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Iowa Department of Agriculture and Land Stewardship

IOWA STATE UNIVERSITY
Iowa Agriculture and Home Economics Experiment Station

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University Extension

In cooperation with Iowa Agriculture and Home Economics Experiment Station and Cooperative Extension Service, Iowa State University; and Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

Soil Survey of Shelby County, Iowa

Part I

How To Use This Soil Survey

This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the general soil map units, detailed soil map units, and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

On the **general soil map**, the survey area is divided into groups of soils called associations. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the soil associations on the color-coded map legend, and then refer to the section **General Soil Map Units** in Part I for a general description of the soils in your area.

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets** in Part III. Note the number of the map sheet, and turn to that sheet. Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. The **Contents** in Part I lists the map units and shows the page where each map unit is described.

The **Contents** in Part II shows which table has information on a specific land use or soil property for each detailed soil map unit. Also, see the **Contents** in Part I and Part II for other sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 2003. Soil names and descriptions were approved in 2004. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2004. The most current official data are available through the NRCS Web Soil Survey (http://soils.usda.gov).

This survey was made cooperatively by the Natural Resources Conservation Service; the Iowa Agriculture and Home Economics Experiment Station and Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. The survey is part of the technical assistance furnished to the Shelby County Soil and Water Conservation District. Funds appropriated by Shelby County were used to defray part of the cost of the survey.

Cover: A combination of terraces and contour farming in the Exira-Marshall-Judson association southeast of Prairie Rose State Park.

Additional information about the Nation's natural resources is available online from the Natural Resources Conservation Service at http://www.nrcs.usda.gov.

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Issued 2007

Foreword

Soil surveys contain information that affects land use planning in survey areas. They include predictions of soil behavior for selected land uses. The surveys highlight soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

Soil surveys are designed for many different users. Farmers, foresters, and agronomists can use the surveys to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the surveys to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the surveys to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described, and information on specific uses is given. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

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Soil Survey of
Shelby County, Iowa

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the Iowa Agriculture and Home Economics Experiment Station and Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

SHELBY COUNTY is in west-central Iowa (fig. 1). It is in the fourth tier of counties north of the Iowa-Missouri state line and is the second county east of the Missouri River. It has an area of about 378,300 acres, or about 590 square miles. Harlan, the county seat, is approximately 95 miles northwest of Des Moines, Iowa.

This survey updates the previous survey of Shelby County published in 1961 (Jury and others, 1961). It provides additional information and new maps, which show the soils in greater detail.

How This Survey Was Made

This survey was made to provide updated information about the soils and miscellaneous areas in the survey area, which is in Major Land Resource Area (MLRA) 107B. Major land resource areas are geographically associated land resource units that share a common land use, elevation, topography, climate, water, soils, and vegetation (USDA, 2006). MLRA 107B is part of the Iowa and Missouri Deep Loess Hills.

The information in this survey includes a description of the soils and miscellaneous areas and their location and a discussion of their properties and the subsequent effects on suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil

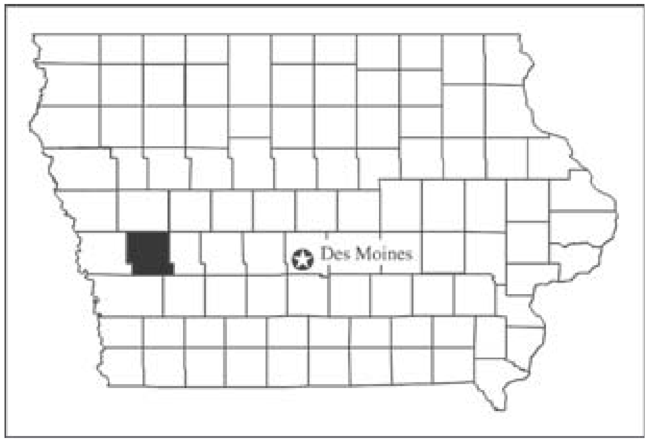

Figure 1.—Location of Shelby County in Iowa.

scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they observed. The maximum depth of observation was about 80 inches (6.7 feet). Soil scientists noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Interpretations are modified as necessary to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a water table within certain depths in most years, but they cannot predict that the water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area may not fully agree with those of the soils in adjacent survey areas. Differences are the result of an improved knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

General Nature of the Survey Area

This section provides some general information about Shelby County. It describes history; industry, transportation facilities, and recreation; and climate.

History

Before Iowa became a State in 1846, the area was primarily hunting and trapping ground for various Native American tribes, including the Pawnee, Omaha, and Otoe tribes from the west; the Sac, Fox, and Sioux tribes from the north; and the Iowa and Potawatomi tribes from the south.

Shelby County, originally a part of Keokuk County, was established in 1851, and the county government was organized in 1853 (Jury and others, 1961). The county was named in honor of General Isaac Shelby, an officer in the Revolutionary War and the first governor of Kentucky. The Mormons from Nauvoo, Illinois, were among the first settlers in Shelby County; they arrived in 1848. Many immigrants, including German, Danish, Norwegian, and Irish, established towns and communities throughout Shelby County.

In 1854, the population of Shelby County was 326. It was 17,932 in 1900 and 13,173 in 2000 (U.S. Department of Commerce, 2004). Shelby County has eleven incorporated towns and three unincorporated hamlets. Thirty-nine percent of the residents live in urban areas (areas having a population of at least 2,500), and the remaining 61 percent are in rural areas.

Industry, Transportation Facilities, and Recreation

Agriculture is the primary industry and the dominant land use in Shelby County. Corn and soybeans have replaced prairie grasses and native timber. The county also has several hog operations. In 2002, cropland or pasture covered 347,500 acres, or 92 percent of the county (Iowa Agricultural Statistics Service, 2004). Currently, the average farm size is 404 acres. In 1970, the average farm size was 256 acres. Although the average farm size is increasing, the number of farms and of crop varieties is decreasing. About 82 percent of the land in the county is used for corn and soybeans. Oats, wheat, alfalfa hay, and other hay crops also are grown.

Farming practices have changed over the years. In 2000, Shelby County farmers harvested 123,320 acres of no-till corn and soybeans. Farm animals included more than 119,000 hogs and pigs, 40,000 head of cattle, and 2,100 sheep and lambs (Iowa Agricultural Statistics Service, 2004). Other industries include manufacturing applications, educational services, medical and mental health groups, and other service-oriented businesses. Mining and mineral resources are minimal.

Transportation facilities include highways, railroads, freight trucking companies, and one airport. Interstate 80 parallels Shelby County's southern boundary a couple of miles to the south. U.S. Highway 59 dissects the center of the county in a north-to-south direction. State Highway 44 crosses the center of the county from east to west. Freight is transported by truck or by railroad. Harlan Municipal Airport is located 4 miles south of Harlan.

Shelby County offers 1,770 acres of parks, including two native wildlife areas—the Derald Dinesen Prairie and Oak Ridge. There are numerous recreational areas and river access areas. The 422-acre Prairie Rose State Park includes 218 acres of lake.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Harlan, Iowa, in the period 1971 to 2000. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 23.4 degrees F and the average daily minimum temperature is 14.1 degrees. In summer, the average temperature is 72.6 degrees and the average daily maximum temperature is 83.4 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 33.4 inches. Of this total, 24.16 inches, or about 72 percent, usually falls in April through September. The growing season for most crops falls within this period.

The average seasonal snowfall is 32.1 inches. On the average, 54 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

Table 1.--Temperature and Precipitation

(Recorded in the period 1971-2000 at Harlan, Iowa)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	29.5	10.2	19.9	56	-19	2	0.78	0.27	1.32	2	7.6
February---	36.0	16.8	26.4	67	-18	15	.80	.36	1.18	2	6.7
March------	48.4	27.0	37.7	79	-3	105	2.17	.74	3.65	5	5.2
April------	62.3	38.1	50.2	89	16	330	3.28	1.51	4.76	6	1.6
May--------	73.0	49.8	61.4	91	31	664	4.18	2.34	5.86	8	.0
June-------	82.4	59.6	71.0	97	43	930	4.35	2.28	6.40	6	.0
July-------	85.2	64.0	74.6	98	48	1,072	4.10	1.89	6.30	5	.0
August-----	82.7	61.9	72.3	96	46	1,002	3.79	1.77	5.59	5	.0
September--	75.7	52.7	64.2	94	31	725	4.46	1.59	6.97	5	.0
October----	63.4	40.6	52.0	86	18	386	2.68	1.02	4.41	4	.9
November---	46.0	27.3	36.7	71	2	79	1.79	.69	2.90	3	3.1
December---	32.7	15.3	24.0	59	-15	6	1.01	.44	1.53	2	7.0
Yearly:											
Average---	59.8	38.6	49.2	---	---	---	---	---	---	---	---
Extreme---	106	-29	---	100	-22	---	---	---	---	---	---
Total-----	---	---	---	---	---	5,316	33.39	27.24	39.42	53	32.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1971-2000 at Harlan, Iowa)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 18	May 1	May 18
2 years in 10 later than--	Apr. 13	Apr. 27	May 12
5 years in 10 later than--	Apr. 5	Apr. 19	Apr. 30
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 15	Oct. 3	Sept. 23
2 years in 10 earlier than--	Oct. 19	Oct. 7	Sept. 27
5 years in 10 earlier than--	Oct. 28	Oct. 15	Oct. 5

Table 3.--Growing Season

(Recorded in the period 1971-2000 at Harlan, Iowa)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	190	166	142
8 years in 10	196	172	149
5 years in 10	207	183	162
2 years in 10	219	194	174
1 year in 10	224	200	181

General Soil Map Units

The general soil map in this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. These broad areas are called associations. Each association on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1—Monona-Ida-Napier Association

Extent of the association in the survey area: 1 percent

Component Description

Monona
Extent: 44 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits, shoulders, backslopes
Geomorphic component: Interfluves
Slope range: 5 to 9 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Ida
Extent: 29 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Geomorphic component: Side slopes
Slope range: 14 to 20 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None

Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Napier
Extent: 25 percent of the unit
Geomorphic setting: Hillslopes
Geomorphic component: Base slopes
Slope range: 2 to 5 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Local alluvium
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 13.1 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Soils of Minor Extent

Burchard
Extent: 1 percent of the unit

Kennebec
Extent: 1 percent of the unit

2—Monona-Judson-Ida Association

Extent of the association in the survey area: 35 percent

Component Description

Monona
Extent: 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders, summits
Geomorphic component: Interfluves
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Judson
Extent: 17 percent of the unit
Geomorphic setting: Uplands
Position on the landform: Footslopes
Geomorphic component: Base slopes
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained

Parent material: Local alluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Ida
Extent: 15 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Geomorphic component: Side slopes
Slope range: 14 to 20 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Soils of Minor Extent

Ackmore
Extent: 6 percent of the unit

Nodaway
Extent: 5 percent of the unit

Burchard
Extent: 1 percent of the unit

Zook
Extent: 1 percent of the unit

3—Exira-Marshall-Judson Association

Extent of the association in the survey area: 48 percent

Component Description

Exira
Extent: 32 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, summits, backslopes
Geomorphic component: Interfluves
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 11.9 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Marshall
Extent: 30 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders, summits
Geomorphic component: Interfluves
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 11.6 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Judson
Extent: 15 percent of the unit
Geomorphic setting: Uplands
Position on the landform: Footslopes
Geomorphic component: Base slopes
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Local alluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Soils of Minor Extent

Nodaway
Extent: 12 percent of the unit

Shelby
Extent: 6 percent of the unit

Ackmore
Extent: 4 percent of the unit

Adair
Extent: 1 percent of the unit

4—Nodaway-Ackmore-Zook Association (fig. 2)

Extent of the association in the survey area: 8 percent

Component Description

Nodaway
Extent: 42 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)

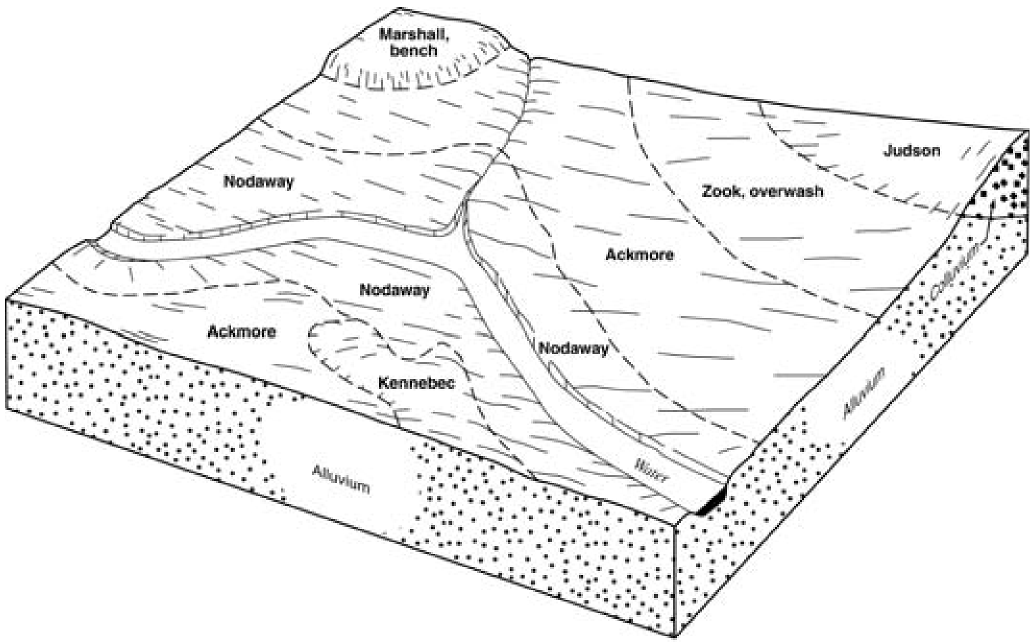

Figure 2.—Typical pattern of soils and parent material in the Nodaway-Ackmore-Zook association.

Drainage class: Moderately well drained
Parent material: Silty alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 4.0 feet (April)
Deepest depth to wet zone: 6.5 feet (August, September, October)
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Ackmore
Extent: 32 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 1.0 foot (April)
Deepest depth to wet zone: 4.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 12.1 inches
Content of organic matter in the upper 10 inches: 2.6 percent

Zook
Extent: 25 percent of the unit
Geomorphic setting: Flood plains

Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: At the surface (April)
Deepest depth to wet zone: 3.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 7.2 inches
Content of organic matter in the upper 10 inches: 4.6 percent

Soils of Minor Extent

Marshall, bench
Extent: 1 percent of the unit

5—Monona-Marshall-Judson Association

Extent of the association in the survey area: 8 percent

Component Description

Monona
Extent: 44 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, backslopes, summits
Geomorphic component: Interfluves
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Marshall
Extent: 24 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits, shoulders
Geomorphic component: Interfluves
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Judson
Extent: 17 percent of the unit
Geomorphic setting: Uplands
Position on the landform: Footslopes
Geomorphic component: Base slopes
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Local alluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Soils of Minor Extent

Ackmore
Extent: 7 percent of the unit

Ida
Extent: 6 percent of the unit

Nodaway
Extent: 1 percent of the unit

Zook
Extent: 1 percent of the unit

Detailed Soil Map Units

The map units delineated on the detailed soil maps in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and lists some of the principal soil properties that should be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Monona silty clay loam, 5 to 9 percent slopes, moderately eroded, is a phase of the Monona series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are called complexes. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Judson-Ackmore-Colo, overwash, complex, 1 to 5 percent slopes, is an example (fig. 3).

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The map unit Pits, sand and gravel, is an example.

The table "Acreage and Proportionate Extent of the Soils" in Part II lists the map units in this survey area. Other tables provided in Part II give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1C3—Ida silt loam, 5 to 9 percent slopes, severely eroded

Component Description

Ida, severely eroded, and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits, shoulders
Slope range: 5 to 9 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 10 percent of the unit

Monona, severely eroded, and similar soils
Extent: 10 percent of the unit

1D3—Ida silt loam, 9 to 14 percent slopes, severely eroded

Component Description

Ida, severely eroded, and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Silt loam

Figure 3.—A typical landscape in an area of Judson-Ackmore-Colo, overwash, complex, 1 to 5 percent slopes.

Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 10 percent of the unit

Monona, severely eroded, and similar soils
Extent: 10 percent of the unit

1E3—Ida silt loam, 14 to 20 percent slopes, severely eroded

Component Description

Ida, severely eroded, and similar soils
Extent: 60 to 80 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 14 to 20 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None

Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 10 percent of the unit

Monona, severely eroded, and similar soils
Extent: 10 percent of the unit

Monona, slightly eroded, and similar soils
Extent: 10 percent of the unit

1F3—Ida silt loam, 20 to 30 percent slopes, severely eroded

Component Description

Ida, severely eroded, and similar soils
Extent: 50 to 90 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 20 to 30 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 15 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

Monona, slightly eroded, and similar soils
Extent: 5 percent of the unit

Monona, severely eroded, and similar soils
Extent: 5 percent of the unit

8B—Judson silty clay loam, 2 to 5 percent slopes

Component Description

Judson and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Alluvial fans; drainageways
Position on the landform: Footslopes
Slope range: 2 to 5 percent

Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Additional Components of Minor Extent

Ackmore and similar soils
Extent: 10 percent of the unit

Colo, overwash, frequently flooded, and similar soils
Extent: 10 percent of the unit

8C—Judson silty clay loam, 5 to 9 percent slopes

Component Description

Judson and similar soils
Extent: 90 to 100 percent of the unit
Geomorphic setting: Alluvial fans; drainageways
Position on the landform: Footslopes
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Additional Components of Minor Extent

Colo, overwash, frequently flooded, and similar soils
Extent: 5 percent of the unit

9—Marshall silty clay loam, 0 to 2 percent slopes

Component Description

Marshall and similar soils
Extent: 90 to 100 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits
Slope range: 0 to 2 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None

Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Additional Components of Minor Extent

Minden and similar soils
Extent: 5 percent of the unit

9B—Marshall silty clay loam, 2 to 5 percent slopes

Component Description

Marshall and similar soils
Extent: 100 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

9C2—Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded

Component Description

Marshall, moderately eroded, and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits, shoulders
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 11.6 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Exira, severely eroded, and similar soils
Extent: 10 percent of the unit

Marshall, slightly eroded, and similar soils
Extent: 10 percent of the unit

9D2—Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded

Component Description

Marshall, moderately eroded, and similar soils
Extent: 60 to 80 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 11.6 inches
Content of organic matter in the upper 10 inches: 2.4 percent

Additional Components of Minor Extent

Exira, severely eroded, and similar soils
Extent: 15 percent of the unit

Marshall, slightly eroded, and similar soils
Extent: 10 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

10C2—Monona silt loam, 5 to 9 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits, shoulders
Slope range: 5 to 9 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, slightly eroded, and similar soils
Extent: 20 percent of the unit

Ida, severely eroded, and similar soils
Extent: 5 percent of the unit

10D2—Monona silt loam, 9 to 14 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 50 to 70 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 1.2 percent

Additional Components of Minor Extent

Ida, severely eroded, and similar soils
Extent: 15 percent of the unit

Monona, severely eroded, and similar soils
Extent: 15 percent of the unit

Monona, slightly eroded, and similar soils
Extent: 5 percent of the unit

Napier and similar soils
Extent: 5 percent of the unit

10E2—Monona silt loam, 14 to 20 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 30 to 50 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, backslopes
Slope range: 14 to 20 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, slightly eroded, and similar soils
Extent: 30 percent of the unit

Ida, severely eroded, and similar soils
Extent: 10 percent of the unit

Monona, severely eroded, and similar soils
Extent: 10 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

Napier and similar soils
Extent: 5 percent of the unit

10F2—Monona silt loam, 20 to 30 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 35 to 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 20 to 30 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, slightly eroded, and similar soils
Extent: 20 percent of the unit

Ida, severely eroded, and similar soils
Extent: 15 percent of the unit

Monona, severely eroded, and similar soils
Extent: 10 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

Napier and similar soils
Extent: 5 percent of the unit

12B—Napier silt loam, 2 to 5 percent slopes

Component Description

Napier and similar soils
Extent: 80 to 100 percent of the unit
Geomorphic setting: Drainageways; alluvial fans
Position on the landform: Footslopes
Slope range: 2 to 5 percent

Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 13.1 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Additional Components of Minor Extent

Danbury, rarely flooded, and similar soils
Extent: 10 percent of the unit

12C—Napier silt loam, 5 to 9 percent slopes

Component Description

Napier and similar soils
Extent: 90 to 100 percent of the unit
Geomorphic setting: Alluvial fans; drainageways
Position on the landform: Footslopes
Slope range: 5 to 9 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 13.1 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Additional Components of Minor Extent

Danbury, rarely flooded, and similar soils
Extent: 5 percent of the unit

24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded

Component Description

Shelby, moderately eroded, and similar soils
Extent: 60 to 80 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 14 to 18 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 10.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Burchard, severely eroded, and similar soils
Extent: 15 percent of the unit

Adair, severely eroded, and similar soils
Extent: 10 percent of the unit

Exira, moderately eroded, and similar soils
Extent: 5 percent of the unit

24F2—Shelby clay loam, 18 to 25 percent slopes, moderately eroded

Component Description

Shelby, moderately eroded, and similar soils
Extent: 40 to 60 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 18 to 25 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 1.8 percent

Additional Components of Minor Extent

Shelby, slightly eroded, and similar soils
Extent: 40 percent of the unit

Adair, moderately eroded, and similar soils
Extent: 5 percent of the unit

Burchard, severely eroded, and similar soils
Extent: 5 percent of the unit

35D2—Liston-Burchard complex, 9 to 14 percent slopes, moderately eroded

Component Description

Liston, moderately eroded, and similar soils
Extent: 45 to 65 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Calcareous glacial till
Flooding: None

Ponding: None
Available water capacity to a depth of 60 inches: 9.9 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Burchard, moderately eroded, and similar soils
Extent: 20 to 60 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Adair, moderately eroded, and similar soils
Extent: 5 percent of the unit

Burchard, severely eroded, and similar soils
Extent: 5 percent of the unit

54—Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Zook, occasionally flooded, and similar soils
Extent: 80 to 100 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: At the surface (April)
Deepest depth to wet zone: 3.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 9.6 inches
Content of organic matter in the upper 10 inches: 5.1 percent

Additional Components of Minor Extent

Zook, overwash, occasionally flooded, and similar soils
Extent: 10 percent of the unit

54+—Zook silt loam, 0 to 2 percent slopes, occasionally flooded, overwash

Component Description

Zook, overwash, occasionally flooded, and similar soils
Extent: 75 to 95 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: At the surface (April)
Deepest depth to wet zone: 3.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 7.2 inches
Content of organic matter in the upper 10 inches: 4.6 percent

Additional Components of Minor Extent

Zook, occasionally flooded, and similar soils
Extent: 15 percent of the unit

59E2—Burchard clay loam, 14 to 18 percent slopes, moderately eroded

Component Description

Burchard, moderately eroded, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 14 to 18 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Liston and similar soils
Extent: 15 percent of the unit

Burchard, severely eroded, and similar soils
Extent: 10 percent of the unit

59F2—Burchard clay loam, 18 to 25 percent slopes, moderately eroded

Component Description

Burchard, moderately eroded, and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 18 to 25 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Liston and similar soils
Extent: 15 percent of the unit

Burchard, severely eroded, and similar soils
Extent: 5 percent of the unit

93D2—Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded

Component Description

Shelby, moderately eroded, and similar soils
Extent: 55 to 75 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 10.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Adair, moderately eroded, and similar soils
Extent: 10 to 30 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained
Parent material: Red paleosol weathered from glacial till
Flooding: None
Shallowest depth to wet zone: 1.0 foot (October)
Deepest depth to wet zone: More than 6.7 feet (January, February, July, August, September)
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 1.8 percent

Additional Components of Minor Extent

Exira, moderately eroded, and similar soils
Extent: 10 percent of the unit

Burchard, severely eroded, and similar soils
Extent: 5 percent of the unit

99D2—Exira silty clay loam, 9 to 14 percent slopes, moderately eroded

Component Description

Exira, moderately eroded, and similar soils
Extent: 40 to 60 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 11.9 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Additional Components of Minor Extent

Exira, severely eroded, and similar soils
Extent: 15 percent of the unit

Adair, moderately eroded, and similar soils
Extent: 10 percent of the unit

Marshall and similar soils
Extent: 10 percent of the unit

Shelby, moderately eroded, and similar soils
Extent: 10 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

99E2—Exira silty clay loam, 14 to 18 percent slopes, moderately eroded

Component Description

Exira, moderately eroded, and similar soils
Extent: 35 to 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 14 to 18 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 11.9 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Additional Components of Minor Extent

Exira, severely eroded, and similar soils
Extent: 30 percent of the unit

Marshall and similar soils
Extent: 10 percent of the unit

Adair, moderately eroded, and similar soils
Extent: 5 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

Shelby, moderately eroded, and similar soils
Extent: 5 percent of the unit

99F2—Exira silty clay loam, 18 to 25 percent slopes, moderately eroded

Component Description

Exira, moderately eroded, and similar soils
Extent: 40 to 60 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 18 to 25 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 11.9 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Additional Components of Minor Extent

Exira, severely eroded, and similar soils
Extent: 20 percent of the unit

Marshall and similar soils
Extent: 15 percent of the unit

Shelby, moderately eroded, and similar soils
Extent: 10 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

100B—Monona silty clay loam, 2 to 5 percent slopes

Component Description

Monona and similar soils
Extent: 45 to 65 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Summits
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.9 inches
Content of organic matter in the upper 10 inches: 3.5 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 45 percent of the unit

100C2—Monona silty clay loam, 5 to 9 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 45 to 65 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, summits
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, slightly eroded, and similar soils
Extent: 20 percent of the unit

Monona, severely eroded, and similar soils
Extent: 20 percent of the unit

Ida, severely eroded, and similar soils
Extent: 5 percent of the unit

100D2—Monona silty clay loam, 9 to 14 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 35 to 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes, shoulders
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, severely eroded, and similar soils
Extent: 20 percent of the unit

Ida, severely eroded, and similar soils
Extent: 15 percent of the unit

Monona, slightly eroded, and similar soils
Extent: 15 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

100D3—Monona silty clay loam, 9 to 14 percent slopes, severely eroded

Component Description

Monona, severely eroded, and similar soils
Extent: 35 to 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, backslopes
Slope range: 9 to 14 percent

Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.8 percent

Additional Components of Minor Extent

Monona, moderately eroded, and similar soils
Extent: 35 percent of the unit

Ida, severely eroded, and similar soils
Extent: 15 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

100E2—Monona silty clay loam, 14 to 20 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 35 to 55 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Shoulders, backslopes
Slope range: 14 to 20 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, severely eroded, and similar soils
Extent: 30 percent of the unit

Ida, severely eroded, and similar soils
Extent: 15 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

100F2—Monona silty clay loam, 20 to 30 percent slopes, moderately eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 45 to 65 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 20 to 30 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, severely eroded, and similar soils
Extent: 25 percent of the unit

Ida, severely eroded, and similar soils
Extent: 10 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

101F3—Monona-Ida complex, 20 to 30 percent slopes, severely eroded

Component Description

Monona, moderately eroded, and similar soils
Extent: 30 to 50 percent of the unit
Geomorphic setting: Loess hills
Position on the landform: Backslopes
Slope range: 20 to 30 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Ida, severely eroded, and similar soils
Extent: 30 percent of the unit
Geomorphic setting: Loess hills

Position on the landform: Backslopes
Slope range: 20 to 30 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Additional Components of Minor Extent

Monona, severely eroded, and similar soils
Extent: 15 percent of the unit

Monona, slightly eroded, and similar soils
Extent: 10 percent of the unit

Burchard, moderately eroded, and similar soils
Extent: 5 percent of the unit

212—Kennebec silt loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Kennebec, occasionally flooded, and similar soils
Extent: 60 to 80 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 4.0 feet (April)
Deepest depth to wet zone: 6.5 feet (August, September, October)
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.7 percent

Additional Components of Minor Extent

Nodaway, occasionally flooded, and similar soils
Extent: 15 percent of the unit

Colo, overwash, occasionally flooded, and similar soils
Extent: 10 percent of the unit

Zook, occasionally flooded, and similar soils
Extent: 5 percent of the unit

220—Nodaway silt loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Nodaway, occasionally flooded, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 4.0 feet (April)
Deepest depth to wet zone: 6.5 feet (August, September, October)
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Ackmore, occasionally flooded, and similar soils
Extent: 20 percent of the unit

Zook, occasionally flooded, and similar soils
Extent: 5 percent of the unit

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded

Component Description

Clarinda, moderately eroded, and similar soils
Extent: 60 to 80 percent of the unit
Geomorphic setting: Hillslopes
Position on the landform: Shoulders, backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Gray paleosol weathered from glacial till
Flooding: None
Shallowest depth to wet zone: At the surface (March, April)
Deepest depth to wet zone: More than 6.7 feet (January, August, September)
Ponding: None
Available water capacity to a depth of 60 inches: 9.2 inches
Content of organic matter in the upper 10 inches: 1.9 percent

Additional Components of Minor Extent

Adair, moderately eroded, and similar soils
Extent: 10 percent of the unit

Exira, moderately eroded, and similar soils
Extent: 10 percent of the unit

Shelby, severely eroded, and similar soils
Extent: 10 percent of the unit

430—Ackmore silt loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Ackmore, occasionally flooded, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 1.0 foot (April)
Deepest depth to wet zone: 4.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 12.1 inches
Content of organic matter in the upper 10 inches: 2.6 percent

Additional Components of Minor Extent

Nodaway, occasionally flooded, and similar soils
Extent: 20 percent of the unit

Zook, occasionally flooded, and similar soils
Extent: 5 percent of the unit

431B—Judson-Ackmore-Colo, overwash, complex, 1 to 5 percent slopes

Component Description

Judson and similar soils
Extent: 45 to 65 percent of the unit
Geomorphic setting: Alluvial fans; drainageways
Position on the landform: Footslopes
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Depth to wet zone: More than 6.7 feet all year
Ponding: None
Available water capacity to a depth of 60 inches: 13.2 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Ackmore, rarely flooded, and similar soils
Extent: 15 to 35 percent of the unit
Geomorphic setting: Flood plains
Slope range: 1 to 3 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Rare (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 1.0 foot (April)
Deepest depth to wet zone: 4.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 12.1 inches
Content of organic matter in the upper 10 inches: 2.6 percent

Colo, overwash, frequently flooded, and similar soils
Extent: 5 to 25 percent of the unit
Geomorphic setting: Flood plains
Slope range: 1 to 3 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Frequent (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: At the surface (April)
Deepest depth to wet zone: 3.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 2.5 percent

Additional Components of Minor Extent

Nodaway, frequently flooded, and similar soils
Extent: 5 percent of the unit

509—Marshall silty clay loam, bench, 0 to 2 percent slopes

Component Description

Marshall, bench, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Summits
Slope range: 0 to 2 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None

Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Additional Components of Minor Extent

Judson and similar soils
Extent: 15 percent of the unit

Minden, bench, and similar soils
Extent: 10 percent of the unit

509B—Marshall silty clay loam, bench, 2 to 5 percent slopes

Component Description

Marshall, bench, and similar soils
Extent: 80 to 100 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Summits
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Additional Components of Minor Extent

Judson and similar soils
Extent: 10 percent of the unit

509C—Marshall silty clay loam, bench, 5 to 9 percent slopes

Component Description

Marshall, bench, and similar soils
Extent: 75 to 95 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Summits
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.0 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Additional Components of Minor Extent

Judson and similar soils
Extent: 15 percent of the unit

509D2—Marshall silty clay loam, bench, 9 to 14 percent slopes, moderately eroded

Component Description

Marshall, bench, moderately eroded, and similar soils
Extent: 55 to 75 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Shoulders, backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 11.6 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Additional Components of Minor Extent

Marshall, bench, slightly eroded, and similar soils
Extent: 20 percent of the unit

Judson and similar soils
Extent: 15 percent of the unit

630—Danbury silt loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Danbury, occasionally flooded, and similar soils
Extent: 70 to 90 percent of the unit
Geomorphic setting: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Alluvium
Months in which flooding does not occur: January, December
Highest frequency of flooding: Occasional (February, March, April, May, June, July, August, September, October, November)
Shallowest depth to wet zone: 2.0 feet (April)
Deepest depth to wet zone: 5.0 feet (September)
Ponding: None
Available water capacity to a depth of 60 inches: 12.3 inches
Content of organic matter in the upper 10 inches: 2.7 percent

Additional Components of Minor Extent

Kennebec, occasionally flooded, and similar soils
Extent: 15 percent of the unit

Colo, overwash, occasionally flooded, and similar soils
Extent: 5 percent of the unit

700B—Monona silty clay loam, bench, 2 to 5 percent slopes

Component Description

Monona, bench, and similar soils
Extent: 65 to 85 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Summits
Slope range: 2 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.9 inches
Content of organic matter in the upper 10 inches: 3.5 percent

Additional Components of Minor Extent

Monona, bench, moderately eroded, and similar soils
Extent: 25 percent of the unit

700C2—Monona silty clay loam, bench, 5 to 9 percent slopes, moderately eroded

Component Description

Monona, bench, moderately eroded, and similar soils
Extent: 40 to 60 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Shoulders, summits
Slope range: 5 to 9 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, bench, slightly eroded, and similar soils
Extent: 30 percent of the unit

Monona, bench, severely eroded, and similar soils
Extent: 15 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

700D2—Monona silty clay loam, bench, 9 to 14 percent slopes, moderately eroded

Component Description

Monona, bench, moderately eroded, and similar soils
Extent: 50 to 70 percent of the unit
Geomorphic setting: Stream terraces
Position on the landform: Shoulders, backslopes
Slope range: 9 to 14 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loess
Flooding: None
Ponding: None
Available water capacity to a depth of 60 inches: 12.7 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Additional Components of Minor Extent

Monona, bench, slightly eroded, and similar soils
Extent: 25 percent of the unit

Monona, bench, severely eroded, and similar soils
Extent: 10 percent of the unit

Judson and similar soils
Extent: 5 percent of the unit

5010—Pits, sand and gravel

Component Description

Pits, sand and gravel
Definition: This map unit consists of areas from which sand and gravel have been removed.
Extent: 100 percent of the unit
Ponding: None

5040—Udorthents, loamy

Component Description

Udorthents and similar soils
Extent: 100 percent of the unit
Texture of the surface layer: Variable
Parent material: Loamy deposits
Flooding: None
Ponding: None

5080—Udorthents, sanitary landfill

Component Description

Udorthents, sanitary landfill
Extent: 100 percent of the unit
Drainage class: Moderately well drained

AW—Animal waste lagoon

- This map unit consists of shallow ponds constructed to hold animal waste from farm feedlots.

SL—Sewage lagoon

- This map unit consists of shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid waste.

W—Water

- This map unit consists of natural bodies of water.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2003). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, superactive, mesic Typic Hapludolls.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

The table “Classification of the Soils” in Part II of this publication indicates the order, suborder, great group, subgroup, and family of the soil series in the survey area.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” (Soil Survey Division Staff, 1993). Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” (Soil Survey Staff, 1999) and in “Keys to Soil Taxonomy” (Soil Survey Staff, 2003). Unless otherwise indicated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

Ackmore Series

Typical Pedon

Ackmore silt loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain; Shelby County, Iowa; 1,000 feet west and 210 feet north of the southeast corner of sec. 20, T. 79 N., R. 40 W.; USGS Portsmouth topographic quadrangle; lat. 41 degrees 37 minutes 54.7 seconds N. and long. 95 degrees 31 minutes 20 seconds W., NAD 83:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam; weak fine and medium subangular blocky structure; friable; many distinct black (10YR 2/1) organic stains on faces of peds; slightly acid; abrupt smooth boundary.

C1—7 to 17 inches; stratified very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silt loam; massive with thin alluvial stratification; friable; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; slightly acid; gradual smooth boundary.

C2—17 to 29 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam; massive with thin alluvial stratification; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; slightly acid; clear smooth boundary.

Ab1—29 to 44 inches; black (10YR 2/1) silty clay loam; moderate fine and medium subangular blocky structure; friable; common fine faint very dark grayish brown (2.5Y 3/2) redoximorphic concentrations; neutral; clear smooth boundary.

Ab2—44 to 56 inches; black (10YR 2/1) silty clay loam; weak fine and medium subangular blocky structure; friable; few fine faint very dark grayish brown (2.5Y 3/2) redoximorphic concentrations; neutral; gradual smooth boundary.

Ab3—56 to 67 inches; very dark gray (10YR 3/1) silty clay loam; weak fine and medium subangular blocky structure; friable; common faint black (10YR 2/1) organic stains on faces of peds; common fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; neutral; gradual smooth boundary.

Ab4—67 to 76 inches; very dark gray (10YR 3/1) silty clay loam; weak medium subangular blocky structure; friable; common faint black (10YR 2/1) organic stains on faces of peds; common fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; neutral; gradual smooth boundary.

Bb—76 to 80 inches; very dark gray (10YR 3/1) silty clay loam; weak fine prismatic structure; friable; common faint black (10YR 2/1) organic stains on faces of peds; common fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; neutral.

Range in Characteristics

Depth to buried soil: 20 to 36 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam
Reaction—moderately acid to neutral

C horizon:
Hue—10YR
Value—2 to 5
Chroma—1 or 2
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

Ab horizon:
Hue—10YR or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silt loam
Reaction—moderately acid to slightly alkaline

Bb horizon:
Hue—10YR
Value—3
Chroma—1
Texture—silty clay loam
Reaction—slightly acid to slightly alkaline

Adair Series

Typical Pedon

Adair clay loam, in an area of Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded, in a cultivated field in the uplands; Shelby County, Iowa; 2,100 feet east and 75 feet north of the southwest corner of sec. 15, T. 80 N., R. 37 W.; USGS Jacksonville topographic quadrangle; lat. 41 degrees 43 minutes 55.3 seconds N. and long. 95 degrees 08 minutes 38.9 seconds W., NAD 83:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, brown (10YR 5/3) dry; weak fine granular structure; friable; many very fine roots; common very fine tubular pores; few fine prominent yellowish brown (10YR 5/6) iron masses; neutral; clear smooth boundary.

2Bt1—6 to 18 inches; strong brown (7.5YR 4/6) clay loam; weak fine subangular blocky structure; firm; few very fine roots; many very fine tubular pores; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent gravel; slightly acid; gradual smooth boundary.

2Bt2—18 to 33 inches; dark yellowish brown (10YR 4/6) and yellowish red (5YR 4/6) clay; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; very firm; few very fine roots; many very fine tubular pores; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; common fine prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; about 2 percent gravel; moderately acid; gradual smooth boundary.

2Bt3—33 to 56 inches; dark yellowish brown (10YR 4/6) clay loam; weak fine and medium prismatic structure parting to moderate medium subangular blocky; firm; few very fine roots; many very fine tubular pores; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; few fine prominent black (10YR 2/1) manganese masses; common fine and medium prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; about 2 percent gravel; slightly acid; gradual smooth boundary.

2BC—56 to 69 inches; dark yellowish brown (10YR 4/6) clay loam; weak medium prismatic structure; friable; many very fine tubular pores; common fine prominent black (10YR 2/1) manganese masses; many medium prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; about 2 percent gravel; slightly acid; gradual smooth boundary.

2C—69 to 80 inches; dark yellowish brown (10YR 4/6) clay loam; massive; friable; many very fine tubular pores; few fine prominent black (10YR 2/1) manganese masses; many medium and coarse prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; about 2 percent gravel; slightly acid.

Range in Characteristics

Ap or A horizon:
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam, clay loam, or silt loam
Reaction—moderately acid to neutral

2Bt horizon:
Hue—2.5YR to 10YR
Value—3 to 5
Chroma—3 to 6
Texture—clay or clay loam
Reaction—strongly acid to slightly acid

2BC horizon:
Hue—2.5YR to 10YR
Value—3 to 5
Chroma—3 to 6
Texture—clay loam
Reaction—moderately acid to slightly alkaline

2C horizon:
Hue—10YR
Value—4 or 5
Chroma—2 to 6
Texture—clay loam
Reaction—moderately acid to slightly alkaline

Taxadjunct features: The typical pedon for the Adair series in Shelby County is a taxadjunct because the surface layer is not thick enough to meet the requirements for a mollic epipedon. This soil is classified as an Oxyaquic Vertic Hapludalf.

Burchard Series

Typical Pedon

Burchard clay loam, in an area of Liston-Burchard complex, 9 to 14 percent slopes, moderately eroded, in an area of cropland in the uplands; Shelby County, Iowa; 925 feet west and 700 feet north of the southeast corner of sec. 35, T. 80 N., R. 40 W.; USGS Panama topographic quadrangle; lat. 41 degrees 41 minutes 25.6 seconds N. and long. 95 degrees 27 minutes 49.2 seconds W., NAD 83:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, brown (10YR 5/3) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common fine and medium roots; few fine tubular pores; about 1 percent fine gravel; neutral; abrupt smooth boundary.

Bt—7 to 13 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky structure; firm; few fine roots; common fine tubular pores; few distinct dark yellowish brown (10YR 4/6) clay films on faces of peds; about 1 percent fine gravel; neutral; abrupt wavy boundary.

Btk—13 to 32 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; few very fine and fine roots; common fine tubular pores; common distinct dark yellowish brown (10YR 4/6) clay films on faces of peds; common fine prominent very pale brown (10YR 8/2) carbonate masses; few fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk—32 to 52 inches; light olive brown (2.5Y 5/4) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common very fine tubular pores; common fine and medium prominent very pale brown (10YR 8/2) carbonate masses; few fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; few fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 3 percent fine gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

C—52 to 80 inches; light yellowish brown (2.5Y 6/3) clay loam; massive; firm; few very fine tubular pores; common medium prominent very pale brown (10YR 8/2) carbonate masses; few fine prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; few medium faint grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 3 percent fine gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 30 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam
Reaction—moderately acid to neutral

Bt horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 6
Texture—clay loam
Reaction—slightly acid or neutral

Btk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6

Chroma—2 to 6
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

C horizon:
Hue—10YR or 2.5Y
Value—6 or 7
Chroma—2 or 3
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

Clarinda Series

Typical Pedon

Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field in the uplands; Shelby County, Iowa; 500 feet west and 300 feet south of the northeast corner of sec. 21, T. 78 N., R. 38 W.; USGS Prairie Rose Lake topographic quadrangle; lat. 41 degrees 32 minutes 09.2 seconds N. and long. 95 degrees 12 minutes 08.8 seconds W., NAD 83:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; few fine tubular pores; slightly acid; abrupt smooth boundary.

2Btg1—7 to 15 inches; grayish brown (2.5Y 5/2) silty clay; weak fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; neutral; clear smooth boundary.

2Btg2—15 to 23 inches; grayish brown (2.5Y 5/2) silty clay; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; common very fine tubular pores; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; slightly alkaline; gradual smooth boundary.

2Btg3—23 to 47 inches; gray (2.5Y 6/1) silty clay; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common very fine tubular pores; common distinct gray (2.5Y 5/1) clay films on faces of peds; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; slightly alkaline; gradual smooth boundary.

2Btg4—47 to 80 inches; gray (2.5Y 6/1) silty clay; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common very fine tubular pores; common distinct gray (2.5Y 5/1) clay films on faces of peds; common medium prominent yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) redoximorphic concentrations; neutral.

Range in Characteristics

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam
Reaction—neutral or slightly acid

2Btg horizon:
Hue—10YR to 5Y

Value—4 to 6
Chroma—1 or 2
Texture—silty clay or clay
Reaction—moderately alkaline to strongly acid

Taxadjunct features: The Clarinda soils in Shelby County are taxadjuncts because the surface layer is not thick enough to meet the requirements for a mollic epipedon. These soils are classified as fine, smectitic, mesic Vertic Epiaqualfs.

Colo Series

Typical Pedon

Colo silt loam, overwash, in an area of Judson-Ackmore-Colo, overwash, complex, 1 to 5 percent slopes, in a cultivated field; Shelby County, Iowa; 900 feet west and 70 feet south of the northeast corner of sec. 2, T. 79 N., R. 40 W.; USGS Panama topographic quadrangle, lat. 41 degrees 41 minutes 34 seconds N. and long. 95 degrees 27 minutes 47.3 seconds W., NAD 83:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common medium roots; few medium tubular pores; neutral; gradual smooth boundary.

A1—7 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common medium roots; common fine tubular pores; neutral; abrupt smooth boundary.

A2—15 to 40 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; common fine tubular pores; neutral; gradual smooth boundary.

BA—40 to 50 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine prismatic structure parting to weak medium subangular blocky; friable; common fine tubular pores; common fine faint gray (2.5Y 4/1) redoximorphic depletions; neutral; gradual smooth boundary.

Bg—50 to 70 inches; dark gray (2.5Y 4/1) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine tubular pores; common fine and medium faint dark grayish brown (2.5Y 4/2) redoximorphic depletions; common fine and medium prominent yellowish brown (10YR 5/4) redoximorphic concentrations; neutral; gradual smooth boundary.

BCg—70 to 80 inches; dark gray (2.5Y 4/1) silty clay loam; weak coarse prismatic structure; friable; few very fine tubular pores; common fine and medium faint dark grayish brown (2.5Y 4/2) redoximorphic depletions; neutral.

Range in Characteristics

Thickness of the mollic epipedon: More than 36 inches
Depth to carbonates: More than 60 inches

Ap or A horizon:
Hue—10YR to 5Y or N
Value—2 or 3
Chroma—0 to 2
Texture—silty clay loam or silt loam
Reaction—moderately acid to neutral

BA horizon:
Hue—10YR to 2.5Y or N
Value—2 or 3
Chroma—0 to 2

Texture—silty clay loam
Reaction—moderately acid to neutral

Bg horizon:
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1
Texture—silty clay loam
Reaction—moderately acid to neutral

BCg horizon:
Hue—10YR to 5Y
Value—3 to 6
Chroma—1 or 2
Texture—silty clay loam
Reaction—moderately acid to neutral

Danbury Series

Typical Pedon

Danbury silt loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain; Woodbury County, Iowa; 1,700 feet north and 500 feet west of the southeast corner of sec. 23, T. 88 N., R. 42 W.; USGS Cushing topographic quadrangle; lat. 42 degrees 25 minutes 34.1 seconds N. and long. 95 degrees 41 minutes 27.2 seconds W., NAD 83:

Ap—0 to 7 inches; about 95 percent very dark grayish brown (10YR 3/2) and 5 percent dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; common fine roots; many very fine pores; moderately acid; abrupt smooth boundary.

C1—7 to 15 inches; about 90 percent very dark grayish brown (10YR 3/2) and 10 percent dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; massive with weak thin alluvial stratification; friable; few very fine roots; many very fine pores; neutral; clear smooth boundary.

C2—15 to 25 inches; about 95 percent very dark grayish brown (10YR 3/2) and 5 percent dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; massive with weak thin alluvial stratification; friable; few very fine roots; many very fine and fine tubular pores; neutral; clear smooth boundary.

C3—25 to 32 inches; about 95 percent very dark grayish brown (10YR 3/2) and 5 percent dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; massive with weak thin alluvial stratification; friable; few very fine roots; many very fine and fine tubular pores; common fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; neutral; abrupt wavy boundary.

2Ab1—32 to 43 inches; black (10YR 2/1) silty clay loam; weak very fine subangular blocky structure; friable; many very fine and fine tubular pores; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; gradual smooth boundary.

2Ab2—43 to 53 inches; black (10YR 2/1) silty clay loam; weak very fine and fine subangular blocky structure; friable; many very fine and fine tubular pores; common fine distinct brown (10YR 4/3) redoximorphic concentrations; neutral; gradual smooth boundary.

2Ab3—53 to 64 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; friable; many very fine and fine tubular pores; common fine distinct brown (10YR 4/3) redoximorphic concentrations; neutral; clear smooth boundary.

2Bwb1—64 to 71 inches; very dark gray (10YR 3/1) silty clay loam; weak very fine prismatic structure parting to weak fine subangular blocky; friable; many very fine and fine tubular pores; common fine distinct brown (10YR 4/3) redoximorphic concentrations; neutral; clear smooth boundary.

2Bwb2—71 to 80 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine prismatic structure parting to weak fine subangular blocky; friable; many very fine and fine tubular pores; common fine distinct brown (10YR 4/3) redoximorphic concentrations; neutral.

Range in Characteristics

Ap or A horizon:

Hue—10YR
Value—2 or 3
Chroma—2 or 3
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

C horizon:

Hue—10YR
Value—3 to 5
Chroma—2 to 4
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

2Ab horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam or silty clay loam
Reaction—slightly acid or neutral

2Bwb horizon:

Hue—10YR or 2.5Y
Value—3 or 4
Chroma—1 to 3
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

Exira Series

Typical Pedon

Exira silty clay loam, 14 to 18 percent slopes, moderately eroded, in a cultivated field; Shelby County, Iowa; about 2,600 feet east and 300 feet north of the southwest corner of sec. 29, T. 81 N., R. 37 W.; USGS Irwin topographic quadrangle; lat. 41 degrees 47 minutes 33.9 seconds N. and long. 95 degrees 10 minutes 49 seconds W., NAD 83:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; weak fine granular structure; friable; common fine roots; common fine tubular pores; moderately acid; abrupt smooth boundary.

Bw1—6 to 15 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; common distinct very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine prominent strong brown (7.5YR 5/8) relict redoximorphic concentrations; common fine faint light brownish gray (10YR 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

Bw2—15 to 28 inches; light olive brown (10YR 5/3) silty clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; friable; common very fine roots; common very fine tubular pores; common distinct very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine faint light brownish gray (10YR 6/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

BC—28 to 40 inches; light olive brown (2.5Y 5/3) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; common very fine tubular pores; common fine prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine faint light brownish gray (10YR 6/2) relict redoximorphic depletions; neutral; gradual smooth boundary.

C1—40 to 60 inches; light olive brown (2.5Y 5/3) silt loam; massive; friable; common very fine tubular pores; many medium prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; many medium faint light brownish gray (10YR 6/2) relict redoximorphic depletions; neutral; gradual smooth boundary.

C2—60 to 80 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; common very fine tubular pores; many medium faint light brownish gray (10YR 6/2) relict redoximorphic depletions; many medium prominent strong brown (7.5YR 5/6) and common medium prominent yellowish red (5YR 5/6) relict redoximorphic concentrations; neutral.

Range in Characteristics

Ap or A horizon:

Hue—10YR
Value—2 or 3
Chroma—2
Texture—silty clay loam
Reaction—moderately acid to neutral

Bw horizon:

Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3
Texture—silty clay loam or silt loam
Reaction—moderately acid or slightly acid

BC horizon:

Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silty clay loam or silt loam
Reaction—moderately acid to neutral

C horizon:

Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam
Reaction—slightly acid or neutral

Taxadjunct features: The Exira soils in Shelby County are taxadjuncts because the surface layer is not thick enough to meet the requirements for a mollic epipedon. These soils are classified as fine-silty, mixed, superactive, mesic Dystric Eutrudepts.

Ida Series

Typical Pedon

Ida silt loam, 9 to 14 percent slopes, severely eroded, in a cultivated field in the uplands; Shelby County, Iowa; 1,200 feet south and 100 feet west of the northeast corner of sec. 34, T. 80 N., R. 40 W.; USGS Panama topographical quadrangle; lat. 41 degrees 42 minutes 02.1 seconds N. and long. 95 degrees 28 minutes 49.9 seconds W., NAD 83:

Ap—0 to 3 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine and fine roots; few fine tubular pores; common faint dark brown (10YR 3/3) organic coatings on faces of peds; slightly effervescent; slightly alkaline; clear smooth boundary.

C1—3 to 14 inches; brown (10YR 5/3) silt loam; massive; friable; common fine tubular pores; slightly effervescent; slightly alkaline; gradual smooth boundary.

C2—14 to 28 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; common fine tubular pores; strongly effervescent; slightly alkaline; gradual smooth boundary.

C3—28 to 69 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; common fine tubular pores; few fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; few fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

C4—69 to 80 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; common fine tubular pores; few fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; few fine faint brown (7.5YR 4/4) relict redoximorphic concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Ap horizon:
Hue—10YR
Value—3 to 5
Chroma—2 or 3
Texture—silt loam
Reaction—neutral to moderately alkaline
Note—the redoximorphic features are considered relict

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—silt loam
Reaction—slightly alkaline or moderately alkaline
Note—the redoximorphic features are considered relict

Judson Series

Typical Pedon

Judson silty clay loam, 2 to 5 percent slopes, in a cultivated field in a drainageway in the uplands; Shelby County, Iowa; 900 feet west and 200 feet south of the northeast corner of sec. 11, T. 81 N., R. 37 W.; USGS Manning SE topographic quadrangle; lat.

41 degrees 50 minutes 55.3 seconds N. and long. 95 degrees 07 minutes 08.8 seconds W., NAD 83:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; many fine tubular pores; slightly acid; abrupt smooth boundary.

A1—7 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few very fine and fine roots; many very fine tubular pores; very many distinct very dark brown (10YR 2/2) organic stains on faces of peds; slightly acid; gradual smooth boundary.

A2—15 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few very fine roots; many very fine tubular pores; few distinct very dark brown (10YR 2/2) organic stains on faces of peds; slightly acid; gradual smooth boundary.

A3—24 to 32 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few very fine roots; many very fine tubular pores; slightly acid; gradual smooth boundary.

AB—32 to 42 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine prismatic structure parting to weak fine subangular blocky; friable; few very fine roots; many very fine tubular pores; slightly acid; clear smooth boundary.

Bw1—42 to 52 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; many very fine tubular pores; common distinct dark brown (10YR 3/3) organic stains on faces of peds; slightly acid; gradual smooth boundary.

Bw2—52 to 61 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; many very fine tubular pores; common fine faint yellowish brown (10YR 5/4) redoximorphic concentrations; slightly acid; clear smooth boundary.

Bw3—61 to 70 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; many very fine tubular pores; common fine faint brown (7.5YR 4/4) redoximorphic concentrations; common fine distinct grayish brown (10YR 5/2) redoximorphic depletions; slightly acid; gradual smooth boundary.

BC—70 to 80 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium prismatic structure; friable; common very fine tubular pores; common fine distinct brown (7.5YR 5/2) and grayish brown (2.5Y 5/2) redoximorphic depletions; slightly acid.

Range in Characteristics

Depth to carbonates: More than 60 inches
Thickness of the mollic epipedon: 32 to 52 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam
Reaction—moderately acid to neutral

AB horizon:
Hue—10YR
Value—2 or 3
Chroma—2

Texture—silty clay loam
Reaction—moderately acid to neutral

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 to 5
Texture—silty clay loam
Reaction—moderately acid to neutral

BC horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—silty clay loam or silt loam
Reaction—slightly acid to slightly alkaline

C horizon (if it occurs):
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—silty clay loam or silt loam
Reaction—slightly acid to slightly alkaline

Kennebec Series

Typical Pedon

Kennebec silt loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain; Shelby County, Iowa; 200 feet west and 1,600 feet south of the northeast corner of sec. 13, T. 80 N., R. 37 W; USGS Kimballton topographic quadrangle; lat. 41 degrees 44 minutes 29.8 seconds N. and long. 95 degrees 05 minutes 38.4 seconds W., NAD 83:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; common fine tubular pores; neutral; abrupt smooth boundary.

A1—9 to 22 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; many fine tubular pores; neutral; gradual smooth boundary.

A2—22 to 32 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; common very fine roots; many fine tubular pores; very many distinct black (10YR 2/1) organic stains on faces of peds; neutral; gradual smooth boundary.

A3—32 to 42 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine prismatic structure parting to weak very fine subangular blocky; friable; common fine roots; many fine tubular pores; very many distinct black (10YR 2/1) organic stains on faces of peds; neutral; gradual smooth boundary.

A4—42 to 50 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine prismatic structure parting to weak fine subangular blocky; friable; common very fine roots; many fine tubular pores; many distinct black (10YR 2/1) organic stains on faces of peds; common fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; neutral; clear smooth boundary.

Bw1—50 to 64 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium prismatic structure parting to weak fine and medium subangular blocky;

friable; common fine roots; many fine tubular pores; many distinct very dark gray (10YR 3/1) organic stains on faces of peds; common fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; neutral; gradual smooth boundary.

Bw2—64 to 73 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; friable; many fine tubular pores; many distinct very dark gray (10YR 3/1) organic stains on faces of peds; few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; neutral; clear smooth boundary.

C—73 to 80 inches; very dark grayish brown (2.5Y 3/2) silty clay loam; massive; friable; many fine tubular pores; many fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; neutral.

Range in Characteristics

Thickness of the mollic epipedon: More than 40 inches
Depth to carbonates: More than 80 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

Bw horizon:
Hue—10YR
Value—2 to 4
Chroma—2 or 3
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

C horizon:
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1 or 2
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

Liston Series

Typical Pedon

Liston clay loam, in an area of Liston-Burchard complex, 9 to 14 percent slopes, moderately eroded, in a wooded pasture in the uplands; Shelby County, Iowa; 950 feet west and 1,450 feet south of the northeast corner of sec. 35, T. 78 N., R. 39 W.; USGS Corley topographic quadrangle; lat. 41 degrees 31 minutes 00.1 second N. and long. 95 degrees 17 minutes 35.3 seconds W., NAD 83:

A—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; common fine tubular pores; about 2 percent fine gravel; neutral; abrupt smooth boundary.

Bw—7 to 16 inches; brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; firm; common fine roots; common fine tubular pores; common distinct very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine faint dark grayish brown (10YR 4/2) relict redoximorphic depletions; about 1 percent fine gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

Bk1—16 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; common fine roots; common fine tubular pores; few distinct dark brown (10YR 3/3) organic stains on faces of peds; common fine and coarse prominent very pale brown (10YR 8/2) carbonate masses; common fine distinct strong brown (7.5YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—23 to 32 inches; yellowish brown (10YR 5/4) clay loam; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots; few fine tubular pores; common fine prominent very pale brown (10YR 8/2) carbonate masses; common fine distinct strong brown (7.5YR 5/6) relict redoximorphic concentrations; about 2 percent fine gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk3—32 to 43 inches; yellowish brown (10YR 5/4) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few fine tubular pores; common fine prominent very pale brown (10YR 8/2) carbonate masses; common fine distinct strong brown (7.5YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 3 percent fine gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—43 to 52 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine and medium prominent very pale brown (10YR 8/2) carbonate masses; common fine prominent yellowish red (5YR 4/6) relict redoximorphic concentrations; about 2 percent fine gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—52 to 62 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine prominent very pale brown (10YR 8/2) carbonate masses; common coarse distinct yellowish brown (10YR 5/4) relict redoximorphic concentrations; about 3 percent fine gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—62 to 76 inches; about 60 percent yellowish brown (10YR 5/4) and 40 percent grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine prominent very pale brown (10YR 8/2) carbonate masses; common medium distinct strong brown (7.5YR 4/6) relict redoximorphic concentrations; about 2 percent fine gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—76 to 80 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; few fine prominent very pale brown (10YR 8/2) carbonate masses; common medium prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; about 2 percent fine gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or clay loam
Reaction—neutral to moderately alkaline

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5

Chroma—3 or 4
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

C horizon:
Hue—7.5YR to 5Y
Value—4 to 6
Chroma—1 to 6
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

Marshall Series

Typical Pedon

Marshall silty clay loam, 2 to 5 percent slopes, in a cultivated field on an interfluve; Shelby County, Iowa; 600 feet north and 1,000 feet east of the southwest corner of sec. 24, T. 79 N., R. 37 W.; USGS Kimballton topographic quadrangle; lat. 41 degrees 38 minutes 52.7 seconds N. and long. 95 degrees 06 minutes 35.2 seconds W., NAD 83:

Ap—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few very fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; few very fine roots; common very fine tubular pores; moderately acid; clear smooth boundary.

Bw1—11 to 19 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; few very fine roots; common very fine and fine tubular pores; many distinct very dark grayish brown (10YR 3/2) organic stains on faces of peds; moderately acid; gradual smooth boundary.

Bw2—19 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine prismatic structure parting to moderate fine and medium subangular blocky; friable; few very fine roots; many very fine tubular pores; many distinct brown (10YR 4/3) organic stains on faces of peds; moderately acid; gradual smooth boundary.

Bw3—26 to 34 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine prismatic structure parting to moderate fine and medium subangular blocky; friable; many very fine tubular pores; common fine distinct dark yellowish brown (10YR 4/6) relict redoximorphic concentrations; slightly acid; gradual smooth boundary.

Bw4—34 to 44 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; many very fine tubular pores; common fine distinct dark yellowish brown (10YR 4/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

BC—44 to 56 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium prismatic structure; friable; common very fine tubular pores; common fine distinct dark yellowish brown (10YR 4/6) relict redoximorphic concentrations; many fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

C1—56 to 66 inches; yellowish brown (10YR 5/4) silty clay loam; massive; friable; common very fine tubular pores; many fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; many fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

C2—66 to 80 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; common very fine tubular pores; many medium distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; many medium distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 24 inches
Depth to carbonates: More than 80 inches
Depth to common relict redoximorphic depletions: More than 30 inches

Ap and A horizons:
Hue—10YR
Value—2 or 3
Chroma—1 or 2; 2 in pedons that have value of 3
Texture—silty clay loam or silt loam
Reaction—moderately acid to neutral

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—silty clay loam
Reaction—moderately acid or slightly acid

BC and C horizons:
Hue—10YR to 5Y
Value—4 or 5
Chroma—2 to 6
Texture—silt loam or silty clay loam
Reaction—slightly acid or neutral

Taxadjunct features: The Marshall soils in map units 9C2, 9D2, and 509D2 are taxadjuncts because the surface layer is not thick enough to meet the requirements for a mollic epipedon. These soils are classified as fine-silty, mixed, superactive, mesic Dystric Eutrudepts.

Minden Series

Typical Pedon

Minden silty clay loam, 0 to 2 percent slopes, in a cultivated field on a slightly convex slope; Cass County, Iowa; 380 feet north and 1,560 feet west of the southeast corner of sec. 31, T. 75 N., R. 37 W.; USGS Griswold topographic quadrangle; lat. 41 degrees 14 minutes 45.9 seconds N. and long. 95 degrees 08 minutes 32.2 seconds W., NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; many very fine roots; many very fine tubular pores; moderately acid; clear smooth boundary.

A1—7 to 15 inches; black (10YR 2/1) silty clay loam, gray (10YR 4/1) dry; weak fine granular structure; friable; many very fine roots; many very fine tubular pores; moderately acid; gradual smooth boundary.

A2—15 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common very fine roots; common very fine tubular pores; moderately acid; gradual smooth boundary.

Bw—22 to 32 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

Bg1—32 to 40 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine and medium subangular blocky structure; friable; few very fine roots; common very fine tubular pores; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

Bg2—40 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; weak fine prismatic structure parting to moderate medium subangular blocky; friable; few very fine roots; common very fine tubular pores; many coarse distinct yellowish brown (10YR 5/4) and many coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

Bg3—48 to 58 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate medium subangular blocky structure; friable; common coarse distinct yellowish brown (10YR 5/4) and many coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

BCg—58 to 66 inches; grayish brown (2.5Y 5/2) silty clay loam; weak coarse subangular blocky structure; friable; common coarse distinct yellowish brown (10YR 5/4) and common coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

Cg—66 to 80 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; common coarse distinct yellowish brown (10YR 5/4) and common coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderately acid.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 24 inches
Depth to carbonates: More than 72 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

Bw or Bg horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2
Texture—silty clay loam
Reaction—moderately acid to neutral

BCg horizon:
Hue—2.5Y or 5Y

Value—4 or 5
Chroma—2 to 6
Texture—silty clay loam
Reaction—moderately acid to neutral

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 to 6
Texture—silt loam
Reaction—moderately acid to neutral

Monona Series

Typical Pedon

Monona silty clay loam, 2 to 5 percent slopes, in a cultivated field on a summit in the uplands; Shelby County, Iowa; 150 feet west and 850 feet north of the southeast corner of sec. 20, T. 81 N., R. 40 W.; USGS Dunlap topographic quadrangle; lat. 41 degrees 48 minutes 26.4 seconds N. and long. 95 degrees 31 minutes 05.7 seconds W., NAD 83:

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; many very fine tubular pores; moderately acid; abrupt smooth boundary.

A—7 to 14 inches; about 85 percent very dark grayish brown (10YR 3/2) and 15 percent dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; few very fine roots; many very fine tubular pores; many distinct very dark brown (10YR 2/2) organic stains on faces of peds; slightly acid; clear smooth boundary.

Bw1—14 to 23 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few very fine roots; many very fine tubular pores; many distinct dark brown (10YR 3/3) organic stains on faces of peds; slightly acid; gradual smooth boundary.

Bw2—23 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; few very fine roots; many very fine tubular pores; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

Bw3—35 to 46 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; many very fine tubular pores; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; slightly acid; gradual smooth boundary.

BC—46 to 58 inches; yellowish brown (10YR 5/4) silt loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; many very fine tubular pores; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; neutral; gradual smooth boundary.

C—58 to 80 inches; yellowish brown (10YR 5/4) silt loam; massive; friable; many very fine tubular pores; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 24 inches
Depth to carbonates: More than 24 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—silt loam or silty clay loam
Reaction—moderately acid to neutral

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—silt loam or silty clay loam
Reaction—slightly acid or neutral
Note—the redoximorphic features are considered relict

BC horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—silt loam
Reaction—neutral or slightly alkaline
Note—the redoximorphic features are considered relict

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—silt loam
Reaction—neutral or slightly alkaline
Note—the redoximorphic features are considered relict

Taxadjunct features: The Monona soils in map units 10C2, 10D2, 10E2, 10F2, 100C2, 100D2, 100D3, 100E2, 100F2, 101F3, 700C2, and 700D2 are taxadjuncts because the surface layer is not thick enough to meet the requirements for a mollic epipedon. These soils are classified as fine-silty, mixed, superactive, mesic Dystric Eutrudepts.

Napier Series

Typical Pedon

Napier silt loam, 2 to 5 percent slopes, in a cultivated field in a drainageway in the uplands; Crawford County, Iowa; 280 feet south and 850 feet east of the northwest corner of sec. 30, T. 84 N., R. 41 W.; USGS Danbury topographic quadrangle; lat. 42 degrees 03 minutes 56.9 seconds N. and long. 95 degrees 40 minutes 05.1 seconds W., NAD 83:

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; friable; common very fine and fine roots; few fine tubular pores; many distinct black (10YR 2/1) organic coatings on faces of peds; slightly acid; abrupt smooth boundary.

A1—9 to 17 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; common fine tubular pores; slightly acid; gradual smooth boundary.

A2—17 to 26 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common very fine roots; common fine tubular pores; slightly acid; gradual smooth boundary.

BA—26 to 36 inches; very dark grayish brown (10YR 3/3) silt loam, dark grayish brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; few very fine roots; common fine tubular pores; many distinct dark brown (10YR 3/2) organic coatings on faces of peds and on surfaces along pores; slightly acid; gradual smooth boundary.

Bw1—36 to 47 inches; brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; few very fine roots; common fine tubular pores; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds and on surfaces along pores; slightly acid; gradual smooth boundary.

Bw2—47 to 61 inches; brown (10YR 4/3) silt loam; weak fine prismatic structure parting to moderate fine subangular blocky; friable; common fine tubular pores; very few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; slightly acid; gradual smooth boundary.

Bw3—61 to 71 inches; brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; common fine tubular pores; slightly acid; clear smooth boundary.

C—71 to 80 inches; brown (10YR 4/3) silt loam; massive; friable; neutral.

Range in Characteristics

Depth to carbonates: More than 36 inches
Thickness of the mollic epipedon: 24 to 40 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam
Reaction—neutral or slightly acid

BA horizon:
Hue—10YR
Value—3
Chroma—3
Texture—silt loam
Reaction—slightly acid to moderately alkaline

Bw horizon:
Hue—10YR
Value—4
Chroma—3 or 4
Texture—silt loam
Reaction—slightly acid to moderately alkaline

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—silt loam
Reaction—slightly acid to moderately alkaline

Nodaway Series

Typical Pedon

Nodaway silt loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain; Shelby County, Iowa; 200 feet south and 1,900 feet east of the northwest corner of sec. 32, T. 78 N., R. 37 W.; USGS Prairie Rose Lake topographic quadrangle; lat. 41 degrees 31 minutes 06.3 seconds N. and long. 95 degrees 07 minutes 48.8 seconds W., NAD 83:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; common fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

C1—7 to 29 inches; stratified very dark grayish brown (10YR 3/2) and grayish brown (10YR 5/2) silt loam; massive with thin alluvial stratification; friable; few very fine roots; common very fine tubular pores; few fine distinct brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) redoximorphic concentrations; slightly acid; gradual smooth boundary.

C2—29 to 44 inches; stratified very dark gray (10YR 3/1), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2) silt loam; massive with thin alluvial stratification; friable; few very fine roots; common very fine tubular pores; common fine distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; slightly acid; abrupt wavy boundary.

2Ab1—44 to 54 inches; black (10YR 2/1) silty clay loam; moderate fine granular structure; friable; few very fine roots; common very fine tubular pores; few fine distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; slightly acid; gradual smooth boundary.

2Ab2—54 to 63 inches; very dark brown (10YR 2/2) silty clay loam; moderate fine granular structure; friable; common very fine tubular pores; very many distinct black (10YR 2/1) organic stains on faces of peds; slightly acid; gradual smooth boundary.

2Ab3—63 to 72 inches; very dark brown (10YR 2/2) silty clay loam; moderate fine prismatic structure parting to moderate fine and very fine subangular blocky; friable; common very fine tubular pores; many distinct black (10YR 2/1) organic stains on faces of peds; slightly acid; clear smooth boundary.

2Bb—72 to 80 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; common very fine tubular pores; common distinct very dark brown (10YR 2/2) organic stains on faces of peds; slightly acid.

Range in Characteristics

Depth to buried soil: More than 36 inches

Ap or A horizon:
Hue—10YR
Value—3
Chroma—1 or 2
Texture—silt loam
Reaction—slightly acid or neutral

C horizon:
Hue—10YR
Value—2 to 6
Chroma—1 or 2
Texture—silt loam or silty clay loam or stratified with these textures
Reaction—slightly acid or neutral

2Ab horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

2Bb horizon:
Hue—10YR
Value—3
Chroma—2
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

Shelby Series

Typical Pedon

Shelby clay loam, in an area of Shelby-Adair complex, 9 to 14 percent slopes, moderately eroded, in cropland in the uplands; Shelby County, Iowa; 1,900 feet west and 700 feet north of the southeast corner of sec. 27, T. 79 N., R. 37 W.; USGS Prairie Rose Lake topographic quadrangle; lat. 41 degrees 37 minutes 05.3 seconds N. and long. 95 degrees 08 minutes 18.1 seconds W., NAD 83:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

Bt1—7 to 17 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; few distinct brown (10YR 5/3) clay films on faces of peds; about 2 percent fine gravel; neutral; gradual smooth boundary.

Bt2—17 to 25 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky structure; firm; few very fine tubular pores; few distinct brown (10YR 5/3) clay films on faces of peds; few fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; few fine faint grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; neutral; gradual smooth boundary.

Bt3—25 to 33 inches; brown (10YR 4/3) clay loam; moderate fine prismatic structure parting to moderate fine and medium subangular blocky; firm; few very fine tubular pores; common distinct brown (10YR 5/3) clay films on faces of peds; few fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; few fine faint grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; neutral; gradual smooth boundary.

Btk—33 to 42 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct brown (10YR 5/3) clay films on faces of peds; few very fine prominent very pale brown (10YR 8/2) carbonate nodules; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common medium distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

Bk—42 to 49 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine prismatic structure parting to weak fine subangular blocky; firm; few fine prominent very pale brown (10YR 8/2) carbonate nodules; common medium distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; common medium distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 2 percent fine gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C—49 to 80 inches; light olive brown (2.5Y 5/3) clay loam; massive; firm; common medium prominent very pale brown (10YR 8/2) carbonate nodules; common coarse prominent yellowish brown (10YR 5/6) relict redoximorphic concentrations; common medium faint grayish brown (2.5Y 5/2) relict redoximorphic depletions; about 3 percent fine gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: More than 30 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam
Reaction—moderately acid to neutral

Bt horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—clay loam
Reaction—slightly acid or neutral

Bk and Btk horizons (if they occur):
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 6
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

C horizon:
Hue—10YR or 2.5Y
Value—5
Chroma—2 or 3
Texture—clay loam
Reaction—neutral to moderately alkaline

Taxadjunct features: The Shelby soils in Shelby County are taxadjuncts because the surface layer is not thick enough to meet the requirements for a mollic epipedon. These soils are classified as fine-loamy, mixed, superactive, mesic Mollic Hapludalfs.

Zook Series

Typical Pedon

Zook silt loam, 0 to 2 percent slopes, occasionally flooded, overwash, in a cultivated field on a flood plain; Shelby County, Iowa; about 400 feet west and 200 feet north of the southeast corner of sec. 11, T. 78 N., R. 40 W.; USGS Shelby topographic quadrangle; lat. 41 degrees 33 minutes 52.6 seconds N. and long. 95 degrees 24 minutes 16.5 seconds W., NAD 83:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine subangular blocky and moderate fine granular structure; friable; common very fine roots; many very fine tubular pores; neutral; abrupt smooth boundary.

A1—9 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; common very fine roots; many very fine tubular pores; neutral; abrupt smooth boundary.

A2—18 to 23 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; common very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

A3—23 to 29 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; few very fine roots; few very fine tubular pores; neutral; clear smooth boundary.

Bg1—29 to 46 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few very fine roots; few very fine tubular pores; neutral; gradual smooth boundary.

Bg2—46 to 64 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few very fine tubular pores; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; neutral; gradual smooth boundary.

Cg—64 to 80 inches; dark gray (10YR 4/1) silty clay loam; massive; firm; few very fine tubular pores; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; neutral.

Range in Characteristics

Thickness of the mollic epipedon: More than 36 inches
Depth to carbonates: More than 60 inches

Ap or A horizon:
Hue—10YR or N; 10YR in overwash phase
Value—2 or 3; 2 or 3 in overwash phase
Chroma—0 or 1; 1 or 2 in overwash phase
Texture—silty clay loam or silty clay; silt loam in overwash phase
Reaction—moderately acid to slightly alkaline; moderately acid to slightly alkaline in overwash phase

Bg horizon:
Hue—10YR to 5Y
Value—2 to 5
Chroma—1
Texture—silty clay loam or silty clay
Reaction—slightly acid or neutral

Cg horizon:
Hue—10YR to 5Y
Value—2 to 5
Chroma—1
Texture—silty clay loam or silty clay
Reaction—slightly acid or neutral

Formation of the Soils

In this section, the major factors of soil formation are described as they relate to the soils of Shelby County.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil (including human activities); the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material (Jenny, 1941).

The factors of soil formation are so closely interrelated that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

The soils in Shelby County formed in a variety of parent materials. The mild climate associated with a mesic temperature regime and a udic moisture regime has conditioned these parent materials, and the prairie grass ecosystem in an undulating topography has also affected the formation of the soils over geologic time. More recently, human activities have also influenced the soils in the county.

Horizons are differentiated from each other when four basic types of change take place. These changes are additions, removals, transfers, and transformations (Simonson, 1959). Each of these kinds of change affects many substances in the soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay materials. Although most of these substances tend to promote horizon differentiation, others tend to offset or retard it. The processes and the resulting changes occur simultaneously in soils. The balance of these changes within the soil governs the ultimate nature of the profile.

An accumulation of organic matter generally is an early phase of horizon differentiation. It has been an important process in the differentiation of horizons in Shelby County. The amount of organic matter that has accumulated in the surface layer of the soils can range from high to very low. In some soils, because of erosion, the content of organic matter is now lower than it was in the past. In Marshall and Monona soils, for example, the organic matter content ranges from 3 to 4 percent in the slightly eroded phase; from 2 to 3 percent in the moderately eroded phase; and from 1 to 2 percent in the severely eroded phase.

Parent Material

The soils in Shelby County formed in glacial till, paleosols, loess, alluvium, or colluvium. In general, the relationship of these parent materials is in order of geologic deposition from oldest to youngest.

Geologic events during the latter part of the Pleistocene epoch, from about 2 million to 14,000 years ago, provided a sequence of glacial drift, paleosols, and loess parent materials. Alluvial and colluvial parent materials were deposited during geologic events dating from about 14,000 years ago to the present.

Glacial drift is a heterogeneous mixture of pulverized, sorted or unsorted rock material. Sediments were transported and deposited directly from glaciers or by meltwater streams flowing from ice sheets as the glaciers retreated. The unweathered till is firm, calcareous clay loam. It may contain pebbles, gravel, sand, silt, or clay. The depth at which carbonates occur in the profile is a significant soil property in Liston, Burchard, and Shelby soils. These soils are also referred to as “till” soils.

Soil formation occurring during the warmer interglacial stages is associated with the formation of paleosols. Clarinda and Adair soils are examples of soils that formed in paleosols. They are characterized by heavy clay. They can be several feet thick and are very slowly permeable. These soils are sometimes referred to as “gumbotil.”

Loess is fine grained material, dominantly of silt-sized particles, deposited by eolian, or windblown, processes around 24,500 to 14,000 years ago (Ruhe, 1956). The Missouri River is the assumed source for much of this sediment (Ruhe, 1969). Differences in soil properties resulting from loess deposition have profoundly affected agriculture and other land uses in Iowa (Fenton and others, 1982). Loess is mainly silt loam; soils that formed in loess have an unrestricted root zone for plants, have a high available water capacity, and generally are well aerated. Ida, Exira, Marshall, and Monona soils are examples of soils that formed in loess. The relationships of the soils on uplands in eastern Shelby County to both parent material and landform position are shown in figure 4.

The youngest, less developed soils that formed in alluvial and colluvial deposits represent some of the more fertile soils in the county. Alluvium occurs along stream channels and on flood plains. It consists of sand, silt, or clay deposited relatively recently on the land by floodwaters (from about 14,000 years ago to the present). Ackmore, Colo, Danbury, Kennebec, Nodaway, and Zook soils are examples soils that formed in alluvium.

Colluvium is soil material deposited at the base of slopes by gravity or local wash. It retains many of the characteristics of the soils from which it is washed. Judson and Napier soils formed in colluvium. These soils are on footslopes in drainageways. They have textures similar to those of the soils at the higher elevations.

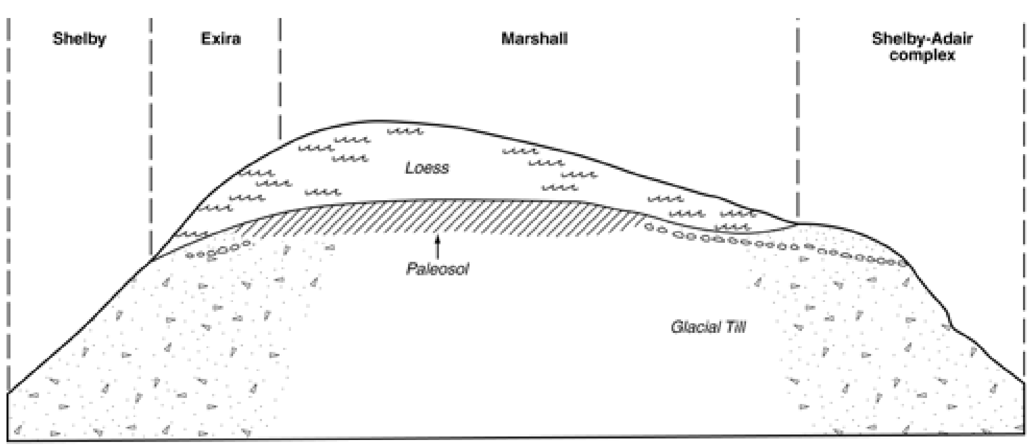

Figure 4.—Diagram showing the relationships of the upland soils in the eastern part of Shelby County to parent material and landforms.

Climate

Climatic environments of the past and present have played a major role in soil development. Climate is perhaps the most influential because it determines the nature of the weathering that occurs (Brady, 1990). For example, temperature and precipitation affect the rates of chemical, physical, and biological processes responsible for profile development. The rate of biochemical reaction doubles for each 10-degree (Celsius) rise in temperature. In turn, the content of organic matter in the soil is influenced by both temperature and effective moisture. Climate also influences the natural vegetation and living organisms in a biome.

Shelby County occurs in a mesic temperature regime and a udic moisture regime. The mesic temperature regime is defined as having a mean annual soil temperature between 8 and 22 degrees C (47 to 59 degrees F). This range is common in the temperate zone. The udic moisture regime is common in humid climates that have well distributed rainfall.

Precipitation influences the communities of natural vegetation and living organisms. Various biomes have different temperatures, precipitation, or other climatic forces that act on soil material. To that extent, climate influences changes in soils that are brought about by differences in plant and animal populations.

Living Organisms

Biological processes of living organisms greatly affect soil formation. For the purposes of this discussion, living organisms include soil organisms, burrowing organisms, vegetation, animals, and humans. Soil organisms play a major role in profile differentiation (Brady, 1990). They enhance all organic matter accumulation, profile mixing, nutrient cycling, and structural stability. Micro-organisms, such as bacteria and fungi, modify plant residues into humus and release plant nutrients. Individual genera of bacteria and fungi tend to colonize and decompose specific plant residues and to prefer specific soil temperature and moisture states (Broder and Wagner, 1988). A diversity of bacteria and fungi genera in a soil ensures that plant residues are continually decomposed, except when the soil is frozen.

Burrowing organisms, including gophers, earthworms, and crayfish, typically influence soil properties in a favorable manner. Animals, such as badgers and pocket gophers, move large amounts of soil from the subsoil to the soil surface. They are active in relatively small areas. In most places the soils appear undisturbed by burrowing animals; however, earthworms and soil insects have a widespread effect. Earthworms move up and down in soils as the soil moisture or temperature changes. In most of the soil profiles examined in the county, earthworms had moved materials from one soil horizon to another. Earthworms are beneficial in several ways. The worm channels they leave improve soil aeration and the rate of infiltration. Earthworm castings enhance the stability of soil aggregates (Shipitalo and Protz, 1988).

Historically, such prairie grasses (fig. 5) as big bluestem, with dense, fibrous root systems concentrated in the upper 12 to 15 inches of the surface, dominated the landscape (Jury and others, 1961). Timber along the major streams or in small steep areas provided habitat for wildlife. Buffalo, black bear, deer, beaver, otter, muskrat, gray fox, raccoon, mink, and wild turkey offered a variety of meat and fur sources. Ring-necked pheasant were introduced into the prairie ecosystem in the early 1900s. Woodland vegetation along streams included box elder, green ash, elm, and willow. Upland species included bur oak, red oak, shagbark hickory, walnut, and basswood. More recently, agriculture has been the dominant land use in Shelby County. Prairie grasses and native timber were supplanted by corn and soybeans. Hog, cattle, and sheep operations have replaced native bear and buffalo populations. Human activities have had the most significant impact on soils in Shelby County.

Figure 5.—Dinesen Prairie is a native prairie nature preserve. The native grasses and forbs provide important habitat for wildlife. Pictured is a gently sloping area of Marshall soils.

Human activity has influenced soil properties in both positive and negative ways. Some activities have had little effect on soil productivity, while others have had dramatic results. Modern conservation practices have increased the productivity of some soils for agricultural crops. Large areas of bottom land are now suitable for cultivation. Installing drainage ditches and levees has helped to minimize the effects of flooding, lowered the water table, and reduced the subsequent deposition of alluvium. Agricultural terraces, erosion-control structures, and ponds reduce the runoff rate and the hazard of erosion in the uplands. Deficiencies in plant nutrients have been improved with applications of commercial fertilizers. As a result of these combined activities, large areas on flood plains and in the uplands are now more suitable for cultivation of modern crops than they were in their native state.

Natural erosion has sculpted landforms in the uplands and built landforms in the lower areas (Soil Survey Division Staff, 1993). Erosion is the detachment of soil material by water and/or wind. It is a natural process affecting soil formation by removing all or part of the soils that formed on the landscape. Changes caused by water erosion and drainage generally are the most significant. Prior to human settlement, the loess-covered areas experienced periods of downcutting of streams, healing over, sedimentation, and repeated downcutting. This process has been accelerated as a result of certain agricultural practices.

Vegetative cover reduces the rate of natural erosion and retards the rate of removal of the mineral surface soil. Differences in the kinds of vegetation commonly result in marked differences in soil properties and development. Prairie soils generally have a higher content of organic matter than forested soils and as a result have dark colors, structural stability, and a relatively high moisture content. Breaking of the sod, removal of the protective vegetative cover, and cultivation practices reduce both fertility and the water-holding capacity of a soils and can result in sedimentation, which is a major source of water pollution. The more sloping areas become more susceptible to sheet and gully erosion, whereas the flat areas become more susceptible to compaction.

Erosion not only has changed the thickness of the surface layer and the content of organic matter but also has changed the soil structure. Slightly eroded soils exhibit mostly granular structure in the surface layer; soil structure tends to be subangular and blocky in areas that are moderately eroded; and the surface layer is cloddy and structureless in areas that are severely eroded. The rate of surface runoff increases with increased erosion, and the rate at which water percolates into the soil decreases. As a result, on many of the cultivated soils in the county, particularly the gently rolling to hilly soils, part of the original surface layer has been lost through sheet erosion and the content of organic matter has been reduced, thereby lowering the fertility of the soils.

In places, shallow to deep gullies can form quickly; however, it takes many years for the scars to heal themselves. Gullies develop in stages that can be described as channel erosion by downward scour, headward erosion and enlargement, healing, and stabilization. Generally, headward erosion is a process of soil sloughing that works from the watercourse and up a hillside, sometimes with costly results. Bridges, roads, driveways, and building sites that parallel streams or rivers are often threatened or damaged by such erosion.

Nearly level areas, which are typically less susceptible to erosion than the more sloping areas, can be subject to compaction by heavy agricultural equipment. In fields that are cultivated continuously, the granular structure that was apparent under native grassland has been broken down. In these fields, the surface tends to crust and harden when it dries. Soils in these areas, especially when they are wet, have a tendency to puddle and are less permeable than the same type of soil in areas where traffic is managed properly.

Topography

Topography refers to the physical features of a region relating to the configuration of the land surface described in terms of differences in elevation, slope, and relief. Elevations are highest along the northern boundary of the county and are lower along the southern boundary. The highest elevation, approximately 1,520 feet, is in Greeley Township. The lowest elevation, approximately 1,140 feet, is in Fairview Township where the Nishnabotna River flows out of Shelby County into Pottawattamie County.

Shelby County is part of an undulating plain (Jury and others, 1961). Originally, the plain was relatively smooth. Rivers and streams, however, have carved dendritic patterns on the land. The county is divided into two distinct topographic divisions: the gently rolling to rolling uplands and the nearly level, narrow valleys of streams. Most of the upland consists of gently sloping divides with rounded hills and long, smooth slopes. The upland area greatly exceeds that of the stream valleys in extent. Wet soils and the properties associated with wetness are common in low-lying places, such as on flood plains in stream valleys, but the soils in the higher areas are typically better drained (Soil Survey Division Staff, 1993).

In many places in the uplands, erosional processes have sliced through the sequence of loess, paleosols, and glacial drift parent materials and have revealed the modern catena of soils on the undulating landscape. A catena is a sequence of soils on a landscape that formed in similar kinds of parent material but have different characteristics because of differences in relief and drainage.

Relief, the variation of elevation in an area, is greatest in the northwestern part of the county. The topography of the land can hasten or delay the work of climatic forces (Brady, 1990). For example, excess water drains more slowly in flat areas than in the more rolling areas. Rolling to hilly topography encourages natural erosion of the surface layer. In areas of steep relief, the soil material is removed before enough time has passed for the development of a thick profile with distinct horizons. Even if the soil material has been in place a long time, the horizons could still exhibit little development because much of the water runs off the slopes rather than through the soil profile. Ida soils in the western part of Shelby County are examples of loess soils that show little subsoil development because of the hilly topography.

The drainage watershed for the West Nishnabotna River covers roughly two-thirds of the eastern side of the county. The river has two main tributaries: the West Fork and the East Branch. Other tributaries include Camp, Dutch, Elk, Elkhorn, Elm, Indian, Kidds, Long Branch, Silver, Snake, Squaw, Walnut, and Willow Creeks. In the western one-third of the county, Mill and Picayune Creeks flow west into the Boyer River and Pigeon, Keg, and Mosquito Creeks ultimately flow into the Missouri River in either Pottawattamie County or Mills County.

Time

Time is required for transformation of unconsolidated organic and mineral material into soil. Duration can directly affect formation of inherent soil properties because time enables climate and relief to alter parent materials (Brady, 1990). Generally, a long period is required for the development of distinct horizons. If other factors continue to operate over long periods, similar kinds of soils are produced from widely different kinds of parent material. Soil formation, however, generally is interrupted by geologic events that expose new parent material.

Residuum is unconsolidated, weathered mineral material that accumulated as consolidated rock disintegrated in place over a long period of time. There are no residual soils in Shelby County because the bedrock has been buried under glacial drift and loess. Relatively speaking, soils that formed in residuum derived from bedrock are older. Alluvium is more recently deposited by floodwater and streams. Soils that formed in alluvium show little or no evidence of development because they have not been in place long enough for the formation of distinct horizons. Examples of alluvial soils in Shelby County include Nodaway, Kennebec, and Colo soils. Judson and Napier soils formed in colluvium from sediments stripped from side slopes and deposited at the base or on footslopes. These soils characteristically are less developed than the soils that formed in residuum and more developed than the soils that formed in alluvium.

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the “National Soil Survey Handbook” (available in local offices of the Natural Resources Conservation Service or on the Internet).

Ablation till. Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

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

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl. A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction toward which a slope faces. Also called slope aspect.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope (fig. 6). In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Basal till. Compact till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

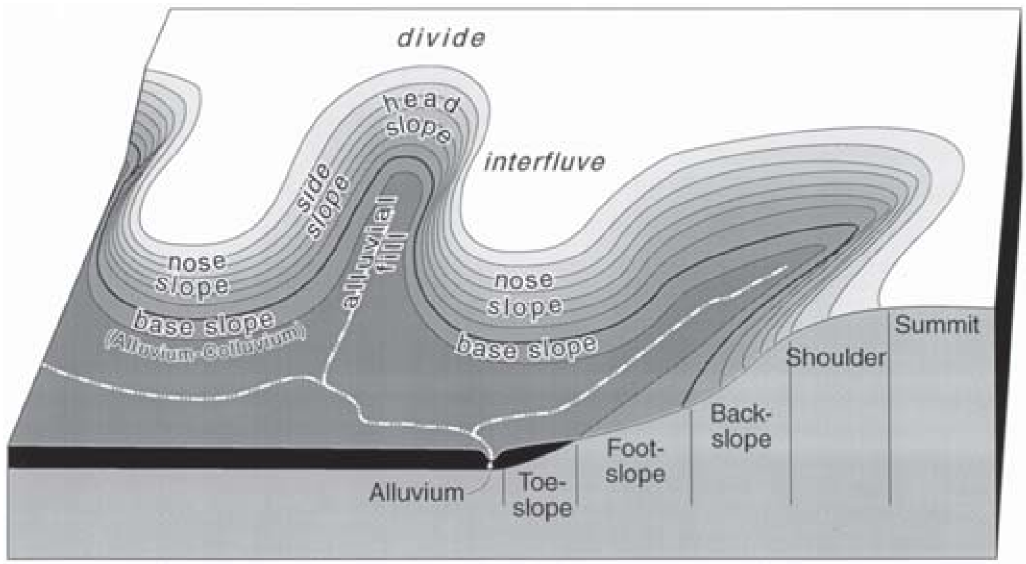

Figure 6.—Landscape relationship of geomorphic components and hillslope positions (modified after Ruhe and Walker, 1968).

Base slope (geomorphology). A geomorphic component of hills (fig. 6) consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Beach deposits. Material, such as sand and gravel, that is generally laid down parallel to an active or relict shoreline of a post-glacial or glacial lake.

Bedding plane. A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

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

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed; the adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Bottom land. An informal term loosely applied to various portions of a flood plain.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

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

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. See Terracettes.

Channery soil material. Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. See Redoximorphic features.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A dense, compact, slowly permeable subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. See Redoximorphic features.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology). A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations). Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divide. (a) The line of separation, or (b) the summit area, or narrow tract of higher ground that constitutes the watershed boundary between two adjacent drainage basins (fig. 6); it divides the surface waters that flow naturally in one direction from those that flow in the opposite direction.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface. Runoff, or surface flow of water, from an area.

Drift. A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Earthy fill. See Mine spoil.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit. Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Esker. A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material. Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms. A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay. A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step. An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial. Of or pertaining to rivers or streams; produced by stream or river action.

Footslope. The concave surface at the base of a hillslope (fig. 6). A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim (in tables). Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology). A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway (fig. 6). The overland waterflow is converging.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope. A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill (fig. 6).

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

L horizon.—A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

Igneous rock. Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Interfluve. A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology). A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill (fig. 6); shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream. A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron depletions. See Redoximorphic features.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame. A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Kame moraine. An end moraine that contains numerous kames. A group of kames along the front of a stagnant glacier, commonly comprising the slumped remnants of a formerly continuous outwash plain built up over the foot of rapidly wasting or stagnant ice.

Karst (topography). A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Ksat. Saturated hydraulic conductivity. (See Permeability.)

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landslide. A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Linear extensibility. Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength. The soil is not strong enough to support loads.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Masses. See Redoximorphic features.

Meander belt. The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar. A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll. One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline.

Mine spoil. An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. A kind of map unit that has little or no natural soil and supports little or no vegetation.

MLRA (major land resource area). A geographic area characterized by a particular pattern of land uses, elevation and topography, soils, climate, water resources, and potential natural vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. See Redoximorphic features.

Nose slope (geomorphology). A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside (fig. 6). The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash. Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain. An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace. An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Parts per million (ppm). The concentration of a substance in the soil, such as phosphorus or potassium, in one million parts of air-dried soil on a weight per weight basis.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Impermeable	less than 0.0015 inch
Very slow	0.0015 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Phosphorus. The amount of phosphorus available to plants at a depth of 30 to 42 inches is expressed in parts per million and based on the weighted average of air-dried soil samples. Terms describing the amount of available phosphorus are:

Very low	less than 7.5 ppm
Low	7.5 to 13.0 ppm
Medium	13.0 to 22.5 ppm
High	more than 22.5 ppm

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitted outwash plain. An outwash plain marked by many irregular depressions, such as kettles, shallow pits, and potholes, which formed by melting of incorporated ice masses.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology). A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings. See Redoximorphic features.

Potassium. The amount of potassium available to plants at a depth of 12 to 24 inches is expressed in parts per million and based on the weighted average of air-dried soil samples. Terms describing the amount of available potassium are:

Very low	less than 50 ppm
Low	50 to 79 ppm
Medium	79 to 125 ppm
High	more than 125 ppm

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. See Redoximorphic features.

Redoximorphic depletions. See Redoximorphic features.

Redoximorphic features. Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix. See Redoximorphic features.

Regolith. All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief. The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill. A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser. The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat). See Permeability.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The convex, erosional surface near the top of a hillslope (fig. 6). A shoulder is a transition from summit to backslope.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope (geomorphology). A geomorphic component of hills consisting of a laterally planar area of a hillside (fig. 6). The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Slickensides (pedogenic). Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slope alluvium. Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Sodium adsorption ratio (SAR). A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stagnation moraine. A body of drift released by the melting of a glacier that ceased flowing. Commonly but not always occurs near ice margins; composed of till, ice-contact stratified drift, and small areas of glacial lake sediment. Typical landforms are knob-and-kettle topography, locally including ice-walled lake plains.

Stone line. In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial.

Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Strath terrace. A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subglacial. Formed or accumulated in or by the bottom parts of a glacier or ice sheet.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope (fig. 6). It has a nearly level (planar or only slightly convex) surface.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine caused by uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology). A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes. Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Till. Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain. An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The gently inclined surface at the base of a hillslope (fig. 6). Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread. The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Upland. An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill. The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

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