies all of Van Buren County. These formations are nearly all limestone, but there are a few interbedded shales. Most of the Mississippian limestone is covered by Des Moines shale of Pennsylvanian age (*26*). The limestone is exposed as a parent material for soils in only a few places along the steeper areas near the Des Moines River and its tributaries. Only the Sogn soils are underlain at shallow depths by limestone bedrock, and they are considered Lithosols, or soils with an AD profile.

Shale bedrock.—The Des Moines shale (Pennsylvanian age) that covers all of Van Buren County and overlies the older Mississippian limestone contains thin lenses of sandstone and limestone and has been covered by glacial deposits. This shale is exposed as a soil parent material only in the more strongly dissected areas along the Des Moines River and some of its tributaries. The shale has weathered to a firm silty clay or silty clay loam, which is usually strongly acid in reaction. The Gosport soils are the only soils developed from shale in Van Buren County.

Glacial till.—The first glacier to cover Van Buren County was the Nebraskan. The till from this glacier has the texture of clay loam, and it is calcareous where no leaching or soil formation has taken place. It covers the Pennsylvanian shales. Soils were formed on the Nebraskan glacial till during the Aftonian interglacial age (*9, 18*). These soils and the Nebraskan glacial material were later covered by Kansan glacial till, and they are not now exposed to any great extent in Van Buren County. If those formed in Nebraskan till are exposed, they are not readily distinguishable from the soils formed in Kansan till.

The last glaciation to cover Van Buren County was the Kansan (*9*). The till left by this glacier is a predominantly calcareous clay loam where no leaching or soil formation has taken place. It covers the Nebraskan till, and the combined thickness of glacial till is generally 50 to 200 feet. Soils were formed from the Kansan glacial till during the Yarmouth interglacial age, the Illinoian glacial age, and the Sangamon interglacial age (*18, 19, 3*). On the level or nearly level areas, a soil formed that had a dark-gray, plastic clay subsoil several feet thick. Many geologists and soil scientists have referred to this soil as gumbotil (*8, 9, 19*). More recently this soil was buried by the deposit of Wisconsin loess. Similar buried soils have been reported to have the morphologic features of a Humic Gley soil (*17, 22, 2*) that developed under grass or forest. Where this soil outcrops on the surface because of geological erosion of the loess mantle, it is called Clarinda and is mapped with the Adair and Clarinda soils in Van Buren County.

As geologic erosion took place on the Kansan till during Sangamon time, a stronger relief developed. On the steeper slopes another soil developed, which has many of the morphological characteristics of the present-day Gray-Brown Podzolic soils (*19, 11*). This paleo, or relict, soil is characterized by (1) a moderately dark colored A_1 horizon; (2) a gray, gritty silt loam A_2 horizon that has developed from leached Late Sangamon pedisediment; (3) a Late Sangamon stoneline; and (4) a brown or reddish-brown silty clay or clay B horizon that has developed from Kansan till (*13, 14*). Ruhe and Scholtes have considered similar buried soils to be Late Sangamon in age (*18*). Where geologic erosion has removed the overlying Wisconsin loess (*13*) and reexposed this Late Sangamon soil on the side slopes, the soil is called Adair if it supported prairie vegetation. This soil is mapped with the Clarinda soils. The relationship of paleosols and modern soils to landscape position is shown in figure 11.

In the development of the modern landscape in Van Buren County, the loess, the gumbotil, and the soils with reddish-colored subsoils of the Late Sangamon age have been removed by geologic erosion from most of the lower and steeper parts of the side slopes. In these positions, the recently exposed and only slightly weathered till occurs. Here the Shelby and Lindley soils have formed, the former under prairie and the latter under trees.

Loess.—The Wisconsin glacial period started at the close of the Sangamon interglacial age. During the Middle to Early Wisconsin period, loess was deposited over Van Buren County (*15, 16*). The possible sources of the loess are believed to have been the Wisconsin till plain in north-central Iowa and the Missouri River bottoms in western Iowa. Loess probably covered all of Van Buren County, but later geologic erosion removed it from the side slopes in varying amounts, depending on the slope and geomorphology of the land surface. The thickest mantle of loess remaining is on level upland flats and wide divides. The relationship between the loess mantle and the underlying glacial till is shown in figures 3 and 11.

A large part of the Van Buren County soils have developed from Wisconsin loess (*12, 20, 23*). The soils derived from Middle to Early Wisconsin loess are of the Grundy, Seymour, Pershing, Weller, Beckwith, Belinda, and Edina series.

The loess, covering many of the benches and adjacent uplands along the Des Moines River and its tributaries, contains a higher percentage of sand than the usual upland loess. This slightly coarser loess may have originated partly in the local, adjacent stream valleys. Soils that have developed in this loess are of the Clinton, Keomah, Rubio, and Givin series. These soils tend to be in the better drained range for the soil series.

A few areas of wind-deposited sand occur on the north and east sides of the Des Moines River, although some occur on the south side. This sand is believed to have had its origin in the valley of the Des Moines River and its tributaries in the Late Wisconsin period. The Lamont soils have formed in eolian sand.

Stream-laid deposits.—These deposits are extensive along the major streams in Van Buren County. Some are recent deposits, mainly silt loam to sand in texture, from which the Nodaway, Perks, and Landes soils have developed. Other stream-laid deposits are older and have a texture ranging from sandy loam to silty clay or clay. Soils formed from these, listed in the order of increasingly fine texture, are the Dickinson, Waukegan, Olmitz, Colo, Gravity, Chequest, Carlow, and Wabash series. The Douds soils and Terrace escarpments are a mixture of medium- to coarse-textured, older stream-laid deposits, Wisconsin loess, eolian sand, and glacial till.

The high bench terraces are composed of stream-laid deposits, which consist of highly stratified sand, silt, and

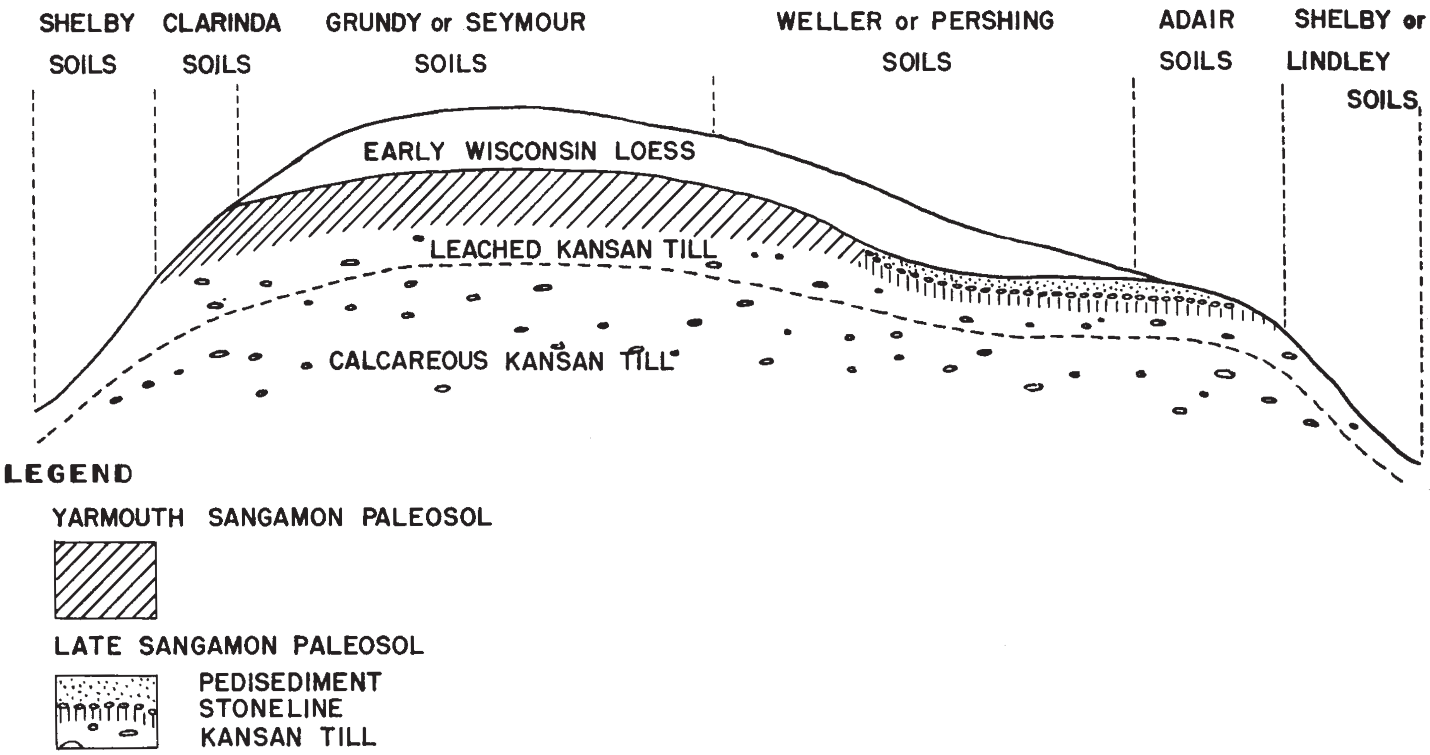

***Figure 11.*—The relationship of the Adair and Clarinda soils to landscape position, parent material, and associated soils. The profile is transverse to the longitudinal axis of the intermediate level interfluvial summits.**

clay. These stream-laid deposits make up the major part of the Douds soils and Terrace escarpments.

There is evidence that bench terraces are pre-Wisconsin in age. Reddish, sandy clay paleosols are exposed in many places on these terraces where the loess has been eroded away. These paleosols have many of the morphological features of the Adair series. Using this evidence as a guide, it is estimated that these high bench terraces, where the Terrace escarpment miscellaneous land type occurs, are of Late Sangamon age (*18, 19*).

Time

The length of time a soil material has been exposed to the effects of climate and vegetation is reflected in the soil. The Van Buren County soils range in age from very young to very old.

By use of radiocarbon dating, scientists have assigned ages to some loess and Pleistocene deposits in Iowa through analyses of wood fragments that have been buried in the loess or glacial materials. According to this procedure, a wood sample buried in Early Wisconsin loess and found near Mitchellville, Polk County, Iowa, was determined to be about 16,720 years old (*15, 16*). As the upland loess of Van Buren County is generally believed to be of the same source and age as that in Polk County, the Haig, Seymour, Grundy, Edina, Weller, Beckwith, Pershing, and Belinda soils are therefore no older than about 16,000 years. The Edina, Beckwith, and Belinda soils probably approach this age, but some of the other soils are probably younger because of bevelling of the surface after the loess was deposited. Compared to the other soils in this county, these soils would be intermediate in age.

The Nodaway and Perks soils are examples of very young soils. They have developed from stream-laid deposits of recent origin. The climatic and vegetational factors of soil formation have not changed the parent material to any great extent.

The Adair and Clarinda series, which have a complex genetic history, are examples of the very old soils of Van Buren County. They have silty clay or clay subsoils and bear very little resemblance to their parent materials. These subsoils probably formed in the Sangamon or Yarmouth ages and may be 150,000 to 750,000 years old. The Adair subsoils are generally considered to have formed in the Late Sangamon interglacial age and are 38,000 to 70,000 years old. The Shelby and Lindley soils probably formed in the Late Wisconsin age, but some of the Lindley profiles may be of the Sangamon age.

The soils developed from stream-laid deposits—the Colo, Wabash, Coppock, Chequest, Carlow, and Waukegan—are considered to be no older than Late Wisconsin, 11,000 to 14,000 years old, and they may be much younger.

Climate

Available evidence suggests that Van Buren County soils have developed under the influence of a midcontinental, subhumid climate for the last 5,000 years (*15, 17*). The morphology and properties of most of the soils of Van Buren County seem to reflect development under a climate similar to that at present. There is evidence that from 6,500 to 16,000 years ago the climate was cool and moist and conducive mostly to forest vegetation (*15, 17*).

Lane's pollen study (*10*) indicates that the climate during the Sangamon period, 20,000 to 150,000 years ago, was cool and moist and conducive to coniferous forest vegetation.

Vegetation

Several postglacial vegetational and climatic changes have occurred in Iowa (*17*, *10*). Spruce vegetation occurred from 12,000 to 8,000 years ago, followed by a coniferous-deciduous forest transition dating 8,000 to 6,500 years ago. The dominance of grass began about 6,500 years ago.

For the last 5,000 years (*17*), the soils of Van Buren County seem to have been influenced by two main types of vegetation—prairie grasses and trees. The prairie grasses were mainly big and little bluestem. The trees were mainly oak, hickory, ash, elm, maple, and other deciduous trees.

Recent studies of the effect of vegetation on soils similar to those in Van Buren County have been made by Cardoso,[3] Corliss,[4] McCracken,[5] and Prill.[6]

In areas bordering trees or grass, there is evidence that shifting of vegetation took place during soil development. The Downs, Pershing, Keomah, Givin, Belinda, and Rubio soils show the influence of both grass and trees. The soils formed under the influence of trees are the Clinton, Keomah, Rushville, Weller, Beckwith, and Lindley. The Adair, Dickinson, Gravity, Olmitz, Grundy, Seymour, Shelby, Waukegan, Haig, and Edina soils show the influence of prairie.

Under similar conditions, soils formed under grass are generally darker in color than those formed under trees. Those formed under trees are usually lighter colored, more acid, and have thinner, dark surface layers than soils formed under grass. Some soils that have formed under shifting or mixed grass and timber vegetation are intermediate in properties between soils of the grasslands and the fully timbered soils.

Topography

The topography of Van Buren County is very important in soil formation because of its effect on drainage, runoff, erosion, and other water factors. Gradients range from level to very steep. The level areas are on the broad upland flats or wide tabular divides. The steep areas are along the Des Moines River and its tributaries. An abundance of upland streams indicates that the landscape of the county is nearly mature. The thickness, color, and horizonation of the soils of Van Buren County show the influence of topography. On the upland prairie flats, the soils have darker, thicker surface horizons and more highly mottled subsoils than elsewhere. On the steeper prairie slopes, the surface horizons are thinner and the subsoils less mottled than on the flat prairie areas. Under forest, soils of flat areas generally have more mottled subsoils than those on more sloping sites.

Living organisms

Living organisms are thought to have a minor influence on soil development. Earthworms, insects, micro-organisms, and other forms of life break down organic matter and change soil structure. Bacteria, fungi, and other micro-organisms aid in weathering rock. They also have a large effect on chemical and biological processes that are active in the soil solum.

Man

Man has had only a minor influence on soil development. He is, however, responsible for accelerating erosion in Van Buren County. Many sloping fields that are now cultivated or that have been cultivated in the last 50 years have lost more than half of the topsoil through erosion. Less than 3 inches is all that now remains of the original 8 to 14 inches of topsoil on these fields. The loss of protective vegetation and the mixing and pulverizing of surface soil in cultivation create an erosion hazard. If erosion is allowed to continue at its present rate, much of the capacity of the soil to support plant life may be destroyed, or greatly reduced.

Morphology

The morphology of the soils in Van Buren County is expressed by both prominent and faint horizons. Nearly all of the major upland soils have strong horizonation. Examples are the Lindley, Grundy, Seymour, Beckwith, Weller, and Pershing series. The more recent Alluvial soils of the county, such as the Nodaway or Perks, have very little or no horizonation because of their youth. Some of the Wiesenbodens that occur on stream bottoms have very little or only medium horizon development. Examples are the Colo, Wabash, and Chequest soils.

Several processes have been involved in the formation of soil horizons in the soils of Van Buren County. These processes are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

Accumulation of organic matter in the upper profile to form an A_1 horizon has been an important process of horizon development. The soils of Van Buren County range from high to very low in their content of organic matter. The upland, prairie-derived Brunizems and Wiesenbodens have thick, dark-colored A_1 horizons that are high in organic matter. The upland, forest-derived Gray-Brown Podzolic soils and the Planosols have thin, light to moderately light colored A_1 horizons that are medium to very low in organic matter.

Leaching of carbonates and bases has occurred in nearly all of the soils in Van Buren County. It is the generally accepted opinion among soil scientists that leaching of bases in soils usually takes place before and during the translocation of silicate clay minerals. Most of the soils in the county are moderately to strongly leached, which has been an important factor in the development of horizons

Reduction and transfer of iron, a process called gleying (*22*), is evident in the poorly and very poorly drained soils of the county. The gray color in subsoil horizons

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[3] CARDOSO, J. SEQUENCE RELATIONSHIPS OF CLARION, LESTER, AND HAYDEN SOIL CATENAS. 1957. [Unpublished Ph. D. thesis. Iowa State College Library, Ames, Iowa.]

[4] CORLISS, J. F. GENESIS OF LOESS-DERIVED SOILS IN SOUTHEASTERN IOWA. 1958. [Unpublished Ph. D. thesis. Iowa State College Library, Ames, Iowa.]

[5] MCCRACKEN, R. SOIL CLASSIFICATION IN POLK COUNTY, IOWA. 1956. [Unpublished Ph. D. thesis. Iowa State College Library, Ames, Iowa.]

[6] PRILL, R. VARIATIONS IN FOREST-DERIVED SOILS FORMED FROM KANSAN TILL. 1955. [Unpublished Ph. D. thesis. Iowa State College Library, Ames, Iowa.]

indicates the reduction and loss of iron. Some horizons contain reddish-brown mottles and concretions, indicating a segregation of iron.

In many soils of Van Buren County, the translocation of clay minerals has contributed to horizon development. The eluviated A_2 horizons, above the B horizons, have a platy structure, are lower in content of clay, and usually are lighter in color. The B horizons usually have accumulation of clay (clay skins) in pores and on ped surfaces. These soils were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clays took place. Leaching of bases and translocation of silicate clay are among the most important processes in horizon differentiation in the soils of Van Buren County.

Classification

In order to compare Van Buren County soils with those in the rest of Iowa, and in other parts of the United States and the world, it is desirable to group the soil series into great soil groups (table 7). A great soil group is a group of soils with similar kinds and arrangements of horizons (genetic layers); it may include a large number of soil series. These great soil groups are based on a few broad characteristics.

The characteristics and classification of these great soil groups have been outlined in a scheme in the 1938 U.S. Department of Agriculture Yearbook (*2*). In 1949, Thorp and Smith (*24*) made some additions to and revisions of this scheme.

Many great soil groups occur in the world, but there are only a few in Van Buren County. Soils in Van Buren County are classified as Brunizems, Gray-Brown Podzolic soils, Planosols, Wiesenbodens, Alluvial soils, and Lithosols (*2*, *24*).

Brunizems, formerly called Prairie soils (*21*), have developed under grass vegetation. Those in Van Buren County have a moderately thick (7 to 14 inches), moderately dark to dark (10YR 2.5/1 to 10YR 3.5/1) A_1 horizon that is moderately high in organic matter, compared to the A_1 horizon in other Brunizems. The content of organic matter decreases gradually with depth. Brunizems have a brown or grayish-brown B horizon, or subsoil. Under virgin conditions, the pH is lowest in the surface horizon and gradually increases with depth. Nearly all Brunizems in Van Buren County have more clay in the B horizon than in the A or C horizon, which suggests the translocation of silicate clay minerals from the A to the B horizon.

Some of the soil series listed under Brunizems in table 7 are transitional between the Brunizems and another great soil group. They have characteristics of both, but they more nearly resemble the Brunizems. The Gravity and Grundy series are transitional to the Wiesenboden great soil group, and the Seymour series is transitional to the Planosol great soil group.

The Adair series is a paleosol, or relict, probably Late Sangamon (*13*) in age. It is thought that this paleosol developed under the influence of trees during the Late Sangamon age. Simonson (*19*) expressed the view that soils very similar to these possessed many of the morphological features of the Gray-Brown Podzolic soils. After the relict soil was reexposed through erosion of the loess mantle, the native vegetation was mostly grass, which is the cause of the dark-colored Brunizemic A_1 horizon.

TABLE 7.—*Van Buren County soils classified into great soil groups*

Great soil group	Soil series
Alluvial soils	Landes, Nodaway, Perks.
Brunizems	Adair, Dickinson, Gravity,[1] Grundy,[1] Hagener, Olmitz, Seymour,[2] Shelby, Waukegan.
Gray-Brown Podzolic soils.	Clinton, Downs,[3] Lamont, Givin,[3] Keomah, Lindley, Pershing,[3] Gosport,[4] Weller.
Lithosols	Sogn.
Planosols	Beckwith, Belinda, Chariton, Coppock,[5] Edina, Rubio, Rushville.
Wiesenbodens (Humic Gley soils).	Carlow,[6] Chequest,[6] Clarinda, Colo,[5] Haig, Wabash.[5]

[1] Intergrade to Wiesenboden.
[2] Intergrade to Planosol.
[3] Intergrade to Brunizem.
[4] Intergrade to Lithosol.
[5] Intergrade to Alluvial.
[6] Intergrade to Alluvial and Planosol.

Gray-Brown Podzolic soils have developed under forest vegetation. They have a thin, moderately dark to light-colored (10YR 3.5/1 to 10YR 4/2, moist) A_1 horizon that is moderately low to low in organic matter. They have a grayish or brownish A_2 horizon and a brown or grayish-brown B horizon. The Gray-Brown Podzolic soils have a higher content of clay in the B horizon than in the A or C horizon. This suggests the translocation of silicate clay minerals from the A to the B horizon.

Some of the soil series listed in the Gray-Brown Podzolic group in table 7 are transitional to other great soil groups. They possess characteristics of both but more closely resemble typical Gray-Brown Podzolic soils in their characteristics. The Downs, Givin, and Pershing series are transitional to the Brunizem great soil group. The Gosport series is transitional to the Lithosol great soil group.

Planosols have developed under grass, forest, or marsh vegetation under conditions of poor drainage. They have a thin (3 to 8 inches), moderately dark to light-colored (10YR 3/1 to 10YR 4/2, moist) A_1 horizon; a moderately thick (6 to 14 inches), grayish A_2 horizon; and a strongly developed, grayish or grayish-brown, genetic claypan B horizon. The claypan in Planosols is a soil horizon that is plastic when wet and slowly to very slowly permeable because of a very high content of clay. The Coppock series is transitional to the Alluvial great soil group in its characteristics.

Wiesenbodens, also called Humic Gley soils, have developed under grass vegetation under conditions of poor drainage. In Van Buren County, most of the Wiesenbodens have a dark to moderately dark (10YR 2/1 to 10YR 3/1.5, moist) A horizon, 12 to 20 inches thick, that is moderately high in organic matter compared to that of other Wiesenbodens. They have a grayish B horizon that is slightly to strongly developed and generally is higher in clay than the A horizon. The lower B horizon is sometimes gleyed; gray (5Y 5/1, moist) or olive-gray (5Y 5/2, moist) colors are common, and the layer is usually strongly mottled. The Colo series is a Wiesenboden transitional to the Alluvial great soil group, with some characteristics of the latter.

The Carlow and Chequest series have a thinner, grayer A horizon than the other Wiesenbodens in the county. They have a moderately thin (6 to 10 inches), moderately dark to moderately light colored (10YR 3/1 to 10YR 3/2, moist, and 10YR 5/1 to 10YR 5/2, dry) A_1 horizon; an indistinct, grayish A_2 horizon; and a moderately well developed, grayish B horizon.

Alluvial soils are a great soil group forming from recent stream-laid deposits. The soil series in the Alluvial great soil group have very little profile horizonation and have a surface layer that varies widely.

Lithosols are shallow soils that lack a B horizon. They have a thin, moderately dark to light colored A horizon underlain by bedrock.

Laboratory Data

Laboratory analyses were made of three extensive soils in Van Buren County: Belinda silt loam, Pershing silt loam, and Weller silt loam. Table 8 gives the physical and chemical properties of these soils.

TABLE 8.—*Physical and chemical properties of three Van Buren County soils*[1]

Soil type	Horizon	Depth	Clay less than 0.002 mm.	Free iron	Organic carbon	Total nitrogen	pH	Exchangeable cations (meq. per 100 grams of soil)			
								Calcium	Magnesium	Hydrogen	Base saturation
		Inches	*Percent*	*Percen*	*Percent*	*Percent*					*Percent*
Belinda silt loam: 500 feet west and 500 feet north of the southeast corner of the SW¼ sec. 10, T. 70 N., R. 8 W.	A_p	0–4	18. 1	0. 89	1. 72	0. 139	7. 3	-------	-------	-------	-------
	A_p	4–7	18. 2	. 77	1. 65	. 130	6. 9	12. 1	2. 7	1. 8	89
	A_2	7–12	20. 8	. 96	. 99	. 084	5. 6	-------	-------	-------	-------
	A_2	12–14	23. 9	1. 08	. 72	. 074	5. 5	7. 5	3. 7	3. 7	75
	A_2	14–17	29. 8	1. 33	. 68	. 063	5. 4	-------	-------	-------	-------
	B_1	[2] 17–19	-------	-------	-------	-------	-------	-------	-------	-------	-------
	B_2	19–21	48. 7	1. 20	. 81	. 082	5. 3	15. 3	9. 7	7. 8	76
	B_2	21–24	52. 3	1. 15	. 73	. 072	5. 3	16. 6	11. 0	8. 0	78
	B_2	24–28	52. 4	1. 14	. 61	. 067	5. 3	16. 0	11. 8	6. 7	81
	B_3	28–33	46. 2	. 98	. 44	-------	5. 5	-------	-------	-------	-------
	B_3	33–38	40. 3	. 99	. 27	. 031	5. 9	-------	-------	-------	-------
	B_3	38–46	38. 0	. 98	. 23	. 030	6. 1	-------	-------	-------	-------
	B_3	46–54	36. 8	. 80	. 16	. 034	6. 1	-------	-------	-------	-------
	C_1	54–66	31. 8	. 90	. 15	. 043	6. 2	14. 5	9. 4	3. 3	88
Pershing silt loam: 30 feet south and 110 feet west of a fence corner, which is 0.1 mile north of southeast corner of the SW¼ sec. 24, T. 70 N., R. 8 W.	A_p	0–4	21. 3	1. 02	1. 96	. 209	5. 2	-------	-------	-------	-------
	A_p	4–8	21. 7	1. 08	1. 64	. 161	5. 3	7. 5	2. 7	8. 0	56
	A_2	8–13	24. 6	1. 10	1. 00	-------	5. 3	6. 8	3. 3	8. 0	56
	B_1	13–17	31. 8	1. 11	. 62	. 072	5. 4	-------	-------	-------	-------
	B_1	[2] 17–18	-------	-------	-------	-------	-------	-------	-------	-------	-------
	B_{21}	18–21	42. 1	1. 24	. 48	. 056	5. 2	12. 2	8. 2	8. 0	72
	B_{22}	21–26	43. 2	1. 21	. 42	. 055	5. 3	14. 6	9. 2	7. 3	76
	B_{23}	26–30	42. 7	1. 30	. 37	. 046	5. 4	14. 6	9. 8	6. 1	80
	B_3	30–36	39. 5	1. 16	. 28	. 037	5. 5	-------	-------	-------	-------
	B_3	36–42	37. 1	1. 10	. 22	. 035	5. 9	-------	-------	-------	-------
	B_3	42–50	33. 0	1. 08	. 18	. 027	6. 3	-------	-------	-------	-------
	C	50–58	29. 9	1. 04	. 16	. 021	6. 5	13. 7	8. 1	4. 4	83
Weller silt loam: 300 feet west and 30 feet south of the northeast corner of the SE¼NW¼ sec. 24, T. 70 N., R. 8 W.	A_p	0–3	18. 4	. 75	2. 47	. 235	6. 0	15. 2	3. 0	5. 1	78
	A_2	3–5	16. 9	1. 06	1. 13	. 107	5. 9	-------	-------	4. 8	-------
	A_2	5–8	17. 6	1. 05	. 56	. 063	5. 4	15. 6	3. 4	4. 5	81
	A_2	8–11	18. 3	1. 14	. 37	. 046	5. 1	-------	-------	5. 6	-------
	A_3	11–14	20. 6	. 90	. 30	. 040	5. 0	7. 2	5. 3	6. 5	66
	B_1	14–16	26. 6	1. 07	. 28	. 045	4. 4	-------	-------	8. 1	-------
	B_2	16–17	42. 3	1. 10	. 33	. 042	4. 1	-------	-------	10. 5	-------
	B_2	17–21	51. 7	1. 10	. 34	. 045	4. 3	18. 3	7. 0	12. 0	68
	B_2	21–24	51. 8	1. 07	. 34	. 042	4. 6	18. 2	6. 1	12. 2	67
	B_3	24–27	46. 3	1. 11	. 28	. 034	4. 7	-------	-------	11. 1	-------
	B_3	27–34	45. 0	1. 12	. 26	. 030	5. 0	-------	-------	9. 0	-------
	B_3	34–41	38. 5	1. 01	. 20	. 025	5. 1	-------	-------	5. 9	-------
	B_3	41–48	35. 3	1. 04	. 18	. 024	5. 3	-------	-------	2. 3	-------
	B_3	48–58	31. 4	. 92	. 15	. 025	5. 8	21. 1	7. 1	1. 1	96
	C_1	58–70	24. 4	1. 13	. 14	-------	6. 4	-------	-------	. 3	-------

[1] CORLISS, J. F. GENESIS OF LOESS-DERIVED SOILS IN SOUTHEASTERN IOWA. 1958. [Unpublished Ph. D. thesis Iowa State College Library, Ames, Iowa.]

[2] Sample at this depth not collected.

Engineering Interpretations of the Soils[7]

This soil survey report for Van Buren County, Iowa, contains information that can be used by engineers to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Assist in the design of drainage and irrigation structures and in planning dams and other structures for water and soil conservation.
3. Make reconnaissance surveys of soil and ground conditions that will aid in selecting highway and airport locations and in planning detailed soil surveys for the intended locations.
4. Locate sources of sand and gravel.
5. Correlate pavement performance with types of soil and thus develop information that will be useful in designing and maintaining the pavements.
6. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs, for the purpose of making soil maps and reports that can be used readily by engineers.

The mapping and the descriptive report are somewhat generalized, however, and should be used only in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed engineering construction.

Soil Science Terminology

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, sand, aggregate, and granular—may have special meanings in soil science. These terms are defined in the Glossary at the end of the report.

Soil Test Data and Engineering Soil Classification Systems

To be able to make the best use of the soil maps and soil survey reports, the engineer should know the physical properties of the soil materials and the in-place condition of the soil. After testing soil materials and observing the behavior of soils when used in engineering structures and foundations, the engineer can develop design recommendations for the soil units delineated on the maps.

Soil test data

Soil samples from one profile of the Adair, truncated Adair, Carlow, Coppock, Edina, Lindley, Seymour, and Shelby soil series were tested in accordance with standard procedures (*1*) to help evaluate the soils for engineering purposes (table 9). In addition, test data for one profile of the Grundy, Haig, and Weller soils sampled in Jefferson County are shown. The data for Jefferson County soils are included because of their nearness to Van Buren County and because they represent the characteristics of these soil series as mapped in Van Buren County.

[7] This section was prepared in cooperation with the Iowa State Highway Commission.

The engineering soil classifications in table 9 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming textural classes for soil classification.

Tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid, or plastic, state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Table 9 also gives compaction (moisture-density) data for the tested soils. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material will increase until the "optimum moisture content" is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Engineering soil classification systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (*1*). In this system, soil materials are classified in seven principal groups. The groups range from A–1, which is gravelly soil of high bearing capacity, to A–7, which consists of clay soil having low strength when wet. In each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best materials to 20 for the poorest. The group index number for each tested soil is shown in parentheses, following the soil group symbol, in the next to last column in table 9.

Some engineers prefer to use the Unified soil classification system (*25*). In this system, soil materials are identified as coarse grained, eight classes; fine grained, six classes; and highly organic soils. An approximate classification of soils can be made in the field. The classification of all Van Buren County soils, according to the Unified system, is given in the last column of table 9.

Engineering Data and Recommendations

The soil engineering data shown in table 10 are based on the soil tests shown in table 9, on information given in the rest of the soil survey report, and on experience with the same kinds of soils in other counties. It will often be necessary, however, to refer to other parts of the report, particularly to those entitled "General Soil Areas," "Descriptions of the Soils," "Use and Management of the Soils," and "General Information About Van Buren County."

Soil characteristics that affect highway construction

In general, the soils of Van Buren County have developed in several feet of loess over Kansan glacial till. The loess varies between 3 and 10 feet in thickness on the level uplands and tops of ridges, but it is absent where glacial till outcrops in the more dissected areas.

The loess soils are very fine grained. They are classified as A–6 and A–7, and predominantly they have high group index numbers according to the AASHO system. According to the Unified system they classify as CL and CH. The classification is somewhat different where the terrain is nearly level to gently rolling. In these places some of the finer soil particles have been removed from the A horizon, and the remaining soil material classified as A–4 to A–6. The finer particles have accumulated in the B horizon, which is classified as A–7 and has high group index numbers. However, the soil material of the B horizon is generally unsuitable for highway subgrades and should not be used within 5 feet of gradeline in embankments or within 2 feet of gradeline in cut sections.

The Kansan glacial till underlying the loess is heterogeneous. Under the loess mantle in less dissected areas is the remains of the original Kansan till plain. In some areas, this consists of an upper layer a few feet thick of very stiff, plastic clay commonly known as gumbotil, which is classified as A–7. Where gumbotil is on the surface, it is named Clarinda soil and, in Van Buren County, is mapped with the Adair soils. Gumbotil is unsuitable for highway subgrades and should not be placed within 5 feet of grade in embankments. When encountered at grade in cuts, it should be removed to a depth of 2 feet and replaced with suitable backfill material. Wherever glacial soil outcrops, this old gumbotil layer may be evident at the upper elevations. Below the gumbotil layer, the till is classified predominantly as A–6, but actually almost any soil material may occur. The extreme range is from sand and gravel pockets to heavy clay pockets or layers, and this results from the manner in which the material was deposited.

The Pennsylvanian shale may be encountered in roadway cuts. Ordinarily, this shale is not suitable for highway subgrades. Cuts through this material should be treated to improve conditions. Shale material excavated in cuts should not be placed within 5 feet of the finished grade in embankments. Some precautions may be required to compact the soil adequately and to stabilize the embankment.

A seasonally high water table in the loess soils usually lies above the place where the glacial till and the loess join. On level soils, a thin, perched water table may occur above the B horizon. The in-place density of the loess is not enough to prevent high moisture content where water is available. This high moisture content may cause instability in embankments, unless moisture-density control is specified in grading operations. Because of its high in-place density, Kansan glacial till usually does not have an excessively high moisture content.

Factors used in computing the shrinkage of soil material in grading operations are generally about 30 percent for loess and 10 percent for glacial till.

Geological information valuable to engineers can be found in the geologic report for Van Buren County (*3*).

Soil characteristics that affect conservation of soil and moisture

The following discussion describes some of the earth structures normally used to conserve soil and moisture and indicates which soils are most suitable for the various structures.

Terraces.—A terrace is an embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff, so that more moisture will soak into the soil and any excess moisture will flow to a prepared outlet without causing erosion.

Terraces should be built on all soils of management groups 3, 4, 9, 10, 11, and 12 if these soils are used for cultivated crops. Topsoil material is thin on most of these soils, and it should be stockpiled for topdressing the terrace channel and ridge after construction is completed.

Diversions.—A diversion is a channel, with a supporting ridge on the lower side, that is constructed across the slope to intercept runoff and to minimize erosion, or to prevent excess runoff from flowing onto lower lying areas. Diversions are also known as diversion terraces. The principal uses of diversions in Van Buren County are (a) to protect the colluvial foot slopes and bottom lands from overflow from adjacent uplands and (b) to collect more water from broad upland flats having a drainage area considerably larger than could be removed by an ordinary terrace. Diversions should be used on many of the soils in management groups 2, 7, 13, and 15, where protection can be given to bottom-land areas. A diversion may also be constructed as a means of draining wet upland.

Drainage ditches and tile lines.—The soils of management groups 8, 15, and 17 have a fine-textured subsoil. Tile drainage systems do not effectively drain these soils and are generally not used. The use of surface drainage systems is suggested for both the loess soils and the alluvial soils in these management groups.

The soils of management group 7 can be effectively drained by tile systems if proper outlets can be obtained.

The soils of management group 6 have a fine-textured subsoil and slow internal drainage. Tile systems are used on these soils to considerable extent, but drainage is slow. Surface drainage systems should be used with the tile systems to provide the most effective drainage for the soils of this group.

Hillside seepage is often a problem on the Adair and Clarinda soils; it can be corrected by properly installing interceptor tile above the seepy area.

Additional information on soil drainage can be obtained in the Iowa Drainage Guide (*6*).

Irrigation structures.—The lack of adequate supplies of water and the slow intake rate of most soils of the county limit the use of supplemental irrigation. Additional information can be obtained in the Iowa Sprinkler Irrigation Guide (*5*).

Farm ponds.—The soils of this county generally are well suited as sites for impounding water. Exceptions are the soils of management groups 22 and 24, which are sands and silt loams on terraces. To reduce leakage of ponds, remove the alluvial material from drainageways at the site for construction and replace this with fine-textured material.

Erosion control structures.—Terraces and diversion terraces already have been discussed as structures used to

TABLE 9.—*Engineering test data for 11 soil profiles*

Soil name and location	Parent material	Bureau of Public Roads (BPR) or Iowa State Highway Commission (ISHC) sample no.	Depth	Horizon	Moisture-density	
					Maximum dry density	Optimum moisture content
			Inches		*Lb. per cu. ft.*	*Percent*
Adair silt loam: (Included in Adair and Clarinda soils); located in a roadcut at the southeast corner of cemetery in the center of sec. 32, T. 68 N., R. 9 W., Van Buren County, Iowa.	Kansan glacial till.	AAD8-10297 (ISHC)	0-5	A_1	97	20.7
		AAD8-10298 (ISHC)	18½-23	B_{22}	102	19.6
		AAD8-10299 (ISHC)	56-62	C	106	20.0
Adair silt loam (truncated): (Included in Adair and Clarinda soils); located 340 feet north and 30 feet east of the southwest corner of NW¼ SW¼ sec. 23, T. 69 N., R. 8 W., Van Buren County, Iowa.	Kansan glacial till.	AAD9-68 (ISHC)	0-5	A_{1p}	105	14.8
		AAD9-69 (ISHC)	17-23	B_{22}	94	23.8
		AAD9-70 (ISHC)	42-48	C_2	105	20.0
Carlow silty clay loam: Located 400 feet east and 200 feet north of the southwest corner of the SW¼ NE¼ sec. 17, T. 68 N., R. 11 W., Van Buren County, Iowa.	Alluvium	AAD9-74 (ISHC)	13-18	A_3 and B_1	85	30.0
		AAD9-75 (ISHC)	18-27	B_2	85	30.5
		AAD9-76 (ISHC)	51-66	C_2	97	22.4
Coppock silt loam: Located 150 feet south and 500 feet west of the northeast corner of the SW¼ NE¼ sec. 17, T. 68 N., R. 11 W., Van Buren County, Iowa.	Alluvium	AAD9-71 (ISHC)	11-17	A_{22}	106	16.8
		AAD9-72 (ISHC)	27-34	B_2	100	20.1
		AAD9-73 (ISHC)	55-63	C_2	103	19.0
Edina silt loam: Located 100 feet north of the southwest corner of the SE¼ of sec. 27, T. 68 N., R. 11 W., Van Buren County, Iowa.	Loess	AAD8-10293 (ISHC)	0-6	A_{1p}	93	23.7
		AAD8-10294 (ISHC)	13-18	A_{22}	102	19.6
		AAD8-10295 (ISHC)	21-27	B_{22}	83	27.2
		AAD8-10296 (ISHC)	47-52	C_2	98	22.4
Grundy silty clay loam: Located 210 feet south of the southeast corner of NW¼NW¼ sec. 23, T. 71 N., R. 10 W., Jefferson County, Iowa.	Loess	S32180 (BPR)	0-4	A_p	102	19.0
		S32181 (BPR)	13-21	B_{22}	94	24.0
		S32182 (BPR)	39-59	C_2	108	17.0
Haig silty clay loam: Located 160 feet north and 40 feet east of the southwest corner of the NW¼SW¼ sec. 31, T. 71 N., R. 9 W., Jefferson County, Iowa.	Loess	S32189 (BPR)	0-9	A_p	99	21.0
		S32190 (BPR)	14-23	B_{21}	95	25.0
		S32191 (BPR)	52-64	C_2	107	19.0
Lindley loam: Located 90 feet north and 90 feet east of barn near northwest corner of NE¼NE¼ sec. 17, T. 70 N., R. 10 W., Van Buren County, Iowa.	Kansan glacial till.	AAD8-10290 (ISHC)	0-6	A_1	110	14.2
		AAD8-10291 (ISHC)	18-25	B_{22}	103	19.3
		AAD8-10292 (ISHC)	47-53	C_2	116	12.9
Seymour silt loam: Located 690 feet north and 175 feet east of the southwest corner of sec. 17, T. 68 N., R. 9 W., Van Buren County, Iowa.	Loess	AAD8-10300 (ISHC)	0-8	A_1	96	22.5
		AAD8-10301 (ISHC)	19-27	B_{22}	89	24.4
		AAD8-10302 (ISHC)	52-62	C_2	103	18.7
Shelby loam: Located 125 feet east and 600 feet south of the northwest corner of the NE¼NW¼ of sec. 5, T. 67 N., R. 11 W., Van Buren County, Iowa.	Kansan glacial till.	AAD8-10287 (ISHC)	0-5	A_{1p}	111	15.4
		AAD8-10288 (ISHC)	17-23	B_{22}	106	17.4
		AAD8-10289 (ISHC)	42-54	C_2	112	16.0
Weller silt loam: Located 470 feet east of the northwest corner of sec. 31, T. 71 N., R. 9 W., Jefferson County, Iowa.	Loess	S32192 (BPR)	0-3	A_1	90	26.0
		S32193 (BPR)	15-28	B_{21}	97	26.0
		S32194 (BPR)	56-66	C_2	107	18.0

[1] Tests performed by the Iowa State Highway Commission or the Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*).

[2] According to the American Association of State Highway Officials Designation: T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the

from Van Buren and Jefferson Counties, Iowa [1]

Mechanical analysis [2]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve [3]			Percentage smaller than [3]						AASHO [4]	Unified [5]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
100	95	72	64	41	19	10	32	8	A–4 (8)	ML.
99	94	73	67	49	39	35	38	17	A–6 (10)	CL.
100	97	78	65	41	31	28	39	21	A–6 (12)	CL.
100	96	76	68	50	22	14	27	7	A–4 (8)	CL–ML.
98	93	76	73	62	49	45	49	23	A–7–6 (15)	CL–MH.
99	92	67	61	53	41	37	47	27	A–7–6 (14)	CL.
--	100	97	94	87	64	50	66	35	A–7–5 (20)	CH–MH.
--	100	96	94	87	66	52	58	28	A–7–5 (19)	CH–MH.
--	100	96	94	87	66	53	62	39	A–7–6 (20)	CH.
100	99	90	83	64	33	24	31	11	A–6 (8)	CL.
--	100	93	87	57	41	34	39	20	A–6 (12)	CL.
--	100	94	88	74	44	36	42	23	A–7–6 (14)	CL.
100	99	98	96	68	30	19	36	10	A–4 (8)	ML.
100	99	97	93	71	33	21	29	8	A–4 (8)	ML–CL.
100	99	98	98	88	67	59	67	34	A–7–5 (20)	CH–MH.
--	--	100	99	76	47	38	50	28	A–7–6 (17)	CL–CH.
100	98	96	95	76	38	30	36	13	A–6 (9)	ML–CL.
100	99	98	97	81	52	45	68	40	A–7–6 (20)	CH.
--	--	99	98	75	35	28	40	18	A–6 (11)	CL.
--	--	100	98	75	37	29	39	14	A–6 (10)	ML–CL.
--	--	100	98	82	54	47	66	40	A–7–6 (20)	CH.
--	--	100	98	78	40	32	45	24	A–7–6 (15)	CL.
96	88	55	47	30	15	10	24	5	A–4 (4)	CL–ML.
99	91	66	59	50	40	36	43	23	A–7–6 (12)	CL.
99	90	52	47	35	27	23	31	17	A–6 (6)	CL.
--	100	97	93	68	32	23	38	13	A–6 (9)	ML–CL.
--	--	99	98	84	59	50	64	36	A–7–6 (20)	CH.
--	100	98	97	76	41	32	44	24	A–7–6 (14)	CL.
99	92	52	41	31	19	14	27	9	A–4 (3)	CL.
99	92	64	59	49	39	33	39	19	A–6 (9)	CL.
99	88	60	54	44	33	28	37	21	A–6 (9)	CL.
100	99	97	95	68	27	19	38	8	A–4 (8)	ML.
--	--	100	98	83	52	44	60	33	A–7–6 (20)	CH.
--	--	99	98	80	38	30	40	19	A–6 (12)	CL.

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

[3] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[4] According to the Classification of Soils and Soil-Aggregate Mixtures for Highway Purposes, AASHO Designation: M 145–49.

[5] According to the Unified soil classification system (*25*).

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TABLE 10.—*Descriptions, properties, and estimated*

Soil series, variants, and miscellaneous land types	Parent material	Brief description of soil profile and ground condition
Adair	Glacial till; may have a thin mantle of loess.	Moderately well to imperfectly drained; firm to very firm silty clay loam or silty clay subsoil containing some small stones.
Beckwith	Loess	Poorly drained; very firm silty clay subsoil (B horizon); glacial till is at depths of 7 to 9 feet.[2]
Beckwith, bench position	Loess	Poorly drained; very firm silty clay subsoil; alluvial material is at depths of 6 to 10 feet.[3]
Belinda	Loess	Poorly drained; very firm silty clay subsoil (B horizon); glacial till is at depths of 7 to 9 feet.[2]
Belinda, bench position	Loess	Poorly drained; very firm silty clay subsoil (B horizon); alluvial material is at depths of 6 to 10 feet.[3]
Carlow	Alluvium	Very poorly drained; firm silty clay or clay subsoil
Chariton	Alluvium	Poorly drained soils; firm, heavy silty clay loam or silty clay subsoil (B horizon).
Chequest	Alluvium	Poorly drained; firm silty clay loam subsoil
Clarinda	Glacial till (gumbotil); may have a thin mantle of loess.	Imperfectly to poorly drained; very firm silty clay or clay subsoil
Clinton	Loess	Well drained; firm silty clay loam subsoil; glacial till is at depths of 8 to 12 feet.[2]
Clinton, bench position	Loess	Well drained; firm silty clay loam subsoil; alluvial material is at depths of 6 to 10 feet.[3]
Colo	Alluvium	Slightly firm to firm, poorly drained to imperfectly drained silty clay loam on flood plains; high in organic matter to depths of 1½ to 2 feet.
Coppock	Alluvium	Imperfectly to poorly drained; sandy loam to silty clay loam subsoil.
Dickinson	Alluvium	Well to somewhat excessively drained; friable sandy loam, loam, or sandy clay loam subsoil.
Douds soils and Terrace escarpments.	Alluvium, local loess, or eolian sand.	Well drained; variable subsoil over stratified sand, silt, and clay.
Downs	Loess	Moderately well to well drained; friable to firm loam or silty clay loam subsoil; alluvial material at depths of 5 to 10 feet.[3]
Edina	Loess	Very poorly drained; very firm silty clay subsoil (B horizon); glacial till is at depths of 7 to 9 feet.[2]
Givin	Loess	Imperfectly drained; firm silty clay loam subsoil; glacial till is at depths of 7 to 9 feet.[2]
Givin, bench position	Loess	Imperfect to moderately well drained; firm silty clay loam subsoil; alluvial material is at depths of 6 to 10 feet.[3]
Gosport	Shale	Moderately well drained; firm clay subsoil; shale is at depths of 1 to 3 feet.
Gravity	Alluvium	Imperfectly to poorly drained; friable silty clay loam subsoil.
Grundy	Loess	Imperfectly to moderately well drained; firm silty clay subsoil (B horizon); glacial till is at depths of 3 to 7 feet.[2]
Grundy, bench position	Loess	Imperfectly to moderately well drained; firm silty clay subsoil; alluvial material is at depths of 6 to 10 feet.[3]
Haig	Loess	Poorly drained soils; firm silty clay subsoil (B horizon); glacial till is at depths of 7 to 9 feet.[2]
Haig, fine textured	Loess	Poorly drained soils; very firm silty clay or clay subsoil (B horizon); glacial material is at depths of 7 to 9 feet.[2]
Keomah	Loess	Imperfectly drained; firm silty clay loam subsoil; glacial till is at depths of 6 to 9 feet.[2]
Keomah, bench position	Loess	Imperfectly drained; firm silty clay loam subsoil; alluvial material is at depths of 6 to 10 feet.[3]
Lamont	Eolian sand	Somewhat excessively drained; friable to loose sandy loam to sandy clay loam subsoil.
Landes	Alluvial	Well drained; substrata are stratified sand, silt, and clay
Lindley	Glacial till	Moderately well to well drained; firm clay loam subsoil
Nodaway	Alluvium	Moderately well to well drained; friable silt loam or loam subsoil
Nodaway, silty clay substratum	Alluvial	Imperfectly to poorly drained; firm silty clay or clay substrata are at depths of 18 to 36 inches.
Olmitz	Alluvium	Moderately well drained; firm loam or clay loam subsoil
Perks and Hagener	Alluvium	Excessively drained soils; loose sand subsoil
Pershing	Loess	Imperfectly to moderately well drained; firm silty clay subsoil (B horizon); glacial till is at depths of 3 to 9 feet.[2]
Pershing, bench position	Loess	Imperfectly to moderately well drained; firm silty clay subsoil; alluvial material is at depths of 3 to 10 feet.[3]
Rubio, bench position	Loess	Poorly drained; firm to very firm silty clay subsoil; alluvial material is at depths of 5 to 10 feet.[3]

See footnotes at end of table.

engineering classifications of Van Buren County soils

Estimated engineering soil classification		Dominant slope	Depth to seasonally high water table	Suitability as source of—	
AASHO	Unified			Topsoil	Borrow for highway construction
		Percent	*Feet*		
A-6 (10) to A-7-6 (16)	CL to CH	5 to 14	0 to 3 [1]	Unsuitable	Fair.
A-6 (12) to A-7-6 (16) with A-7-6 (20) B horizon.	CH to CL	0 to 3	1 to 3	Poor	Poor to unsuitable.
A-7-6 (12 to 20) over A-2, A-4, A-6.	CL, CH over SM, ML, CL	0 to 3	1 to 3 [1]	Poor	Poor to unsuitable.
A-6 (12) to A-7-6 (16) with A-7-6 (20) B horizon.	CH to CL	0 to 3	1 to 3	Good to a depth of 6 inches	Poor to unsuitable.
A-6 (12) to A-7-6 (16) with A-7-6 (20) B horizon.	CH to CL	0 to 3	1 to 3	Good to a depth of 6 inches	Poor to unsuitable.
A-7-6 (16) to A-7-6 (20)	OH to CH	0 to 2	1 to 3	Good to a depth of 12 inches	Unsuitable.
A-6 (12) to A-7-6 (16) with A-7-6 (20) B horizon.	CH to CL	0 to 2	1 to 3	Good to a depth of 6 inches	Unsuitable.
A-7-6 (16) to A-7-6 (20)	OL to CH	0 to 2	1 to 3	Good to a depth of 12 inches	Unsuitable.
A-7-6 (18 to 20)	CH	5 to 14	0 to 3 [1]	Unsuitable	Unsuitable.
A-6 (12) to A-7-6 (16)	CL or CH	5 to 14	(4)	Fair to poor	Poor.
A-6 (10) to A-7-6 (16) over A-2, A-4, A-6.	CL over SM, ML, CL	2 to 14	(4)	Fair to poor	Poor.
A-7-6 (18) to A-7-6 (14)	OL to CH	0 to 2	1 to 3	Good to a depth of 18 inches	Unsuitable.
A-6 (8) to A-7-6 (14)	CL to CH	0 to 5	0 to 3 [1]	Silt loam good; sandy overwash unsuitable.	Poor to fair.
A-2 to A-3	SC to SM	0 to 9	(4)	Poor	Good.
A-4 (4) to A-6 (13)	ML to CL	9 to 25	(4)	Fair to unsuitable	Fair.
A-6 (8) to A-7-6 (13)	CL to CH	5 to 14	(4)	Good	Fair.
A-6 (12) to A-7-6 (16) with A-7-6 (20) B horizon.	CH to CL	0 to 2	1 to 3	Good to a depth of 6 inches	Poor to unsuitable.
A-6 (12) to A-7-6 (16)	CL to CH	2 to 6	(4)	Good to fair	Poor.
A-6 (10) to A-7-6 (16) over A-2, A-4, A-6.	CL over SM, ML, CL	2 to 6	(4)	Good to fair	Poor.
A-6 to A-7	CL to CH	9 to 50	1 to 3 [1]	Unsuitable	Unsuitable.
A-7-6 (14 to 18)	OL to CL; OH or CH	2 to 5	1 to 3	Good to a depth of 1½ feet	Unsuitable.
A-6 (10) to A-7-6 (14) with A-7-6 (20) B horizon.	CL to CH	2 to 9	1 to 3 [1]	Good to depth of dark surface layer.	Poor to unsuitable.
A-6 (9) to A-7-6 (20) over A-2, A-4, A-6.	CL, CH over SM, ML, CH	2 to 9	2 to 3 [1]	Good to depth of dark surface layer.	Poor to unsuitable.
A-6 (10) to A-7-6 (14) with A-7-6 (20) B horizon.	CL to CH	0 to 2	1 to 3	Good to a depth of 1 foot	Unsuitable.
A-7-6 (15 to 18) with A-7-6 (20) B horizon.	CH to OH	0 to 2	0 to 3	Good to a depth of 1 foot	Unsuitable.
A-6 (13) to A-7-6 (17)	CL to CH	2 to 5	(4)	Fair to a depth of 6 inches	Poor.
A-6 (10) to A-7-6 (16) over A-2, A-4, A-6.	CL over SM, ML, CL	2 to 5	(4)	Fair to a depth of 6 inches	Poor.
A-2 or A-3	SC to SM	9 to 14	(4)	Unsuitable	Good.
A-2, A-4, A-6	SM, ML, CL	0 to 2	2 to 3 [1]	Unsuitable	Fair.
A-6 (6) to A-7-6 (14)	CL	14 to 40	(4)	Unsuitable	Good.
A-6 (8) to A-7-6 (12)	ML to CL	0 to 3	(4)	Good	Fair.
A-7-6 (12 to 19)	CL, CH, OH	0 to 2	1 to 3	Fair	Unsuitable.
A-6 (8) to A-7-6 (14)	CL	2 to 5	(4)	Good	Fair.
A-2 or A-3	SC or SM	0 to 5	(4)	Unsuitable	Good.
A-6 (10) to A-7-6 (14) with A-7-6 (20) B horizon.	CL to CH	2 to 9	1 to 3 [1]	Good to depth of dark surface layer.	Poor to unsuitable.
A-6 (10) to A-7-6 (20) over A-2, A-4, A-6.	CL to CH over SM, ML, CH.	2 to 9	2 to 3 [1]	Good to depth of dark surface layer.	Poor.
A-6 (12) to A-7-6 (17)	CL to CH	0 to 3	1 to 3	Good to a depth of 6 inches	Poor.

TABLE 10.—*Descriptions, properties, and estimated engineering*

Soil series, variants, and miscellaneous land types	Parent material	Brief description of soil profile and ground condition
Rushville, bench position	Loess	Poorly drained; firm silty clay subsoil; alluvial material is at depths of 5 to 10 feet.[3]
Seymour	Loess	Imperfectly to moderately well drained; very firm silty clay or clay subsoil (B horizon); glacial till is at depths of 3 to 7 feet.[2]
Shelby	Glacial till	Well drained; firm clay loam to clay subsoil
Steep sandy land	Eolian sand	Well to excessively drained; variable subsoil over stratified sand, silt, and clay.
Sogn	Limestone	Well drained; limestone is at depths of 6 to 15 inches
Wabash	Alluvium	Poorly drained to very poorly drained, very firm silty clay or clay subsoil.
Waukegan	Alluvium	Excessively drained to moderately well drained; loam to silty clay loam subsoil; sand or gravel is at depths of 1 to 6 feet.
Weller	Loess	Imperfectly to moderately well drained; firm to very firm silty clay subsoil (B horizon); glacial till is at depths of 3 to 7 feet.[2]
Weller, bench position	Loess	Imperfectly to moderately well drained; firm, light silty clay subsoil; alluvial material is at depths of 6 to 10 feet.[3]

[1] Perched water table in wet periods only.

[2] Loess-derived soils on the uplands are normally underlain by glacial till. A fine-textured paleosol (figs. 3 and 6), similar to the Adair or Clarinda soils, has usually developed in the upper part of the till.

[3] Loess-derived soils in the bench position are normally underlain

control erosion. Larger structures are needed in some places. For these, detailed investigation of the site chosen is necessary. The extent of such investigation will depend on the size, cost, and complexity of the proposed installation, as well as the nature of the site.

Investigation for the larger earth dams and reservoirs should include examination of the foundation material to determine strength, expected settlement, water loss, and piping potential caused by seepage. Material that is available for embankment should be investigated for strength, stability of slopes, moisture needed for required compaction, drains needed for embankment, and design of filter, if it is needed. The proposed emergency spillway area should be investigated to determine the suitability of excavated material for embankment, erodibility of the spillway material, and its stability on slopes. In the proposed reservoir area, the investigation should determine seepage rate, embankment stability, uplift pressures, and piping potential where it seems advisable.

The soils of this county present no special engineering problems if small structures to stabilize grassed waterways or terrace outlets are built. For these purposes, reinforced concrete structures with headwall type spillways may be used, or earth dams with drop-inlet type spillways. The earth structures may impound water permanently or may be "dry" dams.

Additional information and engineering assistance on these subjects can be obtained from private engineers and through the local soil conservation district.

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classifications of Van Buren County soils—Continued

Estimated engineering soil classification		Dominant slope	Depth to seasonally high water table	Suitability as source of—	
AASHO	Unified			Topsoil	Borrow for highway construction
		Percent	*Feet*		
A-6 (12) to A-7-6 (17)	CL to CH	0 to 3	1 to 3	Poor	Poor.
A-7-6 (11) to A-7-6 (14) with A-7-6 (20) B horizon.	CL to CH	2 to 9	1 to 3 [1]	Good to depth of dark surface layer.	Poor to unsuitable.
A-6 (6) to A-7-6 (14)	CL	14 to 25	(4)	Fair to depth of dark surface layer.	Good.
A-2 or A-3	SM or SC	9 to 30	(4)	Unsuitable	Good.
A-6 (10) to A-7-6 (16)	CL or CH	14 to 50	(4)	Unsuitable	Poor.
A-7-6 (15 to 19)	OH to CH	0 to 1	0 to 3	Poor	Unsuitable.
A-2, A-4, A-6	SM, ML, CL	0 to 9	(4)	Good to depth of dark surface layer.	Fair.
A-6 (10) to A-7-6 (14) with A-7-6 (20) B horizon.	CL to CH	2 to 9	1 to 3 [1]	Poor	Unsuitable.
A-6 (9) to A-7-6 (20) over A-2, A-4, A-6.	CL or CH	2 to 9	2 to 3 [1]	Poor	Poor to unsuitable.

[4] Water table is deep.

by alluvium consisting of stratified sand, silt, or clay. A fine-textured paleosol may have developed in the upper part of the alluvium.

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Glossary

Definitions of technical terms are given for the convenience of readers who cannot refer to them easily elsewhere.

Aggregate. Many fine soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Sand, mud, and other sediment deposited on land by streams. Local alluvium occurs at the bases of slopes and along small streams and is composed of nearly homogeneous soil material.

Bench. See Terrace, geologic.

Bench position. A soil is said to occupy a bench position when it has developed on a bench or geological terrace.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that contains 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.

Drainage, soil. This term refers to the natural drainage condition of a soil before the drainage was changed through the use of artificial methods of removing excess moisture. It is evaluated by observing soil colors and by the experience of soil scientists. The terms used to express the various degrees of natural drainage are: *Excessively drained, somewhat excessively drained, well drained, moderately well drained, imperfectly drained, poorly drained*, and *very poorly drained.*

Excessively drained.—Water is removed from the soil very rapidly. The soils are generally sandy, very porous, and undesirable for ordinary crops. The Perks and moderately deep Waukegan are examples of excessively drained soils.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils are sandy, very porous, and droughty even in years of average rainfall. The Lamont soils are somewhat excessively drained.

Well drained.—Water is removed from the soil readily but not rapidly. These soils generally retain optimum amounts of moisture for plant growth after rains or additions of irrigation water. Artificial drainage through use of tiles or ditches is not needed. The Waukegan soils are well drained.

Moderately well drained.—Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. These soils commonly have a slowly permeable layer in or immediately below the subsoil, a fairly high water table, additions of water through seepage, or some combination of these conditions. The growth of crops is not normally restricted on these soils by wetness except in years of excessive rainfall. Moderately well drained soils seldom, if ever, need artificial drainage. The Olmitz are examples of moderately well drained soils.

Imperfectly drained.—Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. The soils commonly have a slowly permeable layer in the profile, a high water table, additions of water through seepage, or a combination of these conditions. The growth of crops is generally restricted in years that are wetter than average. The Keomah, Givin, and Weller are examples of imperfectly drained soils.

Poorly drained.—Water is removed so slowly that the soil remains wet for a large part of the time. The water table is commonly near the surface during a considerable part of the year. Poorly drained conditions are caused by a high water table, a slowly permeable layer in the profile, seepage, or to a combination of these conditions. The large quantities of water that remain in and on poorly drained soils often prohibit the satisfactory growth of field crops in normal years. Artificial drainage is generally necessary in most years for crop production. The Haig, Edina, Rushville, and Rubio soils are examples of poorly drained soils.

Very poorly drained.—Water is removed from the soil so slowly that it stays wet for long periods. The water table is at or near the surface most of the time. Artificial surface drainage is generally necessary for satisfactory crop production. Soils of this drainage class generally occupy nearly level or slightly depressed sites. Wetness hinders cultivation in most seasons. The Carlow is an example of a very poorly drained soil.

Eolian deposits. Wind-deposited material moved fairly short distances and accumulated in dunes; generally coarse textured.

Granular soil. A soil composed mainly of aggregates having rather indistinct faces and edges in contrast with a fragmental soil, which is composed largely of aggregates having well-defined faces and edges, or in contrast with single grain as in a puddled soil or in sand. In engineering practice "granular soil" means a coarse-grained material.

Gumbotil. A paleosol that is gray to dark-colored, thoroughly weathered, nonlaminated, deoxidized clay. It is very sticky when wet and very hard when dry and has weathered from glacial drift.

Loam. The textural class name for soil having a moderate amount of sand, silt, and clay. Loam soils contain 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loess. A deposit of silty material that has been transported by wind. It is usually uniform unstratified silt but may contain some fine sand and clay.

Paleosol. A fossil or relict soil that was formed on a landscape during the geologic past and preserved by burial through sedimentation subsequent to its formation. Paleosols include fossil soils that are now covered by sediment (buried soils) and fossil soils from which erosion has stripped the mantle of sediment, so that the paleosol is now part of the continuum of soils on the modern surface.

Pedisediment. A layer of translocated, till-like sediment covering an erosion surface (pediment) at the foot of a receded slope that is underlain by rocks or sediments of the upland.

Permeability. This term refers to the rate in which air and water can move through a soil. Terms that describe permeability are: *Very rapid, rapid, moderate, moderately slow, slow,* and *very slow.* Moderate permeability is the most desirable as it allows free and easy movement of air and water except when the water table is high. Tile drainage systems work well in soils that are moderately to rapidly permeable, but they are of questionable value in slowly permeable soils. Soils that are very slowly permeable should be drained by use of surface methods, as they are difficult or impossible to drain with tile. Soils that are very rapidly permeable do not retain enough moisture for plants.

Phase, soil. The subdivision of a soil type or other classificational unit having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of soil types include differences in slope, stoniness, and surface-layer thickness because of accelerated erosion.

Sand. As a soil separate, particles ranging in diameter from 0.05 to 2.0 millimeters. As a textural class, a soil material that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils that have soil horizons similar in their differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and are formed from a particular type of parent material. Soil series is an important category in detailed soil classification. Individual series are given proper names from place names near the first recorded occurrence.

Silt. As a soil separate, mineral particles ranging in diameter from 0.002 to 0.05 millimeter in diameter. As a soil textural class, a soil material that contains 80 percent or more silt and less than 12 percent clay.

Silt loam. Soil material having (1) 50 percent or more silt and 12 to 27 percent clay or (2) 50 to 80 percent silt and less than 12 percent clay.

Soil. A natural body on the surface of the earth characterized by conformable layers resulting from modification of parent material by physical, chemical, and biological forces over periods of time.

Stoneline. A concentration of coarse rock fragments in soils. In cross section the line may be one stone thick or more than one stone thick. The line generally overlies material that has weathered in place, and it usually is overlain by sediment of variable thickness.

Terrace. (1) Agricultural: An embankment or ridge constructed across sloping soils, on or approximately on contour lines, at specific intervals. The terrace intercepts surplus runoff in order to retard it for infiltration into the soil or to direct any excess flow to an outlet at nonerosive velocity.

(2) Geologic: An old alluvial plain, usually flat or undulating, bordering a stream; frequently called second bottom as contrasted with flood plain; seldom subject to overflow.

Till. Unstratified geological deposits.

Topsoil. A presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

Type, soil. A subgroup or category under the soil series based on the texture of the surface soil. A soil type is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. The name of a soil type consists of the name of the soil series plus the textural class name of the upper part of the soil equivalent to the surface soil. Thus Belinda silt loam is the name of a soil type within the Belinda series.

GUIDE TO MAPPING UNITS AND MANAGEMENT GROUPS

Map Symbol	Soil name	Described on page	Management group	Described on page
AcC	Adair and Clarinda soils, 5 to 9 percent slopes	6	16	52
AcC2	Adair and Clarinda soils, 5 to 9 percent slopes, moderately eroded	6	16	52
AcC3	Adair and Clarinda soils, 5 to 9 percent slopes, severely eroded	6	19	53
AcD	Adair and Clarinda soils, 9 to 14 percent slopes	6	18	53
AcD2	Adair and Clarinda soils, 9 to 14 percent slopes, moderately eroded	7	18	53
AcD3	Adair and Clarinda soils, 9 to 14 percent slopes, severely eroded	7	19	53
Ba	Beckwith silt loam	8	17	52
Bb	Beckwith silt loam, bench position	8	17	52
Bd	Belinda silt loam	8	8	50
Bt	Belinda silt loam, bench position	9	8	50
Ca	Carlow silty clay loam	9	15	52
Cb	Carlow silty clay loam, overwashed	9	15	52
Ch	Chariton silt loam	10	8	50
Ck	Chequest silty clay loam	11	7	49
CmB	Clinton silt loam, bench position, 2 to 5 percent slopes	13	3	48
CmC	Clinton silt loam, bench position, 5 to 9 percent slopes	13	9	50
CmC2	Clinton silt loam, bench position, 5 to 9 percent slopes, moderately eroded	13	9	50
CmD	Clinton silt loam, bench position, 9 to 14 percent slopes	13	9	50
CmD2	Clinton silt loam, bench position, 9 to 14 percent slopes, moderately eroded	13	9	50
CnC	Clinton silt loam, 5 to 9 percent slopes	13	9	50
CnC2	Clinton silt loam, 5 to 9 percent slopes, moderately eroded	13	9	50
CnD	Clinton silt loam, 9 to 14 percent slopes	13	9	50
CnD2	Clinton silt loam, 9 to 14 percent slopes, moderately eroded	13	9	50
Co	Colo silty clay loam	14	7	49
Cp	Colo-Gravity Olmitz complex	14	7	49
CsA	Coppock silt loam, 0 to 2 percent slopes	15	7	49
CsB	Coppock silt loam, 2 to 5 percent slopes	15	7	49
CwA	Coppock soils, sandy overwash, 0 to 2 percent slopes	15	13	51
CwB	Coppock soils, sandy overwash, 2 to 5 percent slopes	16	13	51
DbA	Dickinson sandy loam, bench position, 0 to 2 percent slopes	16	5	49
DbB	Dickinson sandy loam, bench position, 2 to 5 percent slopes	16	5	49
DbC2	Dickinson sandy loam, bench position, 5 to 9 percent slopes, moderately eroded.	16	13	51
DtB	Downs silt loam, bench position, 2 to 5 percent slopes	18	3	48
DtC2	Downs silt loam, bench position, 5 to 9 percent slopes, moderately eroded	18	9	50
DwD	Downs and Lamont soils, bench position, 9 to 14 percent slopes	18	22	54
Ed	Edina silt loam	19	8	50
GbB	Givin silt loam, bench position, 2 to 6 percent slopes	20	3	48
GnB	Givin silt loam, 2 to 6 percent slopes	20	3	48
GoD2	Gosport silt loam, 9 to 14 percent slopes, moderately eroded	20	21	53
GoE2	Gosport silt loam, 14 to 18 percent slopes, moderately eroded	20	23	54
GoG2	Gosport silt loam, 18 to 40 percent slopes, moderately eroded	20	23	54
GpD3	Gosport soils, 9 to 14 percent slopes, severely eroded	20	23	54
GpE3	Gosport soils, 14 to 18 percent slopes, severely eroded	21	23	54
GrB	Gravity silty clay loam, 2 to 5 percent slopes	21	7	49
GsB	Grundy silty clay loam, 2 to 5 percent slopes	22	4	49
GsC	Grundy silty clay loam, 5 to 9 percent slopes	22	12	51
GsC2	Grundy silty clay loam, 5 to 9 percent slopes, moderately eroded	22	12	51
GtB	Grundy silt loam, bench position, 2 to 5 percent slopes	22	4	49
GtC2	Grundy silt loam, bench position, 5 to 9 percent slopes, moderately eroded	22	12	51
Ha	Haig silty clay loam	24	6	49
Hc	Haig silty clay loam, fine textured	24	6	49
KaB	Keomah silt loam, 2 to 5 percent slopes	25	3	48
KbB	Keomah silt loam, bench position, 2 to 5 percent slopes	25	3	48
La	Landes soils	26	13	51
LdE2	Lindley loam, 14 to 18 percent slopes, moderately eroded	27	21	53
LdF2	Lindley loam, 18 to 25 percent slopes, moderately eroded	27	23	54
LdG2	Lindley loam, 25 to 40 percent slopes, moderately eroded	27	23	54
LsE3	Lindley soils, 14 to 18 percent slopes, severely eroded	27	23	54
LsF3	Lindley soils, 18 to 25 percent slopes, severely eroded	27	23	54
Nc	Nodaway-Coppock complex	28	7	49
Nf	Nodaway-Coppock complex, flaggy	28	20	53
No	Nodaway silt loam	28	1	48
Ns	Nodaway silt loam, silty clay substratum	28	15	52
OmB	Olmitz loam, 2 to 5 percent slopes	29	2	48
OsB	Olmitz and Gravity soils, 2 to 5 percent slopes	29	2	48
PhA	Perks and Hagener soils, 0 to 2 percent slopes	29	14	52
PhB	Perks and Hagener soils, 2 to 5 percent slopes	29	14	52
PrB	Pershing silt loam, 2 to 5 percent slopes	30	4	49
PrC	Pershing silt loam, 5 to 9 percent slopes	30	12	51
PrC2	Pershing silt loam, 5 to 9 percent slopes, moderately eroded	30	12	51
PsC3	Pershing soils, 5 to 9 percent slopes, severely eroded	30	19	53
PtB	Pershing silt loam, bench position, 2 to 5 percent slopes	31	4	49

GUIDE TO MAPPING UNITS AND MANAGEMENT GROUPS—Continued

Map Symbol	Soil name	Described on page	Management group	Described on page
PtC	Pershing silt loam, bench position, 5 to 9 percent slopes	31	12	51
Rb	Rubio silt loam, bench position	31	8	50
Rt	Rushville silt loam, bench position	32	8	50
SaB	Seymour silt loam, 2 to 5 percent slopes	33	4	49
SaC2	Seymour silt loam, 5 to 9 percent slopes, moderately eroded	33	12	51
SbC3	Seymour soils, 5 to 9 percent slopes, severely eroded	33	19	53
ShE2	Shelby loam, 14 to 18 percent slopes, moderately eroded	33	18	53
ShF2	Shelby loam, 18 to 25 percent slopes, moderately eroded	34	21	53
SmE3	Shelby soils, 14 to 18 percent slopes, severely eroded	34	21	53
SmF3	Shelby soils, 18 to 25 percent slopes, severely eroded	34	23	54
SsF	Steep sandy land	34	24	54
SyG	Sogn, Gosport, and Lindley soils, 14 to 50 percent slopes	34	23	54
Ts	Douds soils and Terrace escarpments	17	22	54
Wa	Wabash silty clay loam	35	15	52
Wb	Wabash silty clay loam, overwashed	35	15	52
WdA	Waukegan loam, deep, 0 to 2 percent slopes	36	1	48
WdB	Waukegan loam, deep, 2 to 5 percent slopes	36	3	48
WdC2	Waukegan loam, deep, 5 to 9 percent slopes, moderately eroded	36	9	50
WmA	Waukegan loam, moderately deep, 0 to 3 percent slopes	36	13	51
WmB	Waukegan loam, moderately deep, 3 to 6 percent slopes	36	13	51
WrB	Weller silt loam, 2 to 5 percent slopes	37	10	51
WrB2	Weller silt loam, 2 to 5 percent slopes, moderately eroded	37	10	51
WrC	Weller silt loam, 5 to 9 percent slopes	37	11	51
WrC2	Weller silt loam, 5 to 9 percent slopes, moderately eroded	38	11	51
WsC3	Weller soils, 5 to 9 percent slopes, severely eroded	38	19	53
WtB	Weller silt loam, bench position, 2 to 5 percent slopes	38	10	51
WtB2	Weller silt loam, bench position, 2 to 5 percent slopes, moderately eroded	38	10	51
WtC	Weller silt loam, bench position, 5 to 9 percent slopes	38	11	51
WtC2	Weller silt loam, bench position, 5 to 9 percent slopes, moderately eroded	38	11	51
WvC3	Weller soils, bench position, 5 to 9 percent slopes, severely eroded	38	19	53

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