United States Department of Agriculture

NRCS

Natural Resources Conservation Service

Iowa Department of Agriculture and Land Stewardship

IOWA STATE UNIVERSITY
Iowa Agriculture and Home Economics Experiment Station

IOWA STATE UNIVERSITY
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 Dickinson 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.

National Cooperative Soil Survey

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 (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey. 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 Dickinson County Soil and Water Conservation District.

Major fieldwork for this soil survey was completed in 2009. Soil names and descriptions were approved in 2010. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2010. The tables reflect the data in effect as of March 2011. The most current official data are available on the Internet (http://soils.usda.gov).

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Nondiscrimination Statement

Cover Photo Caption

A soybean field in northwestern Dickinson County in an area of the Clarion-Nicollet-Webster association. This association is dominated by low-relief, gently rolling swell-and-swale topography.

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

Contents

Issued 2011

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.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

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. The location of each map unit 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
Dickinson 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 the Cooperative Extension Service, Iowa State University; the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship; and the Dickinson County Conference Board

Dickinson County is in northwestern Iowa (fig. 1). It is in the first tier of counties south of Minnesota and in the third column of counties east of the Big Sioux River. It has a total area of 258,600 acres, or 403 square miles, of which 16,508 acres is water. Spirit Lake, the county seat, is in the north-central part of the county.

This soil survey updates the survey of Dickinson County published in 1983 (Dankert, 1983). It provides additional information and has larger 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 Areas 103 and 107A. Major land resource areas (MLRAs) are geographically associated land resource units that share a common land use, elevation, topography, climate, water, soils, and vegetation (USDA/NRCS, 2006). Dickinson County is a subset of MLRAs 103, Central Iowa and Minnesota Till Prairies, and 107A, Iowa and Minnesota Loess Hills.

The information in this survey includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. During the fieldwork for this survey, 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 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 is associated with a particular kind or segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. During mapping,

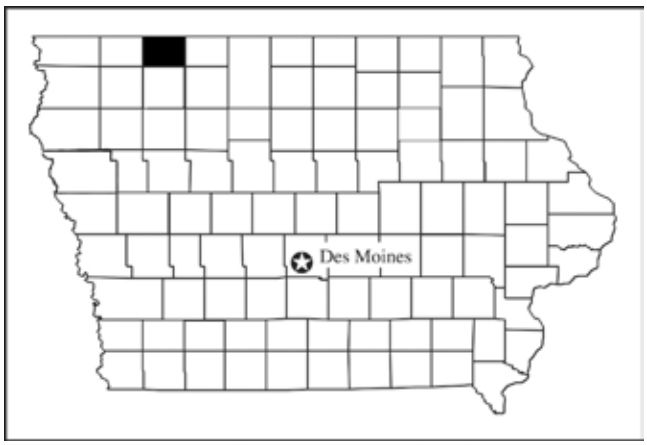

Figure 1.—Location of Dickinson County in Iowa.

this model enables the soil scientists to predict with a considerable degree of accuracy the kind of soil 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 studied. 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 high 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 general information about the survey area. It describes history; industry, transportation facilities, and recreation; physiography and drainage; and climate.

History

The Oneota people occupied northwestern Iowa from about A.D. 950 and likely became the Otoe, Ioway, and Missouria tribes (Fishel, 1996). They remained in the area until they were displaced by settlers of European descent. Hunting, gathering, and farming were all practiced by the Oneota. A site occupied by the Oneota, about 5 miles southwest of West Lake Okoboji, has been identified (Tiffany and Anderson, 1993).

The first settlers of European descent came to the Arnold's Park area in 1856. Thirty-nine of them were killed and four taken captive during the Spirit Lake Massacre in 1857 (fig. 2). Later in 1857, an election was held to organize the county, which was named after Daniel S. Dickinson, a United States Senator from New York. During the grasshopper plagues of 1873–77, more than one-half of the settlers left the county.

Farming was important during the early settlement of the county, but trapping was the most important nonmilitary operation until about 1875. Prairie hay and corn were the main crops. The well drained soils, such as Clarion, Everly, and Sac, were the

Figure 2.—The Abbie Gardner Sharp Cabin, site of the Spirit Lake Massacre, in Arnold's Park, Iowa. Photo courtesy of the State Historical Society of Iowa.

main soils used for farming until drainage improvement projects were begun in the early 1900s. Individual and group drainage projects have made row cropping possible on the poorly drained and very poorly drained soils, which make up about 30 percent of the acreage in the county.

In 2009, the population of Dickinson County was estimated at 16,623. The largest town was Spirit Lake (4,261), followed by Milford (2,474), Arnold's Park (1,162), and Lake Park (1,023). The combined population of Okoboji, Orleans, Superior, Terril, Wahpeton, and West Okoboji was 2,843 (U.S. Department of Commerce, 2009).

Industry, Transportation Facilities, and Recreation

Three large lakes (West Okoboji Lake, East Okoboji Lake, and Spirit Lake) make tourism an important industry in Dickinson County. Wholesale and retail sales accounted for a greater portion of the economy (over $400 million combined) than accommodation and food services (over $38 million) (U.S. Department of Commerce, 2009).

In 2009, Dickinson County had 560 farms and the average farm size was 404 acres (National Agricultural Statistics Service, 2009). Corn and soybeans, the dominant crops, were grown on 93,000 and 83,000 acres, respectively. Therefore, 73 percent of the available land in Dickinson County was used to grow corn and soybeans (fig. 3). Dickinson County had a livestock inventory of 27,000 cattle, 35,000 hogs, and 3,000 sheep.

Other industries in Dickinson County include educational services, medical services, and manufacturing. Mining and quarrying also are carried out in the county (U.S. Department of Commerce, 2005).

Dickinson County is served by U.S. Highway 71 and by State Highways 9 and 86. Other roads include several surfaced, all-weather county roads. Gravel-surfaced roads follow most section lines. The Iowa Great Lakes Trail, a paved bicycle path, runs for 25 miles (Iowa Department of Transportation, 2009). The county has two general airports: Spirit Lake Municipal Airport in Spirit Lake and Fuller Airport in Milford. Public transportation services and water taxis also are available.

The most popular forms of recreation in Dickinson County are lake related, including boating, waterskiing, fishing, and swimming (fig. 4). Hiking, biking, cross-country skiing, and snowmobile trails are available. Nine State parks are in Dickinson County, including Elinor Bedell, Emerson Bay, Gull Point, Lower Gar Access, Marble Beach, Mini-Wakan, Pikes Point, Templar Park, and Trappers Bay.

Figure 3.—A small hayfield adjacent to a field of soybeans in Dickinson County.

Figure 4.—A lakeside picnic area in Dickinson County.

Physiography and Drainage

The topography in Dickinson County primarily consists of two geomorphic surfaces. The dominant surface, which makes up about 85 percent of the county, is referred to by soil scientists as Major Land Resource Area (MLRA) 103, Central Iowa and Minnesota Till Prairies (USDA/NRCS, 2006). This surface is dominated by low-relief, swell-and-swale topography featuring a large number of upland potholes and depressions. This topography becomes much steeper along major streams and rivers, such as the Little Sioux River.

The second surface is in the southwestern part of the county and makes up about 15 percent of the county. This area is an older surface consisting of glacial till overlain with loess-derived sediments. This area is MLRA 107A, Iowa and Minnesota Deep Loess Hills (USDA/NRCS, 2006). It consists of broad, nearly level upland divides and has more sloping areas along the major streams.

Glacial till underlies all of the soils in Dickinson County and has had the greatest influence on the development of the drainage patterns throughout the county. In MLRA 107A, the till is predominantly overlain with loess. The older age of these materials has allowed the formation of a more defined drainage system. The younger glacial soils in MLRA 103, which actually buried the loess-capped older till soils, have a much less defined drainage pattern. Two types of glacial moraines are evident in MLRA 103. They are known as the Altamont and Bemis moraines. The Altamont moraine is characterized by moderate- or high-relief hummocks, esker- and kame-like features, and ice-walled lakes. The Bemis moraine is characterized by low- to high-relief hummocks, and the topography is more subtle than that of the Altamont moraine.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Milford, Iowa, in the period 1971 to 2000 (National Water and Climate Center, 2011). 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 17.7 degrees F and the average daily minimum temperature is 9.0 degrees. In summer, the average temperature is 70.2 degrees F and the average daily maximum temperature is 81.2 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 29 inches. Of this total, 21.6 inches, or about 74 percent, usually falls in April through September. The growing season for most crops falls within this period.

The average seasonal snowfall is 28.2 inches. On the average, 32 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 Milford, Iowa)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	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----	22.8	4.7	13.7	49	-25	1	0.60	0.22	0.94	2	6.6
February---	29.6	11.9	20.8	56	-22	4	.62	.22	.98	2	5.4
March------	41.7	23.2	32.5	75	-9	50	1.91	.80	3.00	4	5.4
April------	57.6	35.2	46.4	86	13	237	3.05	1.44	4.54	6	.7
May--------	71.0	47.5	59.2	91	28	594	3.85	2.37	5.06	7	.0
June-------	79.9	57.1	68.5	97	40	852	4.67	2.61	6.25	7	.0
July-------	83.2	61.3	72.3	98	46	988	3.61	1.50	5.50	5	.0
August-----	80.6	59.1	69.9	94	43	918	3.69	1.84	5.54	5	.0
September--	72.6	50.1	61.3	92	29	638	2.73	1.25	3.95	4	.0
October----	60.2	38.3	49.3	84	18	311	2.06	.66	3.37	4	.4
November---	40.7	23.7	32.2	69	-4	47	1.76	.68	2.71	3	3.4
December---	26.7	10.4	18.6	51	-19	2	.80	.32	1.24	2	6.3
Yearly:											
Average---	55.6	35.2	45.4	---	---	---	---	---	---	---	---
Extreme---	102	-30	---	99	-26	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,642	29.36	22.47	35.62	51	28.2

* 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 Milford, 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. 27	May 10	May 17
2 years in 10 later than--	Apr. 21	May 4	May 12
5 years in 10 later than--	Apr. 9	Apr. 23	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 5	Sept. 28	Sept. 17
2 years in 10 earlier than--	Oct. 10	Oct. 2	Sept. 22
5 years in 10 earlier than--	Oct. 21	Oct. 11	Sept. 30

Table 3.--Growing Season

(Recorded in the period 1971-2000 at Milford, 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	175	152	136
8 years in 10	183	160	143
5 years in 10	197	173	155
2 years in 10	212	187	167
1 year in 10	220	194	174

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 soils or miscellaneous areas making up 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 or miscellaneous areas can be identified on the map. Likewise, areas that 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. Clarion-Nicollet-Webster Association (fig. 5)

Extent of the association in the survey area: 79 percent

Component Description

Clarion
Extent: 38 percent of the association
Position on the landscape: Shoulders and sideslopes
Slope range: 0 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Nicollet
Extent: 27 percent of the association
Position on the landscape: Slightly convex rises
Slope range: 0 to 3 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained

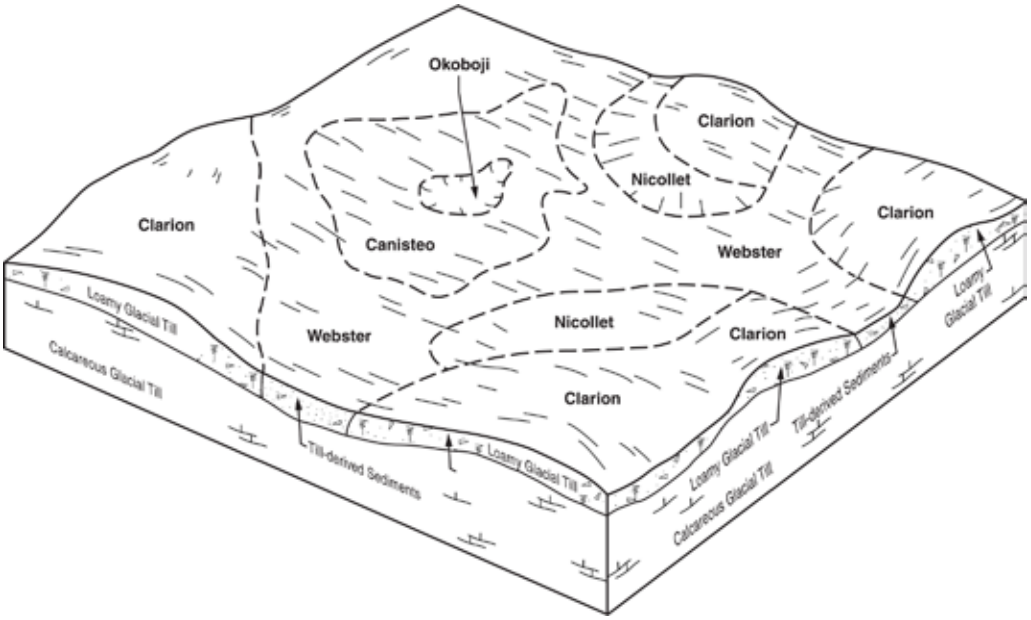

Figure 5.—Typical pattern of soils and parent material in the Clarion-Nicollet-Webster association.

Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 5.5 percent

Webster
Extent: 15 percent of the association
Position on the landscape: Flats and swales
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: Glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Soils of Minor Extent

Okoboji and similar soils
Extent: 10 percent of the association

Canisteo and similar soils
Extent: 6 percent of the association

Terril and similar soils
Extent: 3 percent of the association

Augusta Lake and similar soils
Extent: 1 percent of the association

2. Coland-Calco-Spillville Association (fig. 6)

Extent of the association in the survey area: 2 percent

Component Description

Coland
Extent: 43 percent of the association
Position on the landscape: Flood plains
Slope range: 0 to 3 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 4.7 percent

Calco
Extent: 28 percent of the association
Position on the landscape: 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: Calcareous silty alluvium
Frequency of flooding: Occasional
Ponding: None

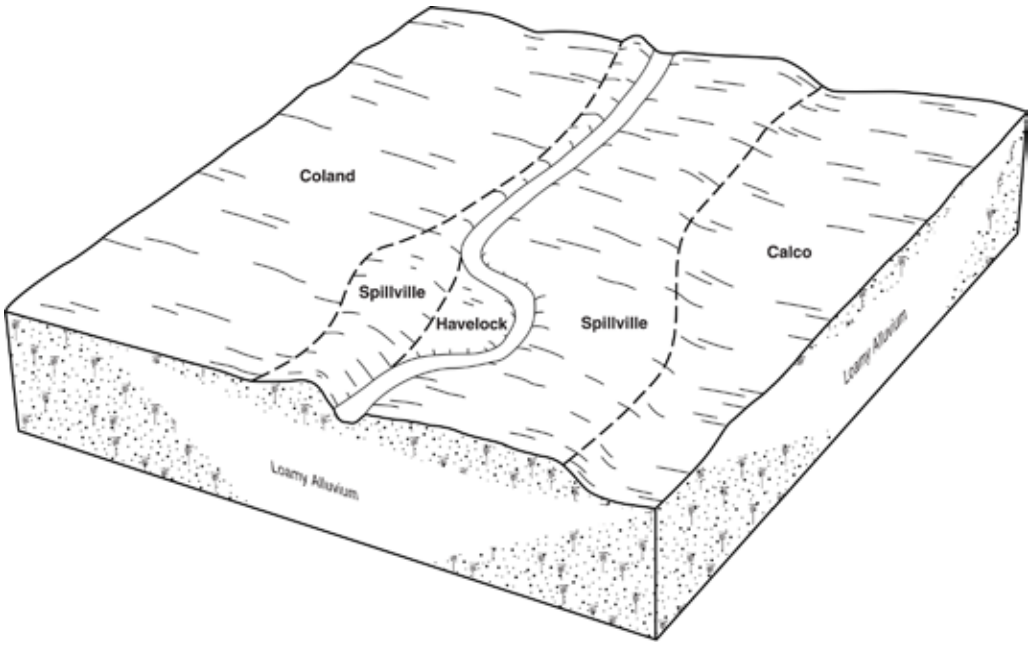

Figure 6.—Typical pattern of soils and parent material in the Coland-Calco-Spillville association.

Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 12.5 inches
Content of organic matter in the upper 10 inches: 4.2 percent

Spillville
Extent: 17 percent of the association
Position on the landscape: Flood plains
Slope range: 0 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Soils of Minor Extent

Havelock, occasionally flooded, and similar soils
Extent: 8 percent of the association

Colo, occasionally flooded, and similar soils
Extent: 4 percent of the association

3. McCreath-Everly-Wilmonton Association (fig. 7)

Extent of the association in the survey area: 12 percent

Component Description

McCreath
Extent: 26 percent of the association
Position on the landscape: Upland divides
Slope range: 0 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loess over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 5.1 percent

Everly
Extent: 23 percent of the association
Position on the landscape: Backslopes and summits
Slope range: 2 to 9 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy sediments over glacial till

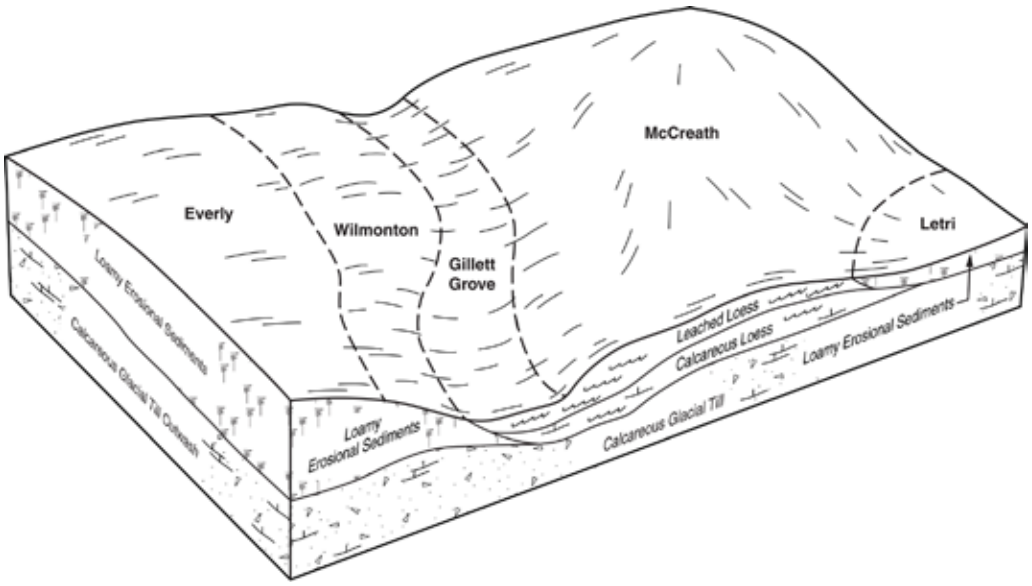

Figure 7.—Typical pattern of soils and parent material in the McCreath-Everly-Wilmonton association.

Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 10.5 inches
Content of organic matter in the upper 10 inches: 2.7 percent

Wilmonton
Extent: 22 percent of the association
Position on the landscape: Upland flats
Slope range: 1 to 3 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Soils of Minor Extent

Gillett Grove and similar soils
Extent: 13 percent of the association

Sac and similar soils
Extent: 10 percent of the association

Letri and similar soils
Extent: 6 percent of the association

4. Wadena-Estherville Association (fig. 8)

Extent of the association in the survey area: 7 percent

Component Description

Wadena
Extent: 40 percent of the association
Position on the landscape: Flats and risers on stream terraces
Slope range: 0 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 2.3 percent

Estherville
Extent: 23 percent of the association
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 9 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet

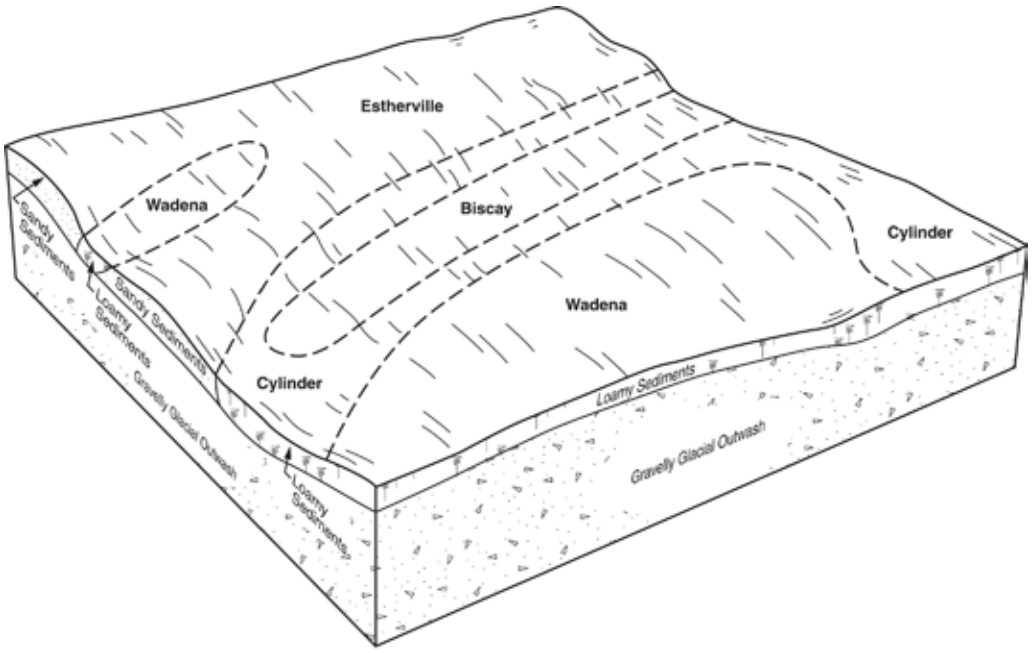

Figure 8.—Typical pattern of soils and parent material in the Wadena-Estherville association.

Available water capacity to a depth of 60 inches: 4.2 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Soils of Minor Extent

Cylinder and similar soils
Extent: 12 percent of the association

Dickinson and similar soils
Extent: 7 percent of the association

Talcot and similar soils
Extent: 7 percent of the association

Biscay and similar soils
Extent: 6 percent of the association

Hawick and similar soils
Extent: 5 percent of the association

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*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. The soils of a given 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, Clarion loam, 2 to 5 percent slopes, is a phase of the Clarion 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. Dickman-Clarion complex, 2 to 5 percent slopes, is an example.

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.

6—Okoboji silty clay loam, 0 to 1 percent slopes

Component Description

Okoboji and similar soils
Extent: 65 to 95 percent of the map unit
Position on the landscape: Depressions
Slope range: 0 to 1 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Parent material: Alluvium derived from glacial till
Flooding: None
Frequency of ponding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 12.3 inches
Content of organic matter in the upper 10 inches: 8.3 percent

Minor Dissimilar Components

Knoke and similar soils
Extent: 5 to 15 percent of the map unit

Harps and similar soils
Extent: 0 to 10 percent of the map unit

Canisteo and similar soils
Extent: 0 to 10 percent of the map unit

27B—Terril loam, 2 to 5 percent slopes

Component Description

Terril and similar soils
Extent: 65 to 95 percent of the map unit
Position on the landscape: Footslopes
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy colluvium
Flooding: None

Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Minor Dissimilar Components

Spillville, rarely flooded, and similar soils
Extent: 5 to 15 percent of the map unit

Delft and similar soils
Extent: 0 to 10 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

28B—Dickman fine sandy loam, 2 to 5 percent slopes

Component Description

Dickman and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Slight rises on outwash plains; treads and risers on stream terraces
Slope range: 2 to 5 percent
Texture of the surface layer: Fine sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Alluvial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.1 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Minor Dissimilar Components

Bolan and similar soils
Extent: 5 to 15 percent of the map unit

Fort Dodge and similar soils
Extent: 0 to 10 percent of the map unit

32—Spicer silty clay loam, MLRA 107, 0 to 2 percent slopes

Component Description

Spicer and similar soils
Extent: 80 to 90 percent of the map unit
Position on the landscape: Flats on uplands
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: Lacustrine deposits and/or loess
Flooding: None
Ponding: None

Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 6.5 percent

Minor Dissimilar Components

Gillett Grove and similar soils
Extent: 10 to 20 percent of the map unit

34—Estherville sandy loam, 0 to 2 percent slopes

Component Description

Estherville and similar soils
Extent: 80 to 90 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 4.1 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Minor Dissimilar Components

Wadena and similar soils
Extent: 10 to 20 percent of the map unit

34B—Estherville sandy loam, 2 to 5 percent slopes

Component Description

Estherville and similar soils
Extent: 50 to 80 percent of the map unit
Position on the landscape: Slight rises on outwash plains; risers on stream terraces
Slope range: 2 to 5 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 4.1 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Minor Dissimilar Components

Ridgeport and similar soils
Extent: 10 to 20 percent of the map unit

Wadena and similar soils
Extent: 10 to 20 percent of the map unit

Estherville, loamy substratum, and similar soils
Extent: 0 to 10 percent of the map unit

34C2—Estherville sandy loam, 5 to 9 percent slopes, moderately eroded

Component Description

Estherville, moderately eroded, and similar soils
Extent: 45 to 85 percent of the map unit
Position on the landscape: Slight rises on outwash plains; risers on stream terraces
Slope range: 5 to 9 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 4.1 inches
Content of organic matter in the upper 10 inches: 1.2 percent

Minor Dissimilar Components

Pilot Grove, moderately eroded, and similar soils
Extent: 10 to 20 percent of the map unit

Clarion, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

Fort Dodge and similar soils
Extent: 0 to 10 percent of the map unit

Wadena and similar soils
Extent: 0 to 10 percent of the map unit

55—Nicollet loam, 1 to 3 percent slopes

Component Description

Nicollet and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Slightly convex rises
Slope range: 1 to 3 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 5.5 percent

Minor Dissimilar Components

Clarion and similar soils
Extent: 5 to 15 percent of the map unit

Webster and similar soils
Extent: 0 to 10 percent of the map unit

77B—Sac silty clay loam, 2 to 5 percent slopes

Component Description

Sac and similar soils
Extent: 85 to 95 percent of the map unit
Position on the landscape: Ridges on uplands
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: Moderately well drained
Parent material: Loess over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.6 percent

Minor Dissimilar Components

Sac, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

95—Harps loam, 0 to 2 percent slopes

Component Description

Harps and similar soils
Extent: 70 to 100 percent of the map unit
Position on the landscape: Rims of depressions
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.1 inches
Content of organic matter in the upper 10 inches: 5.0 percent

Minor Dissimilar Components

Crippin and similar soils
Extent: 0 to 10 percent of the map unit

Okoboji and similar soils
Extent: 0 to 10 percent of the map unit

Canisteo and similar soils
Extent: 0 to 10 percent of the map unit

107—Webster silty clay loam, 0 to 2 percent slopes

Component Description

Webster and similar soils
Extent: 55 to 90 percent of the map unit
Position on the landscape: Flats and swales
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: Glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 6.1 percent

Minor Dissimilar Components

Okoboji and similar soils
Extent: 5 to 15 percent of the map unit

Nicollet and similar soils
Extent: 5 to 15 percent of the map unit

Canisteo and similar soils
Extent: 0 to 15 percent of the map unit

135—Coland clay loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Coland, occasionally flooded, and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 5.7 percent

Minor Dissimilar Components

Spillville, occasionally flooded, and similar soils
Extent: 5 to 15 percent of the map unit

Havelock, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

138B—Clarion loam, 2 to 5 percent slopes

Component Description

Clarion and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Convex rises
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Nicollet and similar soils
Extent: 5 to 15 percent of the map unit

Clarion, moderately eroded, and similar soils
Extent: 0 to 10 percent of the map unit

138C—Clarion loam, 5 to 9 percent slopes

Component Description

Clarion and similar soils
Extent: 55 to 85 percent of the map unit
Position on the landscape: Convex rises
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Clarion, moderately eroded, and similar soils
Extent: 10 to 20 percent of the map unit

Terril and similar soils
Extent: 5 to 15 percent of the map unit

Storden, moderately eroded, and similar soils
Extent: 0 to 10 percent of the map unit

175B—Dickinson fine sandy loam, 2 to 5 percent slopes

Component Description

Dickinson and similar soils
Extent: 70 to 90 percent of the map unit
Position on the landscape: Slight rises on outwash plains; treads and risers on stream terraces
Slope range: 2 to 5 percent
Texture of the surface layer: Fine sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Alluvial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 5.4 inches
Content of organic matter in the upper 10 inches: 1.9 percent

Minor Dissimilar Components

Dickman and similar soils
Extent: 5 to 15 percent of the map unit

Estherville and similar soils
Extent: 5 to 15 percent of the map unit

175C2—Dickinson fine sandy loam, 5 to 9 percent slopes, moderately eroded

Component Description

Dickinson, moderately eroded, and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Side slopes on outwash plains; risers on stream terraces
Slope range: 5 to 9 percent
Texture of the surface layer: Fine sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Alluvial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.6 inches
Content of organic matter in the upper 10 inches: 1.1 percent

Minor Dissimilar Components

Hawick, moderately eroded, and similar soils
Extent: 0 to 10 percent of the map unit

199—Cylinder-Nicollet complex, 0 to 3 percent slopes

Component Description

Cylinder and similar soils
Extent: 0 to 60 percent of the map unit
Position on the landscape: Flats and low rises on till plains
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Nicollet and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Slightly convex rises
Slope range: 1 to 3 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 5.5 percent

Minor Dissimilar Components

Cylinder, loamy substratum, and similar soils
Extent: 10 to 20 percent of the map unit

Lowlein and similar soils
Extent: 5 to 15 percent of the map unit

Crippin and similar soils
Extent: 5 to 15 percent of the map unit

Cylinder, calcareous, and similar soils
Extent: 5 to 15 percent of the map unit

Coriff and similar soils
Extent: 0 to 10 percent of the map unit

200—Cylinder complex, 0 to 2 percent slopes

Component Description

Cylinder and similar soils
Extent: 45 to 80 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Loam

Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Cylinder, calcareous, and similar soils
Extent: 15 to 30 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 8.2 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Minor Dissimilar Components

Biscay and similar soils
Extent: 5 to 15 percent of the map unit

Cylinder, loamy substratum, and similar soils
Extent: 0 to 10 percent of the map unit

259—Biscay clay loam, 0 to 2 percent slopes

Component Description

Biscay and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 7.5 inches
Content of organic matter in the upper 10 inches: 5.4 percent

Minor Dissimilar Components

Cylinder and similar soils
Extent: 5 to 15 percent of the map unit

Talcot and similar soils
Extent: 0 to 10 percent of the map unit

274—Rolfe silty clay loam, 0 to 1 percent slopes

Component Description

Rolfe and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Depressions
Slope range: 0 to 1 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Parent material: Alluvium derived from glacial till
Flooding: None
Frequency of ponding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 9.6 inches
Content of organic matter in the upper 10 inches: 5.0 percent

Minor Dissimilar Components

Webster and similar soils
Extent: 5 to 15 percent of the map unit

Okoboji and similar soils
Extent: 0 to 10 percent of the map unit

282—Ransom silty clay loam, 1 to 3 percent slopes

Component Description

Ransom and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Flats on uplands
Slope range: 1 to 3 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loess over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.9 inches
Content of organic matter in the upper 10 inches: 4.4 percent

Minor Dissimilar Components

McCreath and similar soils
Extent: 5 to 15 percent of the map unit

Gillett Grove and similar soils
Extent: 0 to 10 percent of the map unit

283B—Dickman-Clarion complex, 2 to 5 percent slopes

Component Description

Dickman and similar soils
Extent: 15 to 55 percent of the map unit

Position on the landscape: Convex rises on till plains
Slope range: 2 to 5 percent
Texture of the surface layer: Fine sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy eolian material or alluvial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.1 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Clarion and similar soils
Extent: 20 to 30 percent of the map unit
Position on the landscape: Convex rises
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Bolan and similar soils
Extent: 10 to 20 percent of the map unit

Augusta Lake and similar soils
Extent: 10 to 20 percent of the map unit

Terril and similar soils
Extent: 5 to 15 percent of the map unit

308—Wadena loam, 0 to 2 percent slopes

Component Description

Wadena and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 3.3 percent

Minor Dissimilar Components

Estherville and similar soils
Extent: 5 to 15 percent of the map unit

Augusta Lake and similar soils
Extent: 0 to 10 percent of the map unit

308B—Wadena loam, 2 to 5 percent slopes

Component Description

Wadena and similar soils
Extent: 60 to 90 percent of the map unit
Position on the landscape: Slight rises on outwash plains; risers on stream terraces
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 3.3 percent

Minor Dissimilar Components

Estherville and similar soils
Extent: 10 to 20 percent of the map unit

Dickinson and similar soils
Extent: 0 to 10 percent of the map unit

Augusta Lake and similar soils
Extent: 0 to 10 percent of the map unit

308C—Wadena loam, 5 to 9 percent slopes

Component Description

Wadena and similar soils
Extent: 55 to 85 percent of the map unit
Position on the landscape: Side slopes on outwash plains; risers on stream terraces
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 3.3 percent

Minor Dissimilar Components

Estherville and similar soils
Extent: 10 to 20 percent of the map unit

Dickinson and similar soils
Extent: 5 to 15 percent of the map unit

Augusta Lake and similar soils
Extent: 0 to 10 percent of the map unit

327—Wadena-Augusta Lake-Clarion complex, 0 to 2 percent slopes

Component Description

Wadena and similar soils
Extent: 15 to 55 percent of the map unit
Position on the landscape: Flats and slight rises on till plains
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 3.3 percent

Augusta Lake and similar soils
Extent: 25 to 35 percent of the map unit
Position on the landscape: Slightly convex rises
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 1.5 percent

Clarion and similar soils
Extent: 20 to 30 percent of the map unit
Position on the landscape: Slightly convex rises
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Round Lake and similar soils
Extent: 0 to 10 percent of the map unit

Wadena, loamy substratum, and similar soils
Extent: 0 to 10 percent of the map unit

327B—Wadena-Augusta Lake-Clarion complex, 2 to 5 percent slopes

Component Description

Wadena and similar soils
Extent: 15 to 55 percent of the map unit
Position on the landscape: Slight rises on till plains
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.5 inches
Content of organic matter in the upper 10 inches: 3.3 percent

Augusta Lake and similar soils
Extent: 25 to 35 percent of the map unit
Position on the landscape: Convex rises
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 1.5 percent

Clarion and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Convex rises
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Wadena, loamy substratum, and similar soils
Extent: 5 to 15 percent of the map unit

Terril and similar soils
Extent: 0 to 10 percent of the map unit

331—Madelia silty clay loam, 0 to 2 percent slopes

Component Description

Madelia and similar soils
Extent: 55 to 85 percent of the map unit
Position on the landscape: Flats and swales
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: Lacustrine sediments
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.7 inches
Content of organic matter in the upper 10 inches: 6.0 percent

Minor Dissimilar Components

Kingston and similar soils
Extent: 10 to 20 percent of the map unit

Belmann and similar soils
Extent: 5 to 15 percent of the map unit

Chetomba and similar soils
Extent: 0 to 10 percent of the map unit

341C2—Estherville-Pilot Grove complex, 5 to 9 percent slopes, moderately eroded

Component Description

Estherville, moderately eroded, and similar soils
Extent: 15 to 65 percent of the map unit
Position on the landscape: Convex rises on till plains
Slope range: 5 to 9 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 4.1 inches
Content of organic matter in the upper 10 inches: 1.2 percent

Pilot Grove, moderately eroded, and similar soils
Extent: 25 to 35 percent of the map unit
Position on the landscape: Convex rises
Slope range: 5 to 9 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None

Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 5.4 inches
Content of organic matter in the upper 10 inches: 1.0 percent

Minor Dissimilar Components

Clarion, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

Estherville, moderately eroded, loamy substratum, and similar soils
Extent: 5 to 15 percent of the map unit

Terril and similar soils
Extent: 0 to 10 percent of the map unit

Delft and similar soils
Extent: 0 to 10 percent of the map unit

346B—Augusta Lake-Estherville complex, 2 to 5 percent slopes

Component Description

Augusta Lake and similar soils
Extent: 20 to 60 percent of the map unit
Position on the landscape: Convex rises
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 1.5 percent

Estherville and similar soils
Extent: 25 to 35 percent of the map unit
Position on the landscape: Convex rises on till plains
Slope range: 2 to 5 percent
Texture of the surface layer: Sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 4.1 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Minor Dissimilar Components

Round Lake and similar soils
Extent: 5 to 15 percent of the map unit

Dickinson and similar soils
Extent: 5 to 15 percent of the map unit

Clarion and similar soils
Extent: 5 to 15 percent of the map unit

347B—Augusta Lake loam, 1 to 5 percent slopes

Component Description

Augusta Lake and similar soils
Extent: 50 to 90 percent of the map unit
Position on the landscape: Convex rises
Slope range: 1 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 1.5 percent

Minor Dissimilar Components

Dickinson and similar soils
Extent: 5 to 25 percent of the map unit

Clarion and similar soils
Extent: 5 to 15 percent of the map unit

Terril and similar soils
Extent: 0 to 10 percent of the map unit

347C—Augusta Lake loam, 5 to 9 percent slopes

Component Description

Augusta Lake and similar soils
Extent: 40 to 90 percent of the map unit
Position on the landscape: Convex rises
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 1.5 percent

Minor Dissimilar Components

Ridgeport and similar soils
Extent: 5 to 15 percent of the map unit

Estherville and similar soils
Extent: 5 to 15 percent of the map unit

Fort Dodge and similar soils
Extent: 0 to 10 percent of the map unit

Wadena and similar soils
Extent: 0 to 10 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

374B—Okabena silty clay loam, 1 to 5 percent slopes

Component Description

Okabena and similar soils
Extent: 50 to 90 percent of the map unit
Position on the landscape: Convex rises
Slope range: 1 to 5 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Lacustrine sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 6.0 percent

Minor Dissimilar Components

Guckeen and similar soils
Extent: 10 to 20 percent of the map unit

Collinwood and similar soils
Extent: 0 to 10 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

Waldorf and similar soils
Extent: 0 to 10 percent of the map unit

374C—Okabena silty clay loam, 5 to 9 percent slopes

Component Description

Okabena and similar soils
Extent: 50 to 80 percent of the map unit
Position on the landscape: Convex rises
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: Somewhat poorly drained
Parent material: Lacustrine sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 6.0 percent

Minor Dissimilar Components

Collinwood and similar soils
Extent: 10 to 20 percent of the map unit

Clarion and similar soils
Extent: 10 to 20 percent of the map unit

Truman and similar soils
Extent: 0 to 10 percent of the map unit

390—Waldorf silty clay loam, 0 to 2 percent slopes

Component Description

Waldorf and similar soils
Extent: 20 to 80 percent of the map unit
Position on the landscape: Flats and swales
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: Lacustrine sediments
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.3 inches
Content of organic matter in the upper 10 inches: 7.0 percent

Minor Dissimilar Components

Chetomba and similar soils
Extent: 10 to 20 percent of the map unit

Waldorf, loamy substratum, and similar soils
Extent: 5 to 15 percent of the map unit

Webster and similar soils
Extent: 5 to 15 percent of the map unit

Kingston and similar soils
Extent: 0 to 10 percent of the map unit

Spicer and similar soils
Extent: 0 to 10 percent of the map unit

Lura, depressional, and similar soils
Extent: 0 to 10 percent of the map unit

397—Letri silty clay loam, 0 to 1 percent slopes

Component Description

Letri and similar soils
Extent: 85 to 95 percent of the map unit
Position on the landscape: Flats on uplands
Slope range: 0 to 1 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: Loamy sediments over glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.0 inches
Content of organic matter in the upper 10 inches: 5.8 percent

Minor Dissimilar Components

Jeffers and similar soils
Extent: 5 to 15 percent of the map unit

456—Wilmonton silty clay loam, 1 to 3 percent slopes

Component Description

Wilmonton and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Slight rises on uplands
Slope range: 1 to 3 percent
Texture of the surface layer: Silty clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 5.2 percent

Minor Dissimilar Components

Letri and similar soils
Extent: 0 to 10 percent of the map unit

485—Spillville loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Spillville, occasionally flooded, and similar soils
Extent: 65 to 95 percent of the map unit
Position on the landscape: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Minor Dissimilar Components

Coland, occasionally flooded, and similar soils
Extent: 5 to 15 percent of the map unit

Hanlon, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

Havelock, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

507—Canisteo silty clay loam, 0 to 2 percent slopes

Component Description

Canisteo and similar soils
Extent: 35 to 85 percent of the map unit
Position on the landscape: Flats and swales
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: Glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 6.5 percent

Minor Dissimilar Components

Knoke and similar soils
Extent: 5 to 15 percent of the map unit

Webster and similar soils
Extent: 5 to 15 percent of the map unit

Okoboji and similar soils
Extent: 5 to 15 percent of the map unit

Crippin and similar soils
Extent: 0 to 10 percent of the map unit

Harps and similar soils
Extent: 0 to 10 percent of the map unit

511—Blue Earth mucky silt loam, 0 to 1 percent slopes

Component Description

Blue Earth and similar soils
Extent: 70 to 90 percent of the map unit
Position on the landscape: Depressions
Slope range: 0 to 1 percent
Texture of the surface layer: Mucky silt loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Very poorly drained

Parent material: Coprogenous earth
Flooding: None
Frequency of ponding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 17.5 percent

Minor Dissimilar Components

Harps and similar soils
Extent: 5 to 15 percent of the map unit

Knoke and similar soils
Extent: 5 to 15 percent of the map unit

557—Talcot-Biscay complex, 0 to 2 percent slopes

Component Description

Talcot and similar soils
Extent: 20 to 70 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
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: Very poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 6.0 percent

Biscay and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
Slope range: 0 to 2 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 7.5 inches
Content of organic matter in the upper 10 inches: 5.4 percent

Minor Dissimilar Components

Canisteo and similar soils
Extent: 10 to 20 percent of the map unit

Webster and similar soils
Extent: 5 to 15 percent of the map unit

Biscay, loamy substratum, and similar soils
Extent: 0 to 10 percent of the map unit

Crippin and similar soils
Extent: 0 to 10 percent of the map unit

559—Talcot silty clay loam, 0 to 2 percent slopes

Component Description

Talcot and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Flats on outwash plains; treads on stream terraces
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: Very poorly drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 6.8 inches
Content of organic matter in the upper 10 inches: 6.0 percent

Minor Dissimilar Components

Biscay and similar soils
Extent: 0 to 10 percent of the map unit

574C2—Bolan-Augusta Lake complex, 5 to 9 percent slopes, moderately eroded

Component Description

Bolan, moderately eroded, and similar soils
Extent: 35 to 65 percent of the map unit
Position on the landscape: Convex rises on till plains
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy eolian material
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 7.9 inches
Content of organic matter in the upper 10 inches: 2.1 percent

Augusta Lake, moderately eroded, and similar soils
Extent: 25 to 45 percent of the map unit
Position on the landscape: Convex rises
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Loamy and sandy sediments over glacial till
Flooding: None

Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 6.2 inches
Content of organic matter in the upper 10 inches: 0.7 percent

Minor Dissimilar Components

Clarion, moderately eroded, and similar soils
Extent: 10 to 20 percent of the map unit

577B—Everly clay loam, 2 to 5 percent slopes

Component Description

Everly and similar soils
Extent: 100 percent of the map unit
Position on the landscape: Ridges and shoulders
Slope range: 2 to 5 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 10.5 inches
Content of organic matter in the upper 10 inches: 3.4 percent

577C2—Everly clay loam, 5 to 9 percent slopes, moderately eroded

Component Description

Everly, moderately eroded, and similar soils
Extent: 70 to 90 percent of the map unit
Position on the landscape: Side slopes and shoulders
Slope range: 5 to 9 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy sediments over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 10.4 inches
Content of organic matter in the upper 10 inches: 2.3 percent

Minor Dissimilar Components

Sac and similar soils
Extent: 10 to 20 percent of the map unit

Wilmonton and similar soils
Extent: 0 to 10 percent of the map unit

586B—Coland-Spillville complex, 1 to 5 percent slopes, occasionally flooded

Component Description

Coland, occasionally flooded, and similar soils
Extent: 50 to 80 percent of the map unit
Position on the landscape: Flood plains
Slope range: 1 to 3 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 5.7 percent

Spillville, occasionally flooded, and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Flood plains
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 4.1 percent

Minor Dissimilar Components

Terril and similar soils
Extent: 5 to 15 percent of the map unit

Coland, frequently flooded, and similar soils
Extent: 0 to 10 percent of the map unit

634E2—Belview-Omsrud complex, 14 to 18 percent slopes, moderately eroded

Component Description

Belview, moderately eroded, and similar soils
Extent: 0 to 70 percent of the map unit
Position on the landscape: Side slopes
Slope range: 14 to 18 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None

Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.7 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Omsrud, moderately eroded, and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Side slopes
Slope range: 14 to 18 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Minor Dissimilar Components

Storden, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

Omsrud and similar soils
Extent: 5 to 15 percent of the map unit

Belview and similar soils
Extent: 5 to 15 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

Ridgeton and similar soils
Extent: 0 to 10 percent of the map unit

634G—Belview-Omsrud complex, 18 to 40 percent slopes

Component Description

Belview and similar soils
Extent: 40 to 70 percent of the map unit
Position on the landscape: Side slopes
Slope range: 18 to 40 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.6 inches
Content of organic matter in the upper 10 inches: 3.7 percent

Omsrud and similar soils
Extent: 25 to 35 percent of the map unit
Position on the landscape: Side slopes
Slope range: 25 to 40 percent

Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 2.9 percent

Minor Dissimilar Components

Ridgeton and similar soils
Extent: 5 to 15 percent of the map unit

Storden and similar soils
Extent: 0 to 10 percent of the map unit

635C2—Belview-Storden complex, 5 to 9 percent slopes, moderately eroded

Component Description

Belview, moderately eroded, and similar soils
Extent: 60 to 80 percent of the map unit
Position on the landscape: Side slopes
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.7 inches
Content of organic matter in the upper 10 inches: 1.7 percent

Storden, moderately eroded, and similar soils
Extent: 20 to 30 percent of the map unit
Position on the landscape: Side slopes and knobs
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 1.6 percent

Minor Dissimilar Components

Clarion, moderately eroded, and similar soils
Extent: 0 to 10 percent of the map unit

638C2—Clarion-Storden complex, 5 to 9 percent slopes, moderately eroded

Component Description

Clarion, moderately eroded, and similar soils
Extent: 30 to 70 percent of the map unit
Position on the landscape: Convex rises
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.6 inches
Content of organic matter in the upper 10 inches: 2.2 percent

Storden, moderately eroded, and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Side slopes and knobs
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 1.6 percent

Minor Dissimilar Components

Belview, moderately eroded, and similar soils
Extent: 10 to 20 percent of the map unit

Terril and similar soils
Extent: 5 to 15 percent of the map unit

Omsrud and similar soils
Extent: 0 to 10 percent of the map unit

655—Crippin loam, 1 to 3 percent slopes

Component Description

Crippin and similar soils
Extent: 45 to 85 percent of the map unit
Position on the landscape: Slightly convex rises
Slope range: 1 to 3 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Glacial till
Flooding: None

Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.4 inches
Content of organic matter in the upper 10 inches: 5.5 percent

Minor Dissimilar Components

Nicollet and similar soils
Extent: 10 to 20 percent of the map unit

Canisteo and similar soils
Extent: 5 to 15 percent of the map unit

Okoboji and similar soils
Extent: 0 to 10 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

733—Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Calco, occasionally flooded, and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: 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: Calcareous silty alluvium
Frequency of flooding: Occasional
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 12.5 inches
Content of organic matter in the upper 10 inches: 5.7 percent

Minor Dissimilar Components

Colo, occasionally flooded, and similar soils
Extent: 5 to 15 percent of the map unit

Spillville, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

735—Havelock loam, 0 to 2 percent slopes, occasionally flooded

Component Description

Havelock, occasionally flooded, and similar soils
Extent: 50 to 95 percent of the map unit
Position on the landscape: Flood plains
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained

Parent material: Loamy alluvium
Frequency of flooding: Occasional
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.4 inches
Content of organic matter in the upper 10 inches: 5.7 percent

Minor Dissimilar Components

Coland, occasionally flooded, and similar soils
Extent: 5 to 15 percent of the map unit

Calco, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

Colo, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

Spillville, occasionally flooded, and similar soils
Extent: 0 to 10 percent of the map unit

740D—Hawick gravelly sandy loam, 9 to 14 percent slopes

Component Description

Hawick and similar soils
Extent: 65 to 95 percent of the map unit
Position on the landscape: Side slopes on outwash plains and ground moraines; risers on stream terraces
Slope range: 9 to 14 percent
Texture of the surface layer: Gravelly sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 2.8 inches
Content of organic matter in the upper 10 inches: 0.8 percent

Minor Dissimilar Components

Ridgeport and similar soils
Extent: 5 to 15 percent of the map unit

Fort Dodge and similar soils
Extent: 0 to 10 percent of the map unit

Terril and similar soils
Extent: 0 to 10 percent of the map unit

740F—Hawick gravelly sandy loam, 14 to 24 percent slopes

Component Description

Hawick and similar soils
Extent: 80 to 100 percent of the map unit

Position on the landscape: Side slopes on outwash plains and ground moraines; risers on stream terraces
Slope range: 14 to 24 percent
Texture of the surface layer: Gravelly sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 2.8 inches
Content of organic matter in the upper 10 inches: 0.8 percent

Minor Dissimilar Components

Ridgeport and similar soils
Extent: 0 to 10 percent of the map unit

Omsrud and similar soils
Extent: 0 to 10 percent of the map unit

740G—Hawick gravelly sandy loam, 24 to 40 percent slopes

Component Description

Hawick and similar soils
Extent: 80 to 90 percent of the map unit
Position on the landscape: Side slopes on outwash plains and ground moraines; risers on stream terraces
Slope range: 24 to 40 percent
Texture of the surface layer: Gravelly sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Excessively drained
Parent material: Loamy sediments over sand and gravel
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 2.8 inches
Content of organic matter in the upper 10 inches: 0.8 percent

Minor Dissimilar Components

Omsrud and similar soils
Extent: 10 to 20 percent of the map unit

835D2—Omsrud-Storden complex, 9 to 14 percent slopes, moderately eroded

Component Description

Omsrud, moderately eroded, and similar soils
Extent: 30 to 70 percent of the map unit
Position on the landscape: Side slopes
Slope range: 9 to 14 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)

Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 2.0 percent

Storden, moderately eroded, and similar soils
Extent: 20 to 30 percent of the map unit
Position on the landscape: Side slopes and knobs
Slope range: 9 to 14 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 10.9 inches
Content of organic matter in the upper 10 inches: 1.6 percent

Minor Dissimilar Components

Belview, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

Terril and similar soils
Extent: 5 to 15 percent of the map unit

Clarion, moderately eroded, and similar soils
Extent: 0 to 10 percent of the map unit

854D—Histosols, fens, 5 to 14 percent slopes

Component Description

Histosols, fens, and similar soils
Extent: 100 percent of the map unit
Position on the landscape: Side slopes
Slope range: 5 to 14 percent
Texture of the surface layer: Muck
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Parent material: Organic material
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 18.5 inches
Content of organic matter in the upper 10 inches: 65.0 percent

875B—Roine fine sandy loam, 2 to 5 percent slopes

Component Description

Roine and similar soils
Extent: 80 to 95 percent of the map unit

Position on the landscape: Ridges on uplands
Slope range: 2 to 5 percent
Texture of the surface layer: Fine sandy loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Eolian deposits over loamy sediments and glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 9.1 inches
Content of organic matter in the upper 10 inches: 2.3 percent

Minor Dissimilar Components

Dickinson and similar soils
Extent: 5 to 10 percent of the map unit

Ocheyedan and similar soils
Extent: 0 to 10 percent of the map unit

878—Ocheyedan loam, 0 to 2 percent slopes

Component Description

Ocheyedan and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Flats on uplands
Slope range: 0 to 2 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy glacial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.5 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Fostoria and similar soils
Extent: 0 to 10 percent of the map unit

878B—Ocheyedan loam, 2 to 5 percent slopes

Component Description

Ocheyedan and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Ridges on uplands
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy glacial sediments
Flooding: None
Ponding: None

Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.5 inches
Content of organic matter in the upper 10 inches: 3.2 percent

Minor Dissimilar Components

Fostoria and similar soils
Extent: 5 to 25 percent of the map unit

879—Fostoria loam, 1 to 3 percent slopes

Component Description

Fostoria and similar soils
Extent: 80 to 90 percent of the map unit
Position on the landscape: Ridges on uplands
Slope range: 1 to 3 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Parent material: Loamy glacial sediments
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 10.5 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Minor Dissimilar Components

Ocheyedan and similar soils
Extent: 10 to 20 percent of the map unit

1032—Spicer silty clay loam, 0 to 2 percent slopes

Component Description

Spicer and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Swales and flats
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: Lacustrine deposits and/or loess
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.2 inches
Content of organic matter in the upper 10 inches: 6.5 percent

Minor Dissimilar Components

Okoboji and similar soils
Extent: 0 to 10 percent of the map unit

1091—McCreath silty clay loam, 0 to 2 percent slopes

Component Description

McCreath and similar soils
Extent: 80 to 100 percent of the map unit
Position on the landscape: Flats on uplands
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: Somewhat poorly drained
Parent material: Loess over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.7 inches
Content of organic matter in the upper 10 inches: 5.1 percent

Minor Dissimilar Components

Ransom and similar soils
Extent: 0 to 10 percent of the map unit

Gillett Grove and similar soils
Extent: 0 to 10 percent of the map unit

1091B—McCreath silty clay loam, 2 to 5 percent slopes

Component Description

McCreath and similar soils
Extent: 90 to 100 percent of the map unit
Position on the landscape: Ridges on uplands
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: Somewhat poorly drained
Parent material: Loess over glacial till
Flooding: None
Ponding: None
Depth to seasonal high water table: 1.0 to 3.5 feet
Available water capacity to a depth of 60 inches: 11.7 inches
Content of organic matter in the upper 10 inches: 5.1 percent

Minor Dissimilar Components

Gillett Grove and similar soils
Extent: 0 to 10 percent of the map unit

1092—Gillett Grove silty clay loam, 0 to 2 percent slopes

Component Description

Gillett Grove and similar soils
Extent: 75 to 95 percent of the map unit
Position on the landscape: Flats on uplands
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: Loess over glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 12.1 inches
Content of organic matter in the upper 10 inches: 6.2 percent

Minor Dissimilar Components

McCreath and similar soils
Extent: 5 to 15 percent of the map unit

Afton, frequently flooded, and similar soils
Extent: 0 to 10 percent of the map unit

1511—Blue Earth muck, ponded, 0 to 1 percent slopes

Component Description

Blue Earth, ponded, and similar soils
Extent: 85 to 95 percent of the map unit
Position on the landscape: Depressions
Slope range: 0 to 1 percent
Texture of the surface layer: Muck
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Parent material: Coprogenous earth
Flooding: None
Frequency of ponding: Frequent
Seasonal high water table: At the surface
Available water capacity to a depth of 60 inches: 12.6 inches
Content of organic matter in the upper 10 inches: 17.5 percent

Minor Dissimilar Components

Okoboji, ponded, and similar soils
Extent: 5 to 15 percent of the map unit

1707B—Delft-Terril complex, 1 to 5 percent slopes

Component Description

Delft and similar soils
Extent: 30 to 80 percent of the map unit
Position on the landscape: Swales
Slope range: 1 to 5 percent
Texture of the surface layer: Clay loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Poorly drained
Parent material: Loamy colluvium over glacial till
Flooding: None
Ponding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 7.0 percent

Terril and similar soils
Extent: 15 to 25 percent of the map unit
Position on the landscape: Footslopes
Slope range: 2 to 5 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Parent material: Loamy colluvium
Flooding: None
Ponding: None
Depth to seasonal high water table: 4 to 6 feet
Available water capacity to a depth of 60 inches: 11.8 inches
Content of organic matter in the upper 10 inches: 3.4 percent

Minor Dissimilar Components

Delft, overwash, and similar soils
Extent: 5 to 15 percent of the map unit

Delft, frequently flooded, and similar soils
Extent: 0 to 10 percent of the map unit

Okoboji and similar soils
Extent: 0 to 10 percent of the map unit

Clarion and similar soils
Extent: 0 to 10 percent of the map unit

2700C—Ridgeton loam, 5 to 9 percent slopes

Component Description

Ridgeton and similar soils
Extent: 60 to 90 percent of the map unit
Position on the landscape: Footslopes
Slope range: 5 to 9 percent
Texture of the surface layer: Loam
Depth to restrictive feature: Very deep (more than 60 inches)
Drainage class: Well drained
Parent material: Colluvium
Flooding: None
Ponding: None
Depth to seasonal high water table: More than 6.7 feet
Available water capacity to a depth of 60 inches: 11.7 inches
Content of organic matter in the upper 10 inches: 3.0 percent

Minor Dissimilar Components

Omsrud, moderately eroded, and similar soils
Extent: 5 to 15 percent of the map unit

Terril and similar soils
Extent: 5 to 15 percent of the map unit

Spillville, rarely flooded, and similar soils
Extent: 0 to 10 percent of the map unit

4946B—Udorthents-Highway complex, 0 to 5 percent slopes

Component Description

Udorthents and similar soils
Extent: 65 to 70 percent of the map unit
Slope range: 0 to 5 percent
Texture of the surface layer: Variable
Depth to restrictive feature: Very deep (more than 60 inches)
Parent material: Loamy deposits
Flooding: None
Ponding: None

Highway
Extent: 30 to 35 percent of the map unit
Slope range: 0 to 5 percent

5010—Pits, sand and gravel

- This map unit consists of areas from which sand and gravel have been removed.

5040—Udorthents, loamy

Component Description

Udorthents, loamy, and similar soils
Extent: 100 percent of the map unit
Texture of the surface layer: Variable
Depth to restrictive feature: Very deep (more than 60 inches)
Parent material: Loamy manipulated materials
Flooding: None
Ponding: None

AW—Animal waste lagoon

- This map unit consists of shallow ponds constructed to hold animal waste from 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 2010). 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; 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 *udolls*, 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 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 known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of 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-loamy, mixed, superactive, mesic Typic Hapludolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

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. 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, 2010). 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.

Afton Series

Typical Pedon

Afton silty clay loam, 0 to 2 percent slopes, in a cultivated field in an upland drainageway in Clay County, Iowa; about 500 feet north and 75 feet east of the southwest corner of sec. 24, T. 96 N., R. 38 W.; USGS Royal (IA) topographic quadrangle; lat. 43 degrees 06 minutes 50 seconds N. and long. 95 degrees 17 minutes 21 seconds W.; NAD 83:

Ap—0 to 6 inches; black (N 2/) silty clay loam, very dark gray (N 3/) dry; moderate fine granular structure; friable; slightly acid; abrupt wavy boundary.

A1—6 to 16 inches; black (N 2/) silty clay loam, very dark gray (N 3/) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; slightly acid; gradual smooth boundary.

A2—16 to 25 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; slightly acid; gradual smooth boundary.

A3—25 to 32 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; neutral; clear smooth boundary.

Bg1—32 to 37 inches; dark gray (5Y 4/1) silty clay loam; moderate fine subangular blocky structure; friable; many distinct very dark gray (10YR 3/1) organic coatings on faces of peds; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; neutral; clear smooth boundary.

Bg2—37 to 43 inches; dark gray (5Y 4/1) silty clay loam; moderate fine subangular blocky structure; friable; many fine dark manganese concretions; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; neutral; abrupt wavy boundary.

2Cg1—43 to 54 inches; gray (5Y 5/1) clay loam; massive; friable; many fine dark manganese concretions; common or many medium prominent strong brown (7.5YR 5/6), few fine prominent strong brown (7.5YR 5/8), and few fine and medium prominent yellowish red (5YR 4/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; abrupt wavy boundary.

2Cg2—54 to 65 inches; gray (5Y 5/1) loam with thin strata of sandy loam and silty clay loam; massive; friable; thin strata (2 inches thick) of strong brown (7.5YR 5/8) medium and coarse sand at a depth of 63 to 65 inches (lag line); few medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Cg3—65 to 72 inches; olive gray (5Y 5/2) loam; massive; friable; few fine dark manganese concretions; few medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; about 3 percent gravel and 2 percent fine shale fragments; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Cg4—72 to 80 inches; olive gray (5Y 5/2) loam; massive; firm; many fine and medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; about 3 percent gravel and 2 percent fine shale fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 37 inches
Depth to carbonates: 24 to 55 inches
Depth to till: More than 40 inches

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

Bg horizon:
Hue—2.5Y, 5Y, or N
Value—3 to 5
Chroma—0 to 2
Texture—silty clay loam or silt loam
Reaction—neutral to moderately alkaline

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 10 percent
Reaction—slightly alkaline or moderately alkaline

Augusta Lake Series

Typical Pedon

Augusta Lake loam, 1 to 5 percent slopes, in a grass field on a slight rise on a glacial till plain in Dickinson County, Iowa; about 410 feet east and 2,105 feet north of the southwest corner of sec. 7, T. 100 N., R. 36 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 29 minutes 39 seconds N. and long. 95 degrees 08 minutes 58 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.
A—7 to 12 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bw1—12 to 25 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
Bw2—25 to 46 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine and medium subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bw3—46 to 51 inches; yellowish brown (10YR 5/4) loamy fine sand; single grain; loose; neutral; clear smooth boundary.
2C—51 to 80 inches; light olive brown (2.5Y 5/3) loam; massive; friable; common fine faint grayish brown (2.5Y 5/2) redoximorphic depletions and common fine

prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 3 percent rock fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 19 inches
Depth to loamy sediments or till: 40 to 60 inches
Depth to carbonates: 40 to 70 inches

Ap and A horizons:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam, fine sandy loam, or sandy loam
Reaction—moderately acid to neutral

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 to 6
Texture—fine sandy loam, sandy loam, or loamy fine sand
Reaction—moderately acid to neutral

2C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—silt loam or loam
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The moderately eroded Augusta Lake soils in this survey area do not have a mollic epipedon. These soils are classified as coarse-loamy, mixed, superactive, mesic Typic Eutrudepts.

Belmann Series

Typical Pedon

Belmann clay loam, on a slope of 1 percent in a cultivated field on a glacial lake plain in Clay County, Iowa; about 93 feet west and 700 feet south of the northeast corner of sec. 5, T. 96 N., R. 36 W.; USGS Dickens (IA) topographic quadrangle; lat. 43 degrees 10 minutes 04 seconds N. and long. 95 degrees 06 minutes 46 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common very fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium granular structure; firm; common very fine roots; slightly effervescent; slightly alkaline; clear wavy boundary.

Bg1—16 to 24 inches; olive gray (5Y 4/2) clay loam; weak very fine subangular blocky structure; firm; common very fine roots; common distinct very dark gray (5Y 3/1) organic coatings on faces of peds; common fine prominent light olive brown (2.5Y 5/6) and common fine faint olive (5Y 5/3) redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

2Bg2—24 to 32 inches; olive gray (5Y 5/2) silty clay; moderate very fine and fine subangular blocky structure; firm; common very fine roots; common distinct olive gray (5Y 4/2) organic coatings on faces of peds; common fine distinct light

olive brown (2.5Y 5/4) and common fine prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

2Bkg1—32 to 42 inches; olive gray (5Y 5/2) silty clay; moderate very fine and fine subangular blocky structure; firm; common very fine roots: few distinct dark gray (5Y 4/1) organic coatings on faces of peds; common fine irregular very pale brown (10YR 8/2) calcium carbonate nodules; common fine prominent yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

2Bkg2—42 to 52 inches; olive gray (5Y 5/2) silty clay; moderate very fine and fine subangular blocky structure; friable; few very fine roots; common fine irregular very pale brown (10YR 8/2) calcium carbonate nodules; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.

2BCg—52 to 61 inches; olive gray (5Y 5/2) silty clay loam; weak very fine prismatic structure parting to weak fine subangular blocky; friable; few very fine roots; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg—61 to 80 inches; olive gray (5Y 5/2) silty clay; massive; friable; common medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 24 inches
Depth to carbonates: 0 to 10 inches
Depth to lacustrine material: 20 to 40 inches

Ap and A horizons:
- Hue—10YR, 2.5Y, or N
- Value—2
- Chroma—0 or 1
- Texture—clay loam or loam
- Reaction—moderately acid to neutral

Bg horizon:
- Hue—2.5Y or 5Y
- Value—4 or 5
- Chroma—1 or 2
- Texture—clay loam or silty clay loam
- Reaction—moderately acid to neutral

2Bg and 2Bkg horizons:
- Hue—2.5Y or 5Y
- Value—4 or 5
- Chroma—1 to 3
- Texture—silty clay loam, silty clay, or clay
- Reaction—moderately acid to neutral

2BCg and 2Cg horizons:
- Hue—2.5Y or 5Y
- Value—4 to 6
- Chroma—2 or 3
- Texture—silt loam, silty clay loam, silty clay, or clay
- Reaction—moderately acid to neutral

Belview Series

Typical Pedon

Belview loam, in an area of Belview-Omsrud complex, 14 to 18 percent slopes, on a side slope in a grass field in Dickinson County, Iowa; about 200 feet west and 260 feet north of the southeast corner of sec. 13, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 23 minutes 11 seconds N. and long. 95 degrees 01 minute 60 seconds W.; NAD 83:

A—0 to 11 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—11 to 20 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few distinct light gray (10YR 7/1) masses of carbonate; about 2 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—20 to 35 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few distinct light gray (10YR 7/1) masses of carbonate; about 2 percent rock fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—35 to 48 inches; yellowish brown (10YR 5/4) loam; massive; friable; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—48 to 62 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C3—62 to 80 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; many medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 5 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Carbonates: At the surface

Ap or A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—loam
- Reaction—slightly alkaline or moderately alkaline

Bk horizon:
- Hue—10YR or 2.5Y
- Value—4 to 6
- Chroma—3 to 6
- Texture—loam or clay loam
- Reaction—slightly alkaline or moderately alkaline

C horizon:
- Hue—10YR or 2.5Y
- Value—4 to 6
- Chroma—3 to 6

Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The moderately eroded Belview soils in this survey area do not have a mollic epipedon. These soils are classified as fine-loamy, mixed, superactive, mesic Typic Eutrudepts.

Biscay Series

Typical Pedon

Biscay clay loam, 0 to 2 percent slopes, in a cultivated field on an outwash plain in Dickinson County, Iowa; about 75 feet west and 2,550 feet north of the southeast corner of sec. 8, T. 98 N., R. 37 W.; USGS Milford (IA) topographic quadrangle; lat. 43 degrees 19 minutes 13 seconds N. and long. 95 degrees 13 minutes 46 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A—8 to 15 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
Bg1—15 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate fine and medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
Bg2—32 to 36 inches; olive gray (5Y 4/2) clay loam; moderate medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.
2Cg1—36 to 43 inches; olive gray (5Y 4/2) loamy sand; single grain; loose; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2Cg2—43 to 59 inches; olive gray (5Y 5/2) sand; single grain; loose; about 8 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2Cg3—59 to 80 inches; olive gray (5Y 5/2) coarse sand; single grain; loose; about 10 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 24 inches
Depth to sand and gravel: 20 to 40 inches
Depth to carbonates: 15 to 40 inches

Ap or A horizon:
Hue—10YR, 2.5Y, or N
Value—2 or 3
Chroma—0 or 1
Texture—loam, clay loam, sandy clay loam, or silty clay loam
Content of rock fragments—0 to 2 percent
Reaction—slightly acid to slightly alkaline

Bg horizon:
Hue—10YR, 2.5Y, 5Y, or 5GY
Value—4 or 5
Chroma—1 to 3
Texture—loam, sandy clay loam, clay loam, or silty clay loam
Content of rock fragments—0 to 10 percent
Reaction—neutral or slightly alkaline

2Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—4 to 6
Chroma—1 or 2
Texture—loamy coarse sand, loamy sand, coarse sand, or sand or the gravelly or very gravelly analogs of these textures
Content of rock fragments—5 to 60 percent
Reaction—slightly alkaline or moderately alkaline

Blue Earth Series

Typical Pedon

Blue Earth mucky silt loam, 0 to 1 percent slopes, in a depression in Dickinson County, Iowa; about 480 feet east and 1,935 feet south of the northwest corner of sec. 11, T. 99 N., R. 38 W.; USGS Lake Park (IA) topographic quadrangle; lat. 43 degrees 24 minutes 34 seconds N. and long. 95 degrees 18 minutes 26 seconds W.; NAD 83:

Ap—0 to 10 inches; black (N 2/) mucky silt loam, dark gray (2.5 4/1) dry; moderate fine granular structure; friable; about 5 percent fine fragments of snail shells; violently effervescent; moderately alkaline; abrupt smooth boundary.
Lco1—10 to 22 inches; black (N 2/) mucky silty clay loam, dark gray (2.5 4/1) dry; weak fine subangular blocky structure; friable; about 5 percent fine fragments of snail shells; violently effervescent; moderately alkaline; gradual smooth boundary.
Lco2—22 to 44 inches; black (2.5Y 2.5/1) mucky silty clay loam; weak medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 10 percent fine fragments of snail shells: violently effervescent; moderately alkaline; clear smooth boundary.
Lco3—44 to 80 inches; black (2.5Y 2.5/1) mucky silty clay loam; massive; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 6 percent fine fragments of snail shells; violently effervescent; moderately alkaline.

Range in Characteristics

Thickness of the coprogenous earth and depth to loamy glacial till or glacial lacustrine sediments: 30 to more than 80 inches
Carbonates: At the surface and throughout the profile

Ap or A horizon:
Hue—10YR, 2.5Y, 5Y, or N
Value—2 or 3
Chroma—0 to 2
Texture—mucky silty clay loam, mucky silt loam, mucky silty clay, silt loam, or silty clay loam
Reaction—slightly alkaline or moderately alkaline

Lco horizon:
Hue—10YR, 2.5Y, 5Y, or N
Value—2 to 4
Chroma—0 to 2
Texture—silt loam, silty clay loam, loam, or clay loam or the mucky analogs of these textures
Reaction—slightly alkaline or moderately alkaline

Bolan Series

Typical Pedon

Bolan loam, in an area of Bolan-Augusta Lake complex, 5 to 9 percent slopes, moderately eroded, in a grass field on a slight rise on a glacial till plain in Dickinson County, Iowa; about 117 feet east and 285 feet south of the northwest corner of sec. 33, T. 100 N., R. 37 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 26 minutes 38 seconds N. and long. 95 degrees 13 minutes 47 seconds W.; NAD 83:

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; friable; slightly acid; clear smooth boundary.
Bw1—7 to 20 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
Bw2—20 to 35 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
C1—35 to 46 inches; yellowish brown (10YR 5/4) loamy fine sand; single grain; loose; neutral; gradual smooth boundary.
C2—46 to 80 inches; light olive brown (10YR 5/4) fine sand; single grain; loose; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: More than 48 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam, silt loam, or sandy loam
Content of rock fragments—0 percent
Reaction—moderately acid to neutral

Bw horizon:
Hue—10YR
Value—3 to 6
Chroma—3 to 6
Texture—loam, fine sandy loam, or loamy sand
Content of rock fragments—0 percent
Reaction—moderately acid to neutral

C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—loamy fine sand, fine sand, sandy loam, or sand
Content of rock fragments—0 percent
Reaction—moderately acid to neutral

Taxadjunct features: The moderately eroded Bolan soils in this survey area do not have a mollic epipedon. These soils are classified as coarse-loamy, mixed, superactive, mesic Typic Eutrudepts.

Calco Series

Typical Pedon

Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain in Clay County, Iowa; about 650 feet east and 700 feet south of the northwest corner of sec. 16, T. 95 N., R. 35 W.; USGS Silver Lake (IA) topographic quadrangle; lat. 43 degrees 03 minutes 06 seconds N. and long. 94 degrees 59 minutes 29 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few medium rounded strong brown (7.5YR 5/8) masses of iron; common fine fragments of snail shells; slightly effervescent; slightly alkaline; clear smooth boundary.

A1—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; common medium black (10YR 2/1) wormcasts; slightly effervescent; slightly alkaline; gradual wavy boundary.

A2—17 to 31 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; common medium black (10YR 2/1) wormcasts; slightly effervescent; moderately alkaline; gradual wavy boundary.

A3—31 to 42 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; few fine prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; slightly effervescent; moderately alkaline; gradual wavy boundary.

A4—42 to 50 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bg—50 to 65 inches; very dark gray (N 3/) silty clay loam; weak fine and medium angular blocky structure parting to weak fine and medium subangular blocky; friable; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg—65 to 80 inches; very dark gray (N 3/) silty clay loam; massive; friable; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: More than 30 inches

Ap or A horizon:
- Hue—10YR, 5Y, or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—silty clay loam
- Reaction—slightly alkaline or moderately alkaline

Bg horizon:
- Hue—10YR, 2.5Y, 5Y, or N
- Value—3 to 6
- Chroma—0 to 2
- Texture—silty clay loam or silt loam
- Reaction—slightly alkaline or moderately alkaline

Cg horizon:
- Hue—10YR, 2.5Y, 5Y, or N
- Value—3 to 6
- Chroma—0 to 3

Texture—silty clay loam, silt loam, or loam
Reaction—slightly alkaline or moderately alkaline

Canisteo Series

Typical Pedon

Canisteo loam, 0 to 2 percent slopes, in a cultivated field in an upland swale in Dickinson County, Iowa; about 163 feet south and 1,573 feet west of the northeast corner of sec. 20, T. 100 N., R. 35 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 28 minutes 25 seconds N. and long. 95 degrees 00 minutes 57 seconds W.; NAD 83:

Ap—0 to 9 inches; black (N 2/) loam, very dark gray (N 3/) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

A—9 to 17 inches; black (N 2/) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; about 2 percent rock fragments; strongly effervescent; slightly alkaline; clear wavy boundary.

Bg—17 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; weak medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; slightly alkaline; clear wavy boundary.

Bkg1—26 to 39 inches; dark grayish brown (2.5Y 4/2) clay loam; weak medium subangular blocky structure; friable; common fine distinct light gray (2.5Y 7/2) masses and threads of calcium carbonate; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkg2—39 to 54 inches; grayish brown (2.5Y 5/2) loam; weak fine subangular blocky structure; friable; many fine distinct light gray (2.5Y 7/2) masses and threads of calcium carbonate; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg1—54 to 65 inches; olive gray (5Y 5/2) loam; massive; friable; common fine distinct light gray (2.5Y 7/2) threads of calcium carbonate; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg2—65 to 80 inches; dark grayish brown (2.5Y 4/2) loam; massive; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 8 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 14 to 24 inches

Ap or A horizon:
Hue—10YR or N
Value—2 or 3
Chroma—0 or 1
Texture—clay loam, loam, or silty clay loam
Reaction—slightly alkaline or moderately alkaline

Bg and Bkg horizons:
Hue—10YR, 2.5Y, or 5Y
Value—4 or 5
Chroma—1 or 2

Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 4
Texture—loam or sandy loam
Reaction—slightly alkaline or moderately alkaline

Chetomba Series

Typical Pedon

Chetomba silty clay loam, on a slope of 1 percent in a cultivated field on a ground moraine in Renville County, Minnesota; about 2,600 feet south and 900 feet west of the northeast corner of sec. 19, T. 115 N., R. 36 W.; USGS Renville (MN) topographic quadrangle; lat. 44 degrees 45 minutes 11 seconds N. and long. 95 degrees 13 minutes 20 seconds W.; NAD 83:

Ap—0 to 8 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
A1—8 to 16 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
A2—16 to 23 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
Bg—23 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam; weak medium subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; neutral; clear smooth boundary.
Cg1—31 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.
2Cg2—43 to 80 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; common fine prominent strong brown (7.5YR 5/8) Fe concentrations; few fine dark brown (7.5YR 3/2) manganese concretions; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Depth to carbonates: 20 to 40 inches
Depth to glacial till: 40 to 60 inches

Ap or A horizon:
Hue—10YR or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Texture—silty clay loam or silt loam
Chroma—1 to 3
Reaction—neutral or slightly alkaline

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4
Texture—silty clay loam, silt loam, or loam
Reaction—slightly alkaline or moderately alkaline

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4
Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

Clarion Series

Typical Pedon

Clarion loam, 2 to 5 percent slopes, in a cultivated field on a till plain in Dickinson County, Iowa; about 790 feet north and 112 feet west of the southeast corner of sec. 36, T. 100 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 25 minutes 58 seconds N. and long. 95 degrees 01 minute 58 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; abrupt smooth boundary.

A—7 to 15 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

Bw1—15 to 20 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few fine distinct black (10YR 2/1) organic stains on faces of peds; about 2 percent rock fragments; neutral; clear smooth boundary.

Bw2—20 to 28 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few fine distinct yellowish brown (10YR 5/6) redoximorphic concentrations; about 2 percent rock fragments; slightly effervescent; slightly alkaline; gradual smooth boundary.

BC—28 to 42 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few prominent light gray (10YR 7/1) masses of calcium carbonate; few fine distinct yellowish brown (10YR 5/6) and common fine prominent reddish brown (5YR 4/4) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

C1—42 to 57 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common fine prominent light gray (10YR 7/1) masses and threads of calcium carbonate; few fine and medium prominent reddish brown (5YR 4/4) and many fine faint light olive brown (2.5Y 5/3) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—57 to 72 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common fine prominent light gray (10YR 7/1) masses and threads of calcium carbonate; few medium prominent reddish brown (5YR 4/4) and many medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C3—72 to 80 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common fine prominent light gray (10YR 7/1) masses and threads of calcium carbonate; few medium prominent strong brown (7.5YR 4/6) and many medium yellowish brown

(10YR 5/6) redoximorphic concentrations; about 4 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 50 inches
Thickness of the mollic epipedon: 10 to 20 inches

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

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Reaction—slightly acid to slightly alkaline

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

Taxadjunct features: The moderately eroded Clarion soils in this survey area do not have a mollic epipedon. These soils are classified as fine-loamy, mixed, superactive, mesic Typic Eutrudepts.

Coland Series

Typical Pedon

Coland clay loam, 0 to 2 percent slopes, occasionally flooded, on a flood plain in Dickinson County, Iowa; about 1,615 feet south and 70 feet east of the northwest corner of sec. 15, T. 100 N., R. 27 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 29 minutes 02 seconds N. and long. 95 degrees 12 minutes 37 seconds W.; NAD 83:

Ap—0 to 8 inches; black (N 2/) clay loam, black (10YR 2/1) dry; weak fine granular structure; friable; about 1 percent rock fragments; neutral; clear smooth boundary.
A1—8 to 18 inches; black (N 2/) clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; about 1 percent rock fragments; neutral; clear smooth boundary.
A2—18 to 32 inches; black (N 2/) clay loam, dark gray (2.5Y 4/1) dry; moderate medium subangular blocky structure; friable; about 1 percent rock fragments; neutral; clear smooth boundary.
AB—32 to 46 inches; black (5Y 2.5/1) clay loam; moderate medium subangular blocky structure; friable; few fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; about 3 percent rock fragments; neutral; gradual smooth boundary.
Bg1—46 to 57 inches; dark gray (5Y 4/1) clay loam; moderate medium subangular blocky structure; friable; very few black (5Y 2.5/1) organic stains on faces of peds;

few fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 4 percent rock fragments; neutral; clear smooth boundary.

Bg2—57 to 64 inches; gray (5Y 5/1) clay loam; moderate medium subangular blocky structure; friable; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 4 percent rock fragments; neutral; clear smooth boundary.

Cg—64 to 80 inches; olive gray (5Y 5/2) clay loam; massive; friable; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 6 percent rock fragments; neutral.

Range in Characteristics

Thickness of the mollic epipedon: More than 36 inches
Depth to carbonates: More than 48 inches

Ap or A horizon:
- Hue—10YR or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—silty clay loam, clay loam, or loam
- Reaction—moderately acid to neutral

AB horizon:
- Hue—10YR to 5Y or N
- Value—2 to 4
- Chroma—0 to 2
- Texture—clay loam or loam
- Reaction—slightly acid or neutral

Bg horizon:
- Hue—10YR to 5Y or N
- Value—2 to 5
- Chroma—0 to 2
- Texture—clay loam or loam
- Reaction—slightly acid or neutral

Cg horizon:
- Hue—10YR to 5Y or N
- Value—2 to 6
- Chroma—0 to 2
- Texture—clay loam, loam, or sandy loam; sandy or gravelly sediments below a depth of 60 inches in some pedons
- Reaction—slightly acid to slightly alkaline

Collinwood Series

Typical Pedon

Collinwood silty clay loam, on a slope of 2 percent in a cultivated field on a glacial lake plain in Faribault County, Minnesota; about 1,450 feet east and 850 feet north of the southwest corner of sec. 9, T. 102 N., R. 27 W.; USGS Blue Earth (IA) topographic quadrangle; lat. 43 degrees 38 minutes 50 seconds N. and long. 94 degrees 04 minutes 57 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.
BA—16 to 21 inches; very dark grayish brown (10YR 3/2) silty clay; moderate fine subangular blocky structure; firm; few very dark gray (10YR 3/1) coatings on peds; moderately acid; clear smooth boundary.
Bw—21 to 32 inches; olive brown (2.5Y 4/4) clay; moderate fine prismatic structure; few fine faint dark grayish brown (2.5Y 4/2) Fe depletions and few fine faint light olive brown (2.5Y 5/6) Fe concentrations; moderately acid; clear wavy boundary.
C1—32 to 45 inches; yellowish brown (10YR 5/4) silty clay; massive (varved); firm; common medium distinct gray (10YR 6/1) and few fine distinct strong brown (7.5YR 5/6) Fe concentrations; few fine distinct black (10YR 2/1) Mn oxide granules; slightly effervescent; slightly alkaline; clear smooth boundary.
C2—45 to 60 inches; yellowish brown (10YR 5/4) silty clay; massive; friable; common medium distinct gray (10YR 6/1) Fe depletions and faint pale brown (10YR 6/3) Fe concentrations; few strong brown (7.5YR 5/8) Fe oxide stains; strongly effervescent; slightly alkaline.

Range in Characteristics

Ap and A horizons:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silty clay, clay, or silty clay loam
Reaction—moderately acid or slightly acid

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam
Reaction—moderately acid or slightly acid

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silty clay, clay, silty clay loam, or silt loam in the lower part
Reaction—slightly alkaline or moderately alkaline

Colo Series

Typical Pedon

Colo silty clay loam, 0 to 2 percent slopes, occasionally flooded, in a cultivated field on a flood plain in Clay County, Iowa; about 600 feet north and 30 feet west of the southeast corner of sec. 8, T. 94 N., R. 36 W.; USGS Webb (IA) topographic quadrangle; lat. 42 degrees 56 minutes 15 seconds N. and long. 95 degrees 06 minutes 46 seconds W.; NAD 83:

Ap—0 to 8 inches; black (N 2/) silty clay loam, black (10YR 2/1) dry; weak fine granular and weak fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.
A1—8 to 19 inches; black (N 2/) silty clay loam, black (10YR 2/1) dry; moderate fine and medium subangular blocky and angular blocky structure; friable; common fine roots; neutral; gradual smooth boundary.

A2—19 to 28 inches; black (N 2/) silty clay loam, black (10YR 2/1) dry; weak fine and medium subangular blocky structure; friable; common fine roots; neutral; gradual smooth boundary.
A3—28 to 40 inches; black (N 2/ and 10YR 2/1) silty clay loam, black (10YR 2/1) and very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; common fine roots; neutral; gradual smooth boundary.
A4—40 to 48 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; common fine roots; neutral; gradual smooth boundary.
Cg—48 to 80 inches; very dark gray (10YR 3/1) and very dark grayish brown (2.5Y 3/2) silty clay loam; massive; friable; neutral.

Range in Characteristics

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

A horizon:
Hue—10YR to 5Y or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam
Reaction—neutral to moderately acid

BCg horizon (if it occurs):
Hue—10YR to 5Y or N
Value—3 to 6
Chroma—0 to 2
Texture—silty clay loam
Reaction—neutral to moderately acid

Cg horizon:
Hue—10YR to 5Y or N
Value—3 to 6
Chroma—0 to 2
Texture—silty clay loam, silt loam, or clay loam
Reaction—neutral or slightly acid

Coriff Series

Typical Pedon

Coriff loam, on a slope of 1 percent in a wheat field on a ground moraine in Kandiyohi County, Minnesota; about 300 feet north and 2,100 feet west of the southeast corner of sec. 17, T. 118 N., R. 33 W.; USGS Lake Elizabeth (MN) topographic quadrangle; lat. 45 degrees 01 minute 27 seconds N. and long. 94 degrees 50 minutes 50 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; few roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.
A—10 to 18 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few roots; slightly effervescent; slightly alkaline; clear wavy boundary.
Bg1—18 to 24 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/4) Fe concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg2—24 to 33 inches; light brownish gray (2.5Y 6/2) loamy fine sand; weak medium subangular blocky structure; friable; common medium distinct yellowish brown (10YR 5/4) Fe concentrations; slightly effervescent; slightly alkaline; abrupt smooth boundary.
2Cg—33 to 60 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common medium distinct yellowish brown (10YR 5/4) Fe concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 22 inches
Carbonates: Carbonates occur in all parts of the profile, but the upper 10 inches may be leached.
Depth to glacial till: 24 to 40 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam, sandy loam, or fine sandy loam
Reaction—slightly alkaline or moderately alkaline

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—stratified with sandy loam or fine sandy loam in the upper part and loamy fine sand, sand, or fine sand in the lower part
Reaction—slightly alkaline or moderately alkaline

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

Crippin Series

Typical Pedon

Crippin loam, 0 to 2 percent slopes, in a grass pasture on an upland in Dickinson County, Iowa; about 2,165 feet south and 1,014 feet west of the northeast corner of sec. 35, T. 100 N., R. 37 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 26 minutes 19 seconds N. and long. 95 degrees 10 minutes 26 seconds W.; NAD 83:

Ap—0 to 8 inches; black (N 2/) loam, black (10YR 2/1) dry; weak fine granular structure; friable; about 1 percent rock fragments; slightly effervescent; slightly alkaline; clear smooth boundary.
A—8 to 14 inches; black (N 2/) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; about 1 percent rock fragments; strongly effervescent; slightly alkaline; clear smooth boundary.
Bw1—14 to 26 inches; dark grayish brown (2.5Y 4/2) loam; moderate fine subangular blocky structure; friable; common fine distinct black (10YR 2/1) organic stains on faces of peds; about 2 percent rock fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw2—26 to 36 inches; light olive brown (2.5Y 5/3) loam; moderate fine subangular blocky structure; friable; few fine faint grayish brown (2.5Y 5/2) redoximorphic depletions; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; about 2 percent rock fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

BCk—36 to 47 inches; light olive brown (2.5Y 5/3) loam; weak fine subangular blocky structure; friable; few distinct light gray (10YR 7/1) carbonate masses; common fine faint grayish brown (2.5Y 5/2) redoximorphic depletions; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; about 4 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C1—47 to 59 inches; light olive brown (2.5Y 5/3) loam; massive; friable; common prominent light gray (10YR 7/1) masses of carbonate; common fine faint grayish brown (2.5Y 5/2) redoximorphic depletions; common fine prominent strong brown (7.5YR 5/8) and yellowish brown (10YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—59 to 80 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common prominent light gray (10YR 7/1) masses of carbonate; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; common medium distinct yellowish brown (10YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 12 to 20 inches

Ap or A horizon:
- Hue—10YR or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—loam or clay loam
- Reaction—neutral to moderately alkaline

AB horizon (if it occurs):
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—loam or clay loam
- Reaction—slightly alkaline or moderately alkaline

Bw, BC, or BCk horizon:
- Hue—10YR or 2.5Y
- Value—4 or 5
- Chroma—2 to 4
- Texture—loam or clay loam
- Reaction—slightly alkaline or moderately alkaline

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

Cylinder Series

Typical Pedon

Cylinder loam, in an area of Cylinder complex, 0 to 2 percent slopes, in a cultivated field on an outwash plain in Dickinson County, Iowa; about 1,470 feet west and 70 feet north of the southeast corner of sec. 17, T. 98 N., R. 36 W.; USGS Spirit Lake SE (IA) topographic quadrangle; lat. 43 degrees 17 minutes 57 seconds N. and long. 95 degrees 07 minutes 04 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent rock fragments; slightly acid; clear smooth boundary.

A—8 to 21 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 2 percent rock fragments; slightly acid; clear smooth boundary.

Bg1—21 to 28 inches; dark grayish brown (10YR 4/2) clay loam; weak fine subangular blocky structure; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 3 percent rock fragments; neutral; gradual smooth boundary.

Bg2—28 to 35 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; neutral; clear smooth boundary.

2C1—35 to 47 inches; grayish brown (2.5Y 5/2) loamy sand; single grain; loose; about 5 percent rock fragments; slightly effervescent; slightly alkaline; gradual smooth boundary.

2C2—47 to 56 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C3—56 to 69 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; about 8 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C4—69 to 80 inches; light olive brown (2.5Y 5/3) coarse sand; single grain; loose; about 10 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to sand and gravel: 24 to 40 inches

Ap or A horizon:
- Hue—10YR or 2.5Y
- Value—2 or 3
- Chroma—1 or 2
- Texture—loam, clay loam, or silty clay loam
- Content of rock fragments—0 to 10 percent
- Reaction—moderately acid to neutral

Bg or Bw horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5
- Chroma—2 or 3
- Texture—loam or clay loam
- Content of rock fragments—0 to 10 percent
- Reaction—slightly acid or neutral

2C or 2Cg horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 8
Texture—sand, coarse sand, or loamy sand or the gravelly analogs of these textures
Content of rock fragments—5 to 35 percent
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The calcareous Cylinder soils in map units 199 and 200 contain free carbonates within the control section. These soils are classified as fine-loamy over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Aquic Hapludolls.

Delft Series

Typical Pedon

Delft clay loam, 2 to 5 percent slopes, on a ground moraine in a cultivated field in Cottonwood County, Minnesota; about 200 feet west and 100 feet south of the northeast corner of sec. 31, T. 107 N., R. 36 W.; USGS Jeffers (MN) topographic quadrangle; lat. 44 degrees 02 minutes 08 seconds N. and long. 95 degrees 12 minutes 03 seconds W.; NAD 83:

Ap—0 to 12 inches; black (N 2/) clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; slightly alkaline; abrupt smooth boundary.
A—12 to 29 inches; black (N 2/) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 10 percent gravel; slightly alkaline; clear wavy boundary.
Bg1—29 to 34 inches; dark gray (5Y 4/1) silt loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; common black (5Y 2/1) wormcasts; about 5 percent gravel; slightly alkaline; clear wavy boundary.
Bg2—34 to 46 inches; olive gray (5Y 5/2) clay loam; weak coarse prismatic structure parting to weak fine subangular blocky; friable; about 5 percent gravel; many fine prominent light olive brown (2.5Y 5/4) and few coarse prominent brown (7.5YR 4/4) Fe concentrations; slightly effervescent; slightly alkaline; clear wavy boundary.
Cg—46 to 60 inches; olive gray (5Y 5/2) loam; massive; friable; about 2 percent gravel; about 8 percent carbonates disseminated throughout; many coarse prominent yellowish brown (10YR 5/6) Fe concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Depth to carbonates: 24 to 60 inches

Ap or A horizon:
Hue—10YR to 5Y or N
Value—2 or 3
Chroma—0 to 2
Texture—commonly loam or clay loam; less commonly silty clay loam
Reaction—moderately acid to slightly alkaline

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2

Texture—loam, clay loam, or silt loam that is high in sand
Reaction—neutral or slightly alkaline

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or silt loam
Reaction—slightly alkaline or moderately alkaline

Dickinson Series

Typical Pedon

Dickinson fine sandy loam, 2 to 5 percent slopes, in a cultivated field on a stream terrace in Clay County, Iowa; about 1,700 feet south and 1,000 feet west of the northeast corner of sec. 32, T. 96 N., R. 36 W.; USGS Gillett Grove (IA) topographic quadrangle; lat. 43 degrees 05 minutes 43 seconds N. and long. 95 degrees 07 minutes 07 seconds W.; NAD 83:

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; very friable; common very fine and fine roots; moderately acid; abrupt smooth boundary.
AB—7 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to weak fine granular; very friable; common very fine and fine roots; moderately acid; clear smooth boundary.
Bw1—13 to 24 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; very friable; common very fine and fine roots; moderately acid; gradual smooth boundary.
Bw2—24 to 31 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure; very friable; common very fine and fine roots; moderately acid; diffuse smooth boundary.
BC—31 to 41 inches; mixed dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; common very fine and fine roots; slightly acid; clear smooth boundary.
C1—41 to 64 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid; clear smooth boundary.
C2—64 to 80 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine white (10YR 8/1) calcium carbonate concretions between sand grains; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Depth to carbonates: 60 inches or more

Ap and AB horizons:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam
Reaction—neutral to moderately acid

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4

Texture—sandy loam or fine sandy loam
Reaction—slightly acid or moderately acid

BC and C horizons:
Hue—7.5YR or 10YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy fine sand, loamy sand, fine sand, or sand
Reaction—slightly acid or moderately acid

Taxadjunct features: The moderately eroded Dickinson soils in this survey area do not have a mollic epipedon. These soils are classified as coarse-loamy, mixed, superactive, mesic Typic Eutrudepts.

Dickman Series

Typical Pedon

Dickman fine sandy loam, 2 to 5 percent slopes, in a cultivated field on a stream terrace in Dickinson County, Iowa; about 1,935 feet west and 2,275 feet north of the southeast corner of sec. 16, T. 98 N., R. 37 W.; USGS Milford (IA) topographic quadrangle; lat. 43 degrees 18 minutes 18 seconds N. and long. 95 degrees 13 minutes 00 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.
A—8 to 12 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.
Bw1—12 to 16 inches; brown (10YR 4/3) fine sandy loam; single grain; loose; slightly acid; gradual smooth boundary.
2Bw2—16 to 35 inches; dark yellowish brown (10YR 4/4) loamy fine sand; single grain; loose; slightly acid; gradual smooth boundary.
2C1—35 to 52 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; slightly acid; clear smooth boundary.
2C2—52 to 80 inches; yellowish brown (10YR 5/4) sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 30 inches or more
Thickness of the mollic epipedon: 10 to 20 inches
Depth to sand: 12 to 20 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—coarse sandy loam, fine sandy loam, or sandy loam
Reaction—moderately acid or slightly acid

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—coarse sandy loam, fine sandy loam, or sandy loam
Reaction—moderately acid or slightly acid

2Bw horizon:
Hue—7.5YR, 10YR, or 2.5Y

Value—4 to 6
Chroma—2 to 4
Texture—loamy sand, loamy fine sand, fine sand, coarse sand, or sand
Reaction—moderately acid to neutral

2C horizon:
Hue—7.5YR, 10YR, or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—coarse sand, sand, or fine sand
Reaction—slightly acid to slightly alkaline

Estherville Series

Typical Pedon

Estherville sandy loam, 2 to 5 percent slopes, in a grass pasture on an outwash plain in Dickinson County, Iowa; about 2,630 feet west and 250 feet north of the southeast corner of sec. 21, T. 99 N., R. 37 W.; USGS Milford (IA) topographic quadrangle; lat. 43 degrees 22 minutes 21 seconds N. and long. 95 degrees 13 minutes 12 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 3 percent rock fragments; moderately acid; abrupt smooth boundary.
A—7 to 13 inches; black (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 3 percent rock fragments; moderately acid; clear smooth boundary.
Bw—13 to 19 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; about 6 percent rock fragments; slightly acid; clear smooth boundary.
2C1—19 to 37 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 12 percent rock fragments; neutral; gradual smooth boundary.
2C2—37 to 57 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 15 percent rock fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.
2C3—57 to 80 inches; yellowish brown (10YR 5/3) gravelly coarse sand; single grain; loose; about 15 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 40 inches
Thickness of the mollic epipedon: 7 to 20 inches
Depth to sand and gravel: 10 to 20 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam, coarse sandy loam, or loam
Content of rock fragments—0 to 15 percent
Reaction—moderately acid to neutral

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam, coarse sandy loam, or loam

Content of rock fragments—0 to 15 percent
Reaction—moderately acid to neutral

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—2 to 6
Texture—coarse sand, sand, gravelly sand, or gravelly coarse sand
Content of rock fragments—10 to 35 percent
Reaction—neutral to moderately alkaline

Taxadjunct features: The moderately eroded Estherville soils in this survey area do not have a mollic epipedon. These soils are classified as sandy, mixed, mesic Typic Eutrudepts.

Everly Series

Typical Pedon

Everly clay loam, 2 to 5 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 880 feet north and 340 feet east of the southwest corner of sec. 13, T. 97 N., R. 37 W.; USGS Spencer (IA) topographic quadrangle; lat. 43 degrees 12 minutes 57 seconds N. and long. 95 degrees 10 minutes 07 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine and fine roots; moderately acid; abrupt smooth boundary.

A—8 to 12 inches; black (10YR 2/1) clay loam with a few small streaks and pockets of very dark grayish brown (10YR 3/2) clay loam; very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; common fine and very fine roots; moderately acid; gradual smooth boundary.

BA—12 to 16 inches; mixed black (10YR 2/1) and very dark grayish brown (10YR 3/2) clay loam; moderate fine and very fine subangular blocky structure; friable; common fine and very fine roots; slightly acid; gradual smooth boundary.

Bw1—16 to 20 inches; brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; friable; common very fine and fine roots; about 2 percent gravel; slightly acid; gradual smooth boundary.

Bw2—20 to 26 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky structure; friable; common very fine and fine roots; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; a thin discontinuous band of pebbles in the lower part of the horizon; about 3 percent gravel; neutral; clear smooth boundary.

2Bk1—26 to 36 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; firm; few white (10YR 8/1) calcium carbonate nodules in the lower part; few fine distinct dark gray (10YR 3/1) redoximorphic depletions in the lower part; about 3 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

2Bk2—36 to 50 inches; yellowish brown (10YR 5/4) loam; weak fine prismatic structure; firm; common white (10YR 8/1) calcium carbonate nodules; few fine distinct grayish brown (10YR 5/2) redoximorphic depletions; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

2BC1—50 to 62 inches; yellowish brown (10YR 5/4) loam; weak and moderate coarse prismatic structure; firm; common white (10YR 8/1) calcium carbonate nodules; common medium faint dark yellowish brown (10YR 4/4) redoximorphic concentrations; few fine distinct grayish brown (10YR 5/2) redoximorphic

depletions; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

2BC2—62 to 80 inches; yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) clay loam; moderate coarse and very coarse prismatic structure; firm; common white (10YR 8/1) calcium carbonate nodules; few medium and fine distinct yellowish brown (10YR 5/6) redoximorphic concentrations; about 7 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: 16 to 36 inches
Depth to till: 16 to 36 inches

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

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

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

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

Taxadjunct features: The moderately eroded Everly soils in this survey area do not have a mollic epipedon. These soils are classified as fine-loamy, mixed, superactive, mesic Typic Eutrudepts.

Fort Dodge Series

Typical Pedon

Fort Dodge loam, on a slope of 2 percent in a cultivated field on a footslope in Webster County, Iowa; about 280 feet east and 340 feet north of the southwest corner of sec. 29, T. 90 N., R. 30 W.; USGS Gilmore City SW (IA) topographic quadrangle; lat. 42 degrees 34 minutes 26 seconds N. and long. 94 degrees 25 minutes 19 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; slightly acid; abrupt smooth boundary.

A1—7 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
A2—17 to 31 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
A3—31 to 39 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
Bw1—39 to 50 inches; brown (10YR 4/3) loam; weak fine and medium subangular blocky structure; friable; common distinct very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) organic stains on faces of peds; about 2 percent rock fragments in the lower part; neutral; clear smooth boundary.
Bw2—50 to 58 inches; dark yellowish brown (10YR 4/4) loam; weak fine and medium subangular blocky structure; friable; few fine tubular pores; common distinct dark brown (10YR 3/3) organic stains on faces of peds; about 3 percent rock fragments; many fine shale fragments; neutral; abrupt wavy boundary.
2C—58 to 80 inches; dark yellowish brown (10YR 4/4) loamy coarse sand; single grain; loose; about 3 percent rock fragments; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 55 inches
Depth to carbonates: 40 to more than 80 inches
Depth to loamy sand or coarser material: 40 to 60 inches
Other features: Some pedons have a Bk horizon, which has colors and textures similar to those of the Bw or BC horizon.

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

AB or BA horizon (if it occurs):
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam or clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

Bw or BC horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 to 6
Texture—loam, clay loam, or sandy loam
Content of rock fragments—0 to 15 percent
Reaction—slightly acid or neutral

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—3 to 8
Texture—sand, coarse sand, loamy sand, or loamy coarse sand or the gravelly analogs of these textures

Content of rock fragments—0 to 20 percent
Reaction—slightly acid to moderately alkaline

Fostoria Series

Typical Pedon

Fostoria loam, 1 to 3 percent slopes, in a cultivated field on an upland flat in Clay County, Iowa; about 125 feet north and 150 feet west of the southeast corner of sec. 29, T. 97 N., R. 38 W.; USGS Everly (IA) topographic quadrangle; lat. 43 degrees 11 minutes 03 seconds N. and long. 95 degrees 20 minutes 55 seconds W.; NAD 83:

Ap—0 to 7 inches; black (N 2/) loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; friable; common very fine and fine roots; neutral; abrupt smooth boundary.

A1—7 to 15 inches; black (N 2/) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common very fine and fine roots; neutral; gradual smooth boundary.

A2—15 to 19 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; some mixing of dark grayish brown (2.5Y 4/2); weak very fine subangular blocky and weak fine granular structure; friable; common very fine and fine roots; neutral; gradual smooth boundary.

Bg1—19 to 24 inches; dark grayish brown (2.5Y 4/2) loam; very weak fine subangular blocky structure; friable; common very fine roots; very dark grayish brown (10YR 3/2) organic stains on faces of peds; neutral; gradual smooth boundary.

Bg2—24 to 29 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; common very fine roots; common fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; neutral; gradual smooth boundary.

Bk—29 to 34 inches; olive brown (2.5Y 4/4) loam; weak fine and medium subangular blocky structure; friable; common very fine roots; common fine and medium very pale brown (10YR 8/2) calcium carbonate concretions; fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2C—34 to 42 inches; light olive brown (2.5Y 5/4) silt loam; massive; friable; common fine and medium very pale brown (10YR 8/2) rounded calcium carbonate concretions; common fine distinct yellowish brown (10YR 5/6 and 5/8) redoximorphic concentrations; common medium prominent gray (10YR 5/1) redoximorphic depletions; strongly effervescent; moderately alkaline; gradual smooth boundary.

2Cg1—42 to 60 inches; gray (10YR 5/1) silt loam; massive; friable; common fine and medium very pale brown (10YR 8/2) calcium carbonate concretions; many fine and medium prominent yellowish brown (10YR 5/6 and 5/8) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary.

2Cg2—60 to 68 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; many fine and medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; abrupt wavy boundary.

3C—68 to 80 inches; yellowish brown (10YR 5/6) loam; massive; firm; about 3 percent gravel; common fine prominent grayish brown (2.5Y 5/2) redoximorphic depletions; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 19 inches
Depth to carbonates: 24 to 48 inches

Ap and A horizons:
Hue—10YR or N
Value—2
Chroma—0 or 1
Texture—loam
Content of rock fragments—0 percent
Reaction—slightly acid or neutral

BA or AB horizon (if it occurs):
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—2
Texture—loam, silt loam, or clay loam
Content of rock fragments—0 percent
Reaction—slightly acid or neutral

Bg and Bk horizons:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam, silt loam, or clay loam
Content of rock fragments—0 percent
Reaction—neutral to moderately alkaline

2Cg horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 to 4
Content of rock fragments—0 percent
Texture—silt loam or loam
Reaction—slightly alkaline or moderately alkaline

3C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 6
Texture—loam or clay loam
Content of rock fragments—1 to 8 percent
Reaction—slightly alkaline or moderately alkaline

Gillett Grove Series

Typical Pedon

Gillett Grove silty clay loam, 0 to 2 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 2,500 feet west and 2,000 feet north of the southeast corner of sec. 19, T. 95 N., R. 36 W.; USGS Greenville (IA) topographic quadrangle; lat. 43 degrees 01 minute 50 seconds N. and long. 95 degrees 08 minutes 27 seconds W.; NAD 83:

Ap—0 to 7 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
A—7 to 11 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.
AB—11 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; common medium prominent dark gray (5Y 4/1) redoximorphic depletions; neutral; gradual smooth boundary.

Bg1—16 to 22 inches; dark gray (2.5Y 4/1) silty clay loam; moderate fine and medium angular and subangular blocky structure; friable; common very dark gray (5Y 3/1) organic coatings on faces of peds; common fine dark manganese concretions that increase in abundance with increasing depth; common medium distinct dark gray (5Y 4/1) redoximorphic depletions; neutral; gradual smooth boundary.

Bg2—22 to 42 inches; olive gray (5Y 4/2) silty clay loam; weak fine and medium subangular blocky structure; friable; common fine dark manganese concretions; common fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; common medium faint dark gray (5Y 4/1) redoximorphic depletions; slightly effervescent; slightly alkaline; gradual wavy boundary.

BCg1—42 to 48 inches; grayish brown (2.5Y 5/2) silt loam; weak coarse prismatic structure parting to weak fine and medium subangular blocky; friable; common fine dark manganese concretions that increase in abundance with increasing depth; white (10YR 8/1) and pale brown (10YR 7/1) calcium carbonate coatings on faces of peds and root channels; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual wavy boundary.

2BCg2—48 to 80 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic structure parting to weak fine and medium subangular blocky; friable; common fine dark manganese concretions; white (10YR 8/1) calcium carbonate coatings on faces of peds; about 3 percent gravel; common fine and medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to carbonates: 24 to 48 inches
Depth to till: 40 to 60 inches

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

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silty clay
Reaction—slightly acid to moderately alkaline

BCg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silt loam
Reaction—slightly alkaline or moderately alkaline

2BCg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Guckeen Series

Typical Pedon

Guckeen silty clay loam, on a slope of 2 percent in a cultivated field on a ground moraine in Waseca County, Minnesota; about 100 feet east and 100 feet north of the southwest corner of sec. 7, T. 105 N., R. 24 W.; USGS Mapleton NE (MN) topographic quadrangle; lat. 43 degrees 54 minutes 23 seconds N. and long. 93 degrees 46 minutes 03 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A1—8 to 12 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; moderately acid; clear smooth boundary.

A2—12 to 15 inches; very dark gray (10YR 3/1) silty clay, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; moderately acid; clear smooth boundary.

Bw1—15 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) coatings on faces of peds; strong fine angular blocky structure; firm; common very dark gray (10YR 3/1) earthworm casts; moderately acid; clear smooth boundary.

Bw2—18 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay; dark grayish brown (10YR 4/2) coatings on faces of peds; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; moderately acid; clear smooth boundary.

2Bw3—24 to 30 inches; grayish brown (2.5Y 5/2) clay loam; dark grayish brown (10YR 4/2) coatings on faces of peds; moderate coarse prismatic structure parting to moderate fine and medium subangular blocky; firm; about 5 percent gravel; slightly acid; clear smooth boundary.

2Cg1—30 to 68 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; common medium faint olive gray (5Y 5/2) iron depletions; many fine prominent olive (5Y 5/6) and few medium prominent red (2.5YR 4/8) iron concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—68 to 80 inches; olive gray (5Y 5/2) loam; massive; friable; common medium dark yellowish brown (10YR 4/4) and common medium prominent brown (7.5YR 4/4) iron concentrations; about 6 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Depth to carbonates: 18 to 48 inches
Depth to till: 20 to 40 inches

Ap and A horizons:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—silty clay loam, silty clay, clay loam, or clay
- Content of rock fragments—0 to 5 percent
- Reaction—moderately acid to neutral

Bw horizon:
- Hue—10YR or 2.5Y
- Value—3 or 4
- Chroma—2 or 3

Texture—silty clay loam, silty clay, clay loam, or clay
Content of rock fragments—0 to 5 percent
Reaction—moderately acid to neutral

2Bw horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam or loam; a thin sandy subhorizon in the upper part in some pedons
Content of rock fragments—2 to 8 percent
Reaction—slightly acid to slightly alkaline

2Bk horizon (if it occurs):
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam
Content of rock fragments—2 to 8 percent
Reaction—slightly alkaline or moderately alkaline

2Cg or 2C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam
Content of rock fragments—2 to 8 percent
Reaction—neutral to moderately alkaline

Hanlon Series

Typical Pedon

Hanlon fine sandy loam, on a nearly level flood plain in Mitchell County, Iowa; about 100 feet north and 2,315 feet west of the southeast corner of sec. 23, T. 99 N., R. 18 W.; USGS Osage SW (IA) topographic quadrangle; lat. 43 degrees 22 minutes 18 seconds N. and long. 92 degrees 56 minutes 02 seconds W.; NAD 83:

A1—0 to 7 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to weak fine granular; very friable; neutral; clear smooth boundary.
A2—7 to 27 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; very friable; neutral; clear smooth boundary.
A3—27 to 40 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; neutral; clear smooth boundary.
A4—40 to 50 inches; very dark brown (10YR 2/2) fine sandy loam grading to medium sandy loam with depth, dark grayish brown (10YR 4/2) dry; weak medium and coarse subangular blocky structure; very friable; neutral; gradual smooth boundary.
Bt—50 to 69 inches; very dark grayish brown (10YR 3/2) sandy loam; weak medium and coarse subangular blocky structure; friable; some clay bridging between sand grains; very dark brown (10YR 2/2) coatings on faces of peds; neutral; abrupt wavy boundary.
BC—69 to 80 inches; dark grayish brown (10YR 4/2) loam; weak coarse prismatic structure; friable; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 40 to 71 inches
Depth to carbonates: More than 48 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam or sandy loam; overwash sediments of silt loam or loam 6 to 18 inches thick in some pedons
Reaction—slightly acid or neutral

Bt horizon or Bw horizon (if it occurs):
Hue—10YR
Value—3 or 4
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, or loamy fine sand
Reaction—moderately acid to neutral

BC horizon or BCg horizon (if it occurs):
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—1 or 2
Texture—loam, sandy loam, loamy sand, or sand
Reaction—moderately acid to slightly alkaline

Harps Series

Typical Pedon

Harps loam, 0 to 2 percent slopes, on the rim of a depression in Dickinson County, Iowa; about 945 feet south and 235 feet west of the northeast corner of sec. 3, T. 98 N., R. 35 W.; USGS Terril (IA) topographic quadrangle; lat. 43 degrees 20 minutes 21 seconds N. and long. 94 degrees 57 minutes 16 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; violently effervescent; moderately alkaline; clear smooth boundary.

Ak—8 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (2.5Y 4/1) dry; weak fine subangular blocky structure; friable; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg1—16 to 25 inches; dark gray (2.5Y 4/1) loam; weak medium subangular blocky structure; friable; few fine distinct very dark gray (10YR 3/1) organic stains on faces of peds; common prominent light gray (10YR 7/2) masses of calcium carbonate; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; common fine prominent olive (5Y 5/6) redoximorphic depletions; violently effervescent; moderately alkaline; gradual smooth boundary.

Bkg2—25 to 31 inches; dark gray (2.5Y 4/1) loam; moderate medium subangular blocky structure; friable; common prominent light gray (10YR 7/1) masses of calcium carbonate; common fine prominent dark yellowish brown (10YR 4/6) and strong brown (7.5YR 4/6) redoximorphic concentrations; common fine faint gray (5Y 5/1) redoximorphic depletions; violently effervescent; moderately alkaline; gradual smooth boundary.

Bkg3—31 to 46 inches; grayish brown (2.5Y 5/2) loam; moderate medium subangular blocky structure; friable; common fine distinct light gray (10YR 7/2) masses of

calcium carbonate; common fine distinct yellowish brown (10YR 5/4) and common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary.

BCg—46 to 56 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg1—56 to 66 inches; olive gray (5Y 5/2) loam; massive; friable; common medium prominent yellowish brown (10YR 5/4) and strong brown (7.5YR 4/6) redoximorphic concentrations; common prominent light gray (10YR 7/2) masses of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg2—66 to 80 inches; olive gray (5Y 5/2) loam; massive; friable; common prominent light gray (10YR 7/2) masses of calcium carbonate; common coarse prominent strong brown (7.5YR 4/6) and common medium prominent yellowish red (5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Carbonates: Throughout the profile

Ap or Ak horizon:
Hue—10YR or N
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam
Reaction—moderately alkaline or strongly alkaline

AB horizon (if it occurs):
Hue—10YR to 5Y or N
Value—3 or 4
Chroma—0 or 1
Texture—loam or clay loam
Reaction—moderately alkaline or strongly alkaline

Bkg horizon:
Hue—10YR to 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam, clay loam, or sandy clay loam
Reaction—moderately alkaline or strongly alkaline

BCg or Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, fine sandy loam, sandy loam, or clay loam
Reaction—moderately alkaline or strongly alkaline

Havelock Series

Typical Pedon

Havelock loam, 0 to 2 percent slopes, occasionally flooded, in a timbered area on a flood plain in Dickinson County, Iowa; about 650 feet east and 835 feet north of the southwest corner of sec. 15, T. 98 N., R. 37 W.; USGS Milford (IA) topographic

quadrangle; lat. 43 degrees 18 minutes 03 seconds N. and long. 95 degrees 12 minutes 25 seconds W.; NAD 83:

A1—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; strongly effervescent; moderately alkaline; gradual smooth boundary.
A2—10 to 35 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; strongly effervescent; moderately alkaline; gradual smooth boundary.
A3—35 to 45 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; clear smooth boundary.
Cg1—45 to 61 inches; dark gray (2.5Y 4/1) clay loam; massive; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary.
Cg2—61 to 80 inches; gray (2.5Y 5/1) clay loam; massive; friable; common fine and medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 36 inches or more

Ap or A horizon:
Hue—10YR, 5Y, or N
Value—2 to 4
Chroma—0 or 1
Texture—clay loam, silty clay loam, loam, sandy loam, or silt loam
Reaction—slightly alkaline or moderately alkaline

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam; strata of coarser textures in some pedons
Reaction—neutral to moderately alkaline

Hawick Series

Typical Pedon

Hawick gravelly loamy sand, 9 to 14 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 2,600 feet east and 550 feet north of the southwest corner of sec. 23, T. 96 N., R. 35 W.; USGS Silver Lake (IA) topographic quadrangle; lat. 43 degrees 06 minutes 50 seconds N. and long. 94 degrees 56 minutes 38 seconds W.; NAD 83:

Ap—0 to 8 inches; very dark brown (10YR 2/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; common very fine to medium roots; about 22 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.
Bw—8 to 27 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; very weak fine subangular blocky structure; very friable; common very fine and fine roots; about 19 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

C1—27 to 46 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; common very fine roots; about 20 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.
C2—46 to 80 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 20 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 30 inches
Thickness of the mollic epipedon: 7 to 16 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—gravelly loamy sand or loamy sand
Reaction—slightly acid to slightly alkaline

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—2 to 4
Texture—gravelly loamy sand, gravelly loamy coarse sand, or gravelly coarse sand
Reaction—slightly acid to slightly alkaline

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—gravelly loamy sand, gravelly coarse sand, or gravelly sand
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The moderately eroded Hawick soils in this survey area do not have a mollic epipedon. These soils are classified as sandy, mixed, mesic Typic Eutrudepts.

Jeffers Series

Typical Pedon

Jeffers clay loam, on a slope of 2 percent in a cultivated field on a till plain in Murray County, Minnesota; about 2,200 feet east and 1,050 feet south of the northwest corner of sec. 26, T. 108 N., R. 39 W.; USGS Walnut Grove (MN) topographic quadrangle; lat. 44 degrees 08 minutes 06 seconds N. and long. 95 degrees 29 minutes 40 seconds W.; NAD 83:

Ap—0 to 10 inches; black (2.5Y 2/1) clay loam, dark gray (2.5Y 4/1) dry; weak fine subangular blocky structure; friable; few fine gypsum crystals in root channels; about 1 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.
A—10 to 18 inches; very dark gray (2.5Y 3/1) clay loam, gray (2.5Y 5/1) dry; weak fine subangular blocky structure; very friable; few fine gypsum crystals in root channels; about 1 percent gravel; violently effervescent; slightly alkaline; clear wavy boundary.
BA—18 to 22 inches; dark gray (2.5Y 4/1) clay loam; weak fine subangular blocky structure; friable; common distinct olive brown (2.5Y 4/4) and very dark grayish brown (2.5Y 3/2) wormcasts; few fine gypsum crystals in root channels; few fine

faint dark grayish brown (2.5Y 4/2) Fe depletions; about 2 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

Bkg—22 to 30 inches; grayish brown (2.5Y 5/2) clay loam; weak fine and medium subangular blocky structure; friable; many fine calcium carbonate masses; many fine gypsum threads; few fine oxide stains; common fine distinct light olive brown (2.5Y 5/4) Fe depletions; about 5 percent gravel; violently effervescent; slightly alkaline; clear wavy boundary.

Bk—30 to 35 inches; light olive brown (2.5Y 5/4) clay loam; weak fine and medium subangular blocky structure; friable; many fine calcium carbonate masses; many fine gypsum threads; few fine oxide stains; common fine distinct light olive brown (2.5Y 5/4) Fe depletions; about 5 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C1—35 to 47 inches; light olive brown (2.5Y 5/4) clay loam; firm; many fine calcium carbonate masses; few fine oxide stains; many large prominent yellowish brown distinct yellowish brown (10YR 5/6) Fe concentrations; about 8 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C2—47 to 60 inches; light olive brown (2.5Y 5/4) clay loam; firm; many fine calcium carbonate masses; few fine oxide stains; common large prominent olive gray (5Y 5/2) Fe depletions; about 8 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to firm 2B or 2C horizon: 20 to 40 inches
Carbonates: At the surface

Ap or A horizon:
Hue—2.5Y
Value—2 or 3
Chroma—1
Texture—clay loam
Reaction—slightly alkaline or moderately alkaline

BA, Bkg, or Bk horizon:
Hue—2.5Y
Value—4 or 5
Chroma—1 or 2 in the upper part; 1 to 4 in the lower part
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

2C horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam, loam, or sandy clay loam
Reaction—slightly alkaline or moderately alkaline

Kingston Series

Typical Pedon

Kingston silty clay loam, on a slope of 1 percent in a cultivated field on a glacial lake plain in Meeker County, Minnesota; about 1,620 feet north and 100 feet west of the southeast corner of sec. 26, T. 120 N., R. 30 W.; USGS Forest City (MN) topographic quadrangle; lat. 45 degrees 10 minutes 14 seconds N. and long. 94 degrees 23 minutes 59 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.
A1—8 to 13 inches; black (10YR 2/1) silty clay loam; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
A2—13 to 16 inches; very dark gray (10YR 3/1) silty clay loam; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bg1—16 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; friable; very dark grayish brown (2.5Y 3/2) coatings on faces of peds; common dark krotovinas; slightly acid; clear smooth boundary.
Bg2—20 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam; weak fine subangular blocky structure; friable; many fine distinct light olive brown (2.5Y 5/4) Fe concentrations; slightly acid; abrupt smooth boundary.
C—25 to 60 inches; light olive brown (2.5Y 5/4) silt loam; weak thin to thick platy structure; very friable; common fine distinct olive gray (5Y 5/2) Fe depletions; common fine faint olive (5Y 5/3) Fe concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Depth to carbonates: 20 to 40 inches

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

B horizon:
Hue—10YR or 2.5Y
Value—3 or 4 in the upper part; 4 or 5 in the lower part
Chroma—2 or 3 in the upper part; 2 to 4 in the lower part
Texture—silty clay loam or silt loam
Reaction—moderately acid to neutral

C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam or silty clay loam
Reaction—slightly alkaline or moderately alkaline

Knoke Series

Typical Pedon

Knoke mucky silt loam, on a slope of 1 percent in a cultivated field in a depression in Calhoun County, Iowa; about 1,440 feet north and 50 feet west of the southeast corner of sec. 3, T. 88 N., R. 33 W.; USGS Rockwell City (IA) topographic quadrangle; lat. 42 degrees 27 minutes 39 seconds N. and long. 94 degrees 40 minutes 12 seconds W.; NAD 83:

Ap—0 to 8 inches; black (5Y 2/1) mucky silt loam, dark gray (10YR 4/1) dry; weak medium platy structure parting to weak fine subangular blocky; friable; many snail shells; violently effervescent; moderately alkaline; abrupt smooth boundary.
A1—8 to 13 inches; very dark gray (5Y 3/1) mucky silty clay loam, gray (10YR 5/1) dry; weak medium platy structure; friable; brown (7.5YR 5/4) coatings in fine vertical

tubular pores; many snail shells; violently effervescent; moderately alkaline; abrupt smooth boundary.

A2—13 to 18 inches; black (5Y 2/1) mucky silty clay loam, dark gray (10YR 4/1) dry; weak medium platy structure; friable; many snail shells; brown (7.5YR 5/4) coatings in fine vertical tubular pores; violently effervescent; moderately alkaline; clear smooth boundary.

A3—18 to 33 inches; black (N 2/) silty clay loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; friable; few olive brown (2.5Y 4/4) coatings in fine vertical tubular pores; slightly effervescent; slightly alkaline; gradual smooth boundary.

A4—33 to 40 inches; black (N 2/) silty clay loam, dark gray (10YR 4/1) dry; weak fine angular and subangular blocky structure; friable; few olive brown (2.5Y 4/4) coatings in fine vertical tubular pores; strongly effervescent; slightly alkaline; clear smooth boundary.

A5—40 to 46 inches; black (N 2/) silty clay loam, gray (10YR 5/1) dry; weak fine prismatic structure parting to weak fine subangular blocky; friable; common medium prominent olive brown (2.5Y 4/4) Fe concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.

BCg—46 to 54 inches; gray (5Y 5/1), very dark gray (5Y 3/1), and dark gray (2.5Y 4/1) silty clay loam; weak fine prismatic structure; friable; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg—54 to 63 inches; gray (5Y 5/1) silty clay loam; massive; friable; common soft lime accumulations; many medium prominent dark yellowish brown (10YR 4/4) Fe concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to more than 60 inches

Ap and A horizons:

Hue—10YR, 2.5Y, 5Y, or N
Value—2 or 3
Chroma—0 to 2
Texture—mucky silt loam, mucky silty clay loam, or silty clay loam; silty clay loam, clay loam, or silty clay below a depth of 20 inches
Reaction—slightly alkaline or moderately alkaline

Bg horizon (if it occurs):

Hue—10YR, 2.5Y, 5Y, or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, clay loam, or silty clay
Reaction—slightly alkaline or moderately alkaline

BCg horizon:

Hue—2.5Y, 5Y, or N
Value—2 to 5
Chroma—0 or 1
Texture—silty clay loam, clay loam, or silty clay
Reaction—slightly alkaline or moderately alkaline

Cg horizon:

Hue—2.5Y, 5Y, or 5G
Value—3 to 6
Chroma—1 or 2
Texture—silty clay loam; thin strata of loam, silt loam, or clay loam in some pedons
Reaction—slightly alkaline or moderately alkaline

Letri Series

Typical Pedon

Letri silty clay loam, 0 to 2 percent slopes, in a cultivated field on an upland in Dickinson County, Iowa; about 2,500 feet south and 80 feet east of the northwest corner of sec. 25, T. 98 N., R. 38 W.; USGS Lake Park SE (IA) topographic quadrangle; lat. 43 degrees 16 minutes 39 seconds N. and long. 95 degrees 17 minutes 20 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A1—7 to 13 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A2—13 to 21 inches; very dark gray (2.5Y 3/1) clay loam, dark gray (2.5Y 4/1) dry; moderate fine and medium subangular blocky structure; friable; neutral; gradual smooth boundary.

Bg—21 to 29 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

2Bkg—29 to 41 inches; grayish brown (2.5Y 5/2) clay loam; moderate medium subangular blocky structure; firm; common fine distinct light gray (10YR 7/2) masses of calcium carbonate; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 1 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C1—41 to 59 inches; grayish brown (2.5Y 5/3) clay loam; massive; firm; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C2—59 to 80 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to carbonates: 16 to 30 inches

A horizon:
- Hue—10YR, 2.5Y, 5Y, or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—clay loam or silty clay loam
- Reaction—slightly acid to slightly alkaline

Bg or 2Bkg horizon:
- Hue—2.5Y or 5Y
- Value—4 or 5
- Chroma—1 or 2
- Texture—clay loam or silty clay loam
- Reaction—neutral to moderately alkaline

2C horizon:
- Hue—10YR or 2.5Y

Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Lowlein Series

Typical Pedon

Lowlein sandy loam, on a slope of 2 percent in a cultivated field on a till plain in Kandiyohi County, Minnesota; about 1,920 feet east and 760 feet south of the northwest corner of sec. 8, T. 118 N., R. 34 W.; USGS Little Kandiyohi Lake (MN) topographic quadrangle; lat. 45 degrees 03 minutes 03 seconds N. and long. 94 degrees 58 minutes 29 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common roots; about 1 percent rock fragments; slightly acid; abrupt smooth boundary.
A—10 to 14 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few roots; about 1 percent rock fragments; slightly acid; clear wavy boundary.
Bw1—14 to 24 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; about 2 percent rock fragments; slightly acid; clear wavy boundary.
2Bw2—24 to 31 inches; olive brown (2.5Y 4/4) loamy sand; weak fine subangular blocky structure; very friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions; about 2 percent rock fragments; neutral; abrupt wavy boundary.
3Cg—31 to 60 inches; olive gray (5Y 5/2) loam; massive; friable; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; about 3 percent rock fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: 20 to 40 inches
Depth to till or lacustrine sediments: 20 to 40 inches
Other features: Some pedons have a 3Bk horizon, which has colors and textures similar to those of the 3C horizon.

Ap and A horizons and AB horizon (if it occurs):
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—loam, sandy loam, fine sandy loam, coarse sandy loam, or silt loam
Content of rock fragments—1 to 10 percent
Reaction—slightly acid or neutral

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—sandy loam, coarse sandy loam, fine sandy loam, or loam
Content of rock fragments—1 to 10 percent
Reaction—slightly acid or neutral

2Bw horizon or 2Bg horizon (if it occurs):
Hue—7.5YR, 10YR, or 2.5Y
Value—4 to 6

Chroma—2 to 4
Texture—loamy sand, loamy fine sand, coarse sand, fine sand, or sand or the gravelly analogs of these textures
Content of rock fragments—2 to 35 percent
Reaction—slightly acid to slightly alkaline

3Cg horizon or 3C horizon (if it occurs):
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, clay loam, silt loam, or silty clay loam
Content of rock fragments—0 to 15 percent
Reaction—slightly alkaline or moderately alkaline

Lura Series

Typical Pedon

Lura silty clay, in a cultivated field in a depression on a lacustrine-mantled ground moraine in Blue Earth County, Minnesota; about 800 feet south and 360 feet west of the center of sec. 26, T. 105 N., R. 27 W.; USGS Delavan (MN) topographic quadrangle; lat. 43 degrees 52 minutes 02 seconds N. and long. 94 degrees 02 minutes 26 seconds W.; NAD 83:

Ap—0 to 10 inches; black (N 2/) silty clay, black (10YR 2/1) dry; moderate very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A1—10 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate very fine angular blocky structure; firm; neutral; clear smooth boundary.
A2—20 to 26 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; about 30 percent coarse inclusions of very dark gray (5Y 3/1); weak coarse prismatic structure parting to moderate very fine angular blocky; firm; few fine prominent olive (5Y 5/4) Fe concentrations; neutral; clear smooth boundary.
A3—26 to 46 inches; black (5Y 2/1) clay, very dark gray (5Y 3/1) dry; moderate very fine angular blocky structure; firm; neutral; clear smooth boundary.
A4—46 to 58 inches; very dark gray (5Y 3/1) silty clay, olive gray (5Y 4/2) dry; moderate very fine angular blocky structure; firm; neutral; clear smooth boundary.
Bg—58 to 72 inches; gray (5Y 5/1) silty clay; weak coarse subangular blocky structure; firm; many fine faint olive gray (5Y 5/2) Fe depletions and common fine distinct olive (5Y 5/4) Fe concentrations; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 66 inches
Depth to carbonates: 40 to 80 inches; as shallow as 20 inches in the firm substratum phase
Depth to till: More than 40 inches

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

Bg horizon:
Hue—5Y
Value—4 or 5
Chroma—1 or 2

Texture—silty clay, clay, clay loam, or silty clay loam
Reaction—slightly acid to slightly alkaline

Bkg and Cg horizons (if they occur):
Hue—2.5Y, 5Y, or BG
Value—5 or 6
Chroma—1 or 2
Texture—silty clay loam, silty clay, or clay
Reaction—slightly alkaline or moderately alkaline

Madelia Series

Typical Pedon

Madelia silty clay loam, 0 to 2 percent slopes, in a grass field on a ground moraine in Dickinson County, Iowa; about 530 feet east and 2,585 feet south of the northwest corner of sec. 13, T. 100 N., R. 37 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 28 minutes 52 seconds N. and long. 95 degrees 10 minutes 08 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
A—8 to 16 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
Bg1—16 to 32 inches; olive gray (5Y 4/2) silty clay loam; weak medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
Bg2—32 to 60 inches; olive gray (5Y 5/2) silty clay loam; massive; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; gradual smooth boundary.
2Cg—60 to 80 inches; light olive gray (5Y 6/2) loam; massive; friable; common medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to carbonates: 20 to 40 inches

A or Ap horizon:
Hue—10YR or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silt loam
Reaction—slightly acid or neutral

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam
Reaction—neutral or slightly alkaline

BC or C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4

Texture—silt loam, silty clay loam, or loam that has a high content of very fine sand
Reaction—slightly alkaline or moderately alkaline

2C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 4
Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

McCreath Series

Typical Pedon

McCreath silty clay loam, 0 to 2 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 30 feet north and 1,250 feet west of the southeast corner of sec. 18, T. 94 N., R. 38 W.; USGS Peterson (IA) topographic quadrangle; lat. 42 degrees 57 minutes 14 seconds N. and long. 95 degrees 15 minutes 17 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; common very fine and fine roots; neutral; clear smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium granular structure; friable; common very fine and fine roots; slightly acid; clear smooth boundary.

A2—13 to 17 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; common very fine and fine roots; common fine and medium dark grayish brown (10YR 4/2) wormcasts; slightly acid; clear wavy boundary.

AB—17 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and medium granular structure; friable; common very fine roots; few distinct very dark brown (10YR 2/2) organic coatings on faces of peds; slightly acid; gradual wavy boundary.

Bg—22 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay loam; weak fine subangular blocky structure; friable; common very fine roots; very few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common fine very dark brown (10YR 2/2) rounded iron-manganese nodules; neutral; gradual wavy boundary.

Bkg—33 to 47 inches; grayish brown (2.5Y 5/2) loam; weak medium subangular blocky structure; friable; common very fine roots; common fine very dark brown (10YR 2/2) rounded iron-manganese nodules; few fine and medium light gray (2.5Y 7/2) calcium carbonate nodules; common fine and medium prominent light olive brown (2.5Y 5/6) and common fine and medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; very slightly effervescent; slightly alkaline; gradual wavy boundary.

2C—47 to 80 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; few very fine roots; few fine and medium black (10YR 2/1) rounded iron-manganese concretions; common medium and coarse light gray (2.5Y 7/2) calcium carbonate nodules; about 4 percent gravel; many fine and medium distinct yellowish brown (10YR 5/6) redoximorphic concentrations; common fine distinct gray (10YR 6/1) redoximorphic depletions; slightly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 24 inches

Depth to carbonates: 24 to 50 inches
Depth to till: 40 to 60 inches

A horizon:
Hue—10YR 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—4 or 5
Chroma—2 or 3
Texture—silty clay loam
Reaction—slightly acid to slightly alkaline

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

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

Nicollet Series

Typical Pedon

Nicollet loam, 1 to 3 percent slopes, in a grass field on an upland in Dickinson County, Iowa; about 1,175 feet south and 226 feet west of the northeast corner of sec. 2, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 25 minutes 38 seconds N. and long. 95 degrees 03 minutes 11 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

A—10 to 16 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

Bg1—16 to 25 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium and fine subangular blocky structure; friable; common fine distinct very dark gray (10YR 3/1) organic stains on faces of peds; few fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 3 percent rock fragments; neutral; clear smooth boundary.

Bg2—25 to 32 inches; grayish brown (2.5Y 5/2) clay loam; weak medium subangular blocky structure; friable; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 4 percent rock fragments; neutral; clear smooth boundary.

BCkg—32 to 53 inches; grayish brown (2.5Y 5/2) loam; weak medium subangular blocky structure; friable; common distinct light gray (10YR 7/1) masses of calcium

carbonate; many medium prominent strong brown (7.5YR 4/6) and common medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

C1—53 to 71 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common prominent light gray (10YR 7/1) masses and threads of calcium carbonate; common medium distinct dark yellowish brown (10YR 4/6) redoximorphic concentrations; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 5 percent rock fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

C2—71 to 80 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few prominent light gray (10YR 7/1) masses of calcium carbonate; common medium distinct dark yellowish brown (10YR 4/6) redoximorphic concentrations; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 5 percent rock fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 48 inches
Thickness of the mollic epipedon: 10 to 20 inches

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

B horizon:
- Hue—10YR or 2.5Y
- Value—3 or 4 in the upper part; 4 or 5 in the lower part
- Chroma—2 to 4
- Texture—clay loam, loam, or silty clay loam
- Reaction—moderately acid to neutral in the upper part; slightly acid to slightly alkaline in the lower part

BC or C horizon:
- Hue—2.5Y or 5Y
- Value—5 or 6
- Chroma—2 to 4
- Texture—loam, sandy loam, or clay loam
- Reaction—slightly alkaline or moderately alkaline

Ocheyedan Series

Typical Pedon

Ocheyedan loam, 2 to 5 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 960 feet north and 710 feet east of the southwest corner of sec. 28, T. 97 N., R. 38 W.; USGS Everly (IA) topographic quadrangle; lat. 43 degrees 11 minutes 12 seconds N. and long. 95 degrees 20 minutes 43 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A—7 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; friable; few brown (10YR 4/3) earthworm casts; slightly acid; gradual smooth boundary.

Bw1—14 to 21 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few black (10YR 2/1) earthworm casts; neutral; gradual smooth boundary.
Bw2—21 to 26 inches; brown (10YR 4/3) sandy clay loam; weak fine subangular blocky structure; friable; few black (10YR 2/1) earthworm casts; neutral; gradual smooth boundary.
Bw3—26 to 34 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; many pores about 1/16 inch in diameter; neutral; gradual smooth boundary.
2BC—34 to 44 inches; mixed dark yellowish brown (10YR 4/4) and grayish brown (2.5Y 5/2) silt loam; weak medium subangular blocky structure; friable; common fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; slightly alkaline; gradual smooth boundary.
2Cg—44 to 65 inches; grayish brown (2.5Y 5/2) silt loam; massive; friable; common fine and medium very pale brown (10YR 8/2) masses of calcium carbonate; common medium prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; abrupt smooth boundary.
3C—65 to 80 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; massive; firm; common fine and medium very pale brown (10YR 8/2) masses of calcium carbonate; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 55 inches
Thickness of the mollic epipedon: 10 to 16 inches

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

Bw horizon:
Hue—10YR
Value—4
Chroma—3 or 4
Texture—loam, fine sandy loam, or sandy clay loam
Reaction—slightly acid or neutral

2BC and 2C horizons:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 6
Texture—sandy loam, silt loam, or sandy clay loam
Reaction—slightly alkaline or moderately alkaline

3C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Okabena Series

Typical Pedon

Okabena silty clay loam, 1 to 5 percent slopes, in a grass field on a till plain in Dickinson County, Iowa; about 1,680 feet west and 460 feet north of the southeast corner of sec. 2, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 24 minutes 58 seconds N. and long. 95 degrees 03 minutes 31 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

AB—10 to 20 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) organic stains on faces of peds; neutral; clear smooth boundary.

Bw—20 to 33 inches; light olive brown (2.5Y 5/3) silty clay loam; moderate medium subangular blocky structure; friable; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations and few medium faint grayish brown (2.5YR 5/2) redoximorphic depletions; about 1 percent rock fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

Bkg—33 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate medium subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; common fine distinct light gray (10YR 7/1) masses and threads of calcium carbonate; about 1 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg1—41 to 58 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; common fine distinct light gray (10YR 7/1) masses of carbonate; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2Cg2—58 to 80 inches; olive gray (5Y 5/2) clay loam; massive; friable; few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 20 to 40 inches
Depth to till: 40 to 60 inches

Ap or A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—silty clay loam, silt loam, or loam
- Content of rock fragments—0 to 3 percent
- Reaction—moderately acid to neutral

AB horizon or BA horizon (if it occurs):
- Hue—10YR
- Value—2 or 3
- Chroma—1 to 3
- Texture—silty clay loam, silt loam, or loam
- Content of rock fragments—0 to 3 percent
- Reaction—moderately acid to neutral

Bw horizon:
- Hue—10YR or 2.5Y

Value—3 to 5
Chroma—2 to 4
Texture—silty clay loam or silt loam
Content of rock fragments—0 to 3 percent
Reaction—moderately acid to neutral

Bkg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silty clay loam or silt loam
Content of rock fragments—0 to 3 percent
Reaction—slightly alkaline or moderately alkaline

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silty clay loam or silt loam
Content of rock fragments—0 to 3 percent
Reaction—slightly alkaline or moderately alkaline

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—2 to 8 percent
Reaction—slightly alkaline or moderately alkaline

Okoboji Series

Typical Pedon

Okoboji silty clay loam, 0 to 1 percent slopes, in a depression in a grass field in Dickinson County, Iowa; about 2,830 feet north and 512 feet west of the southeast corner of sec. 2, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 25 minutes 21 seconds N. and long. 95 degrees 03 minutes 14 seconds W.; NAD 83:

Ap—0 to 10 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
A1—10 to 21 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; neutral; clear smooth boundary.
A2—21 to 34 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
Bg—34 to 46 inches; olive gray (5Y 4/2) silty clay loam; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
BCg—46 to 72 inches; olive gray (5Y 5/2) silty clay loam; weak fine subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.
Cg—72 to 80 inches; olive gray (5Y 5/2) silty clay loam; massive; friable; common medium prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Depth to carbonates: 20 to 60 inches

Ap and A horizons:
- Hue—10YR to 5Y or N
- Value—2
- Chroma—0 or 1
- Texture—silty clay loam, mucky silty clay loam, silty clay, silt loam, or mucky silt loam
- Reaction—slightly acid to slightly alkaline

Bg horizon:
- Hue—2.5Y, 5Y, or N
- Value—3 to 6
- Chroma—0 to 2
- Texture—silty clay loam or silty clay
- Reaction—neutral or slightly alkaline

BCg horizon:
- Hue—2.5Y, 5Y, or N
- Value—4 to 6
- Chroma—0 to 2
- Texture—silty clay loam
- Reaction—slightly alkaline or moderately alkaline

Cg horizon:
- Hue—2.5Y, 5Y, or N
- Value—4 to 6
- Chroma—0 to 2
- Texture—silty clay loam or silt loam; stratified silt loam, very fine sandy loam, or clay loam in the lower part in some pedons
- Reaction—slightly alkaline or moderately alkaline

2Cg horizon (if it occurs) (below a depth of 60 inches):
- Hue—2.5Y, 5Y, or N
- Value—4 to 6
- Chroma—0 to 2
- Texture—loam, clay loam, or sandy loam
- Content of rock fragments—1 to 8 percent
- Reaction—slightly alkaline or moderately alkaline

Omsrud Series

Typical Pedon

Omsrud loam, in an area of Belview-Omsrud complex, 18 to 40 percent slopes, on a side slope in a grass field in Dickinson County, Iowa; about 730 feet west and 855 feet north of the southeast corner of sec. 13, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 23 minutes 17 seconds N. and long. 95 degrees 02 minutes 07 seconds W.; NAD 83:

A—0 to 16 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

Bw—16 to 25 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

Bk—25 to 40 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few distinct light gray (10YR 7/1) masses of carbonate; about 2 percent rock fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

C—40 to 80 inches; yellowish brown (10YR 5/4) loam; massive; friable; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 18 to 50 inches

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

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

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—loam, sandy loam, or clay loam
Reaction—slightly alkaline or moderately alkaline

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

Taxadjunct features: The moderately eroded Omsrud soils in this survey area do not have a mollic epipedon. These soils are classified as fine-loamy, mixed, superactive, mesic Typic Eutrudepts.

Pilot Grove Series

Typical Pedon

Pilot Grove sandy loam, 5 to 9 percent slopes, in a cultivated field on an upland in Faribault County, Minnesota; about 2,315 feet south and 1,280 feet east of the northwest corner of sec. 25, T. 101 N., R. 28 W.; USGS Pilot Grove (MN) topographic quadrangle; lat. 43 degrees 31 minutes 28 seconds N. and long. 94 degrees 08 minutes 33 seconds W.; NAD 83:

Ap—0 to 9 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common very fine roots; about 8 percent gravel; slightly acid; abrupt smooth boundary.

Bw—9 to 17 inches; brown (10YR 4/3) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; common dark brown (10YR 3/3) streaks on faces of peds; very friable; common very fine roots; about 7 percent gravel; slightly acid; clear wavy boundary.
2BC—17 to 21 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; loose; about 5 percent gravel; neutral; gradual wavy boundary.
2C1—21 to 36 inches; brown (10YR 5/3) sand; single grain; loose; few fine distinct yellowish brown (10YR 5/8) iron concentrations; about 8 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.
2C2—36 to 58 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 15 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.
3C3—58 to 80 inches; yellowish brown (10YR 5/4) loam; massive with some horizontal planes; friable; few fine prominent strong brown (7.5YR 5/8) iron concentrations; common fine dark yellowish brown (10YR 3/4) manganese concentrations; few masses of calcium carbonate; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 40 inches
Thickness of the mollic epipedon: 7 to 20 inches
Depth to glacial till: 40 to 60 inches

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

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam, coarse sandy loam, or loam
Reaction—moderately acid to neutral

2BC horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 or 4
Texture—loamy coarse sand, coarse sand, or loamy sand or the gravelly analogs of these textures
Reaction—slightly acid to slightly alkaline

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—3 to 6
Texture—coarse sand, sand, gravelly coarse sand, or gravelly sand
Reaction—slightly alkaline or moderately alkaline

3C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4

Texture—loam, sandy loam, or clay loam or stratified silt loam, silty clay loam, or very fine sandy loam
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The moderately eroded Pilot Grove soils in this survey area do not have a mollic epipedon. These soils are classified as sandy, mixed, mesic Typic Eutrudepts.

Ransom Series

Typical Pedon

Ransom silty clay loam, 0 to 2 percent slopes, in a cultivated field on an upland in Dickinson County, Iowa; about 2,415 feet east and 55 feet south of the northwest corner of sec. 20, T. 98 N., R. 37 W.; USGS Milford (IA) topographic quadrangle; lat. 43 degrees 17 minutes 56 seconds N. and long. 95 degrees 14 minutes 25 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
A—8 to 15 inches; black (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Bw1—15 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; gradual smooth boundary.
Bw2—24 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; slightly alkaline; clear smooth boundary.
2BC—32 to 48 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine prismatic structure; firm; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 2 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2C1—48 to 68 inches; dark grayish brown (2.5Y 4/4) clay loam; massive; firm; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2C2—68 to 80 inches; dark grayish brown (2.5Y 5/4) clay loam; massive; firm; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 22 inches
Depth to carbonates: 22 to 40 inches
Depth to till: 24 to 40 inches

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

BA and Bw horizons:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—2 to 4
Texture—silty clay loam or silt loam
Reaction—slightly acid to slightly alkaline

2BC and C horizons:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 5
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Ridgeport Series

Typical Pedon

Ridgeport fine sandy loam, on a slope of 1 percent in a bromegrass-alfalfa meadow on a stream terrace in Palo Alto County, Iowa; about 2,600 feet north and 900 feet east of the southwest corner of sec. 3, T. 97 N., R. 33 W.; USGS Ingham Lake (IA) topographic quadrangle; lat. 43 degrees 14 minutes 57 seconds N. and long. 94 degrees 44 minutes 07 seconds W.; NAD 83:

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam; weak fine granular structure; very friable; many fine roots; black (10YR 2/1) coatings on faces of peds; neutral; gradual smooth boundary.

A—7 to 13 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) fine sandy loam; weak fine granular structure; very friable; many fine roots decreasing with depth to common fine roots; black (10YR 2/1) and very dark brown (10YR 2/2) coatings on faces of peds; neutral; gradual smooth boundary.

BA—13 to 19 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak fine subangular blocky structure parting to weak fine granular; very friable; common fine roots; very dark brown (10YR 2/2) coatings on faces of peds; common medium distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; neutral; gradual smooth boundary.

Bw1—19 to 24 inches; brown (10YR 4/3) sandy loam; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; common fine roots; few very dark grayish brown (10YR 3/2) coatings in old root channels; dark brown (10YR 3/3) coatings on faces of peds; neutral; gradual smooth boundary.

Bw2—24 to 36 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; common fine roots; dark brown (10YR 3/3) coatings on faces of peds; neutral; gradual smooth boundary.

2BC—36 to 39 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; weak medium subangular blocky structure parting to single grain; very friable; dark brown (10YR 3/3) coatings on faces of peds; neutral; clear wavy boundary.

2C—39 to 60 inches; brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) sand and gravel; single grain; loose; few cobbles 2 to 5 centimeters in diameter; slightly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: 20 to 48 inches
Depth to sandy and gravelly sediments: 20 to 40 inches

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam, sandy loam, or fine sandy loam
Content of rock fragments—0 percent
Reaction—moderately acid to neutral

BA horizon (if it occurs):
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—2 to 4
Texture—sandy loam or fine sandy loam
Content of rock fragments—0 to 15 percent
Reaction—moderately acid to neutral

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4
Texture—sandy loam or fine sandy loam
Content of rock fragments—0 to 15 percent
Reaction—moderately acid to neutral

2BC horizon (if it occurs):
Hue—7.5YR or 10YR
Value—4 or 5
Chroma—4 to 6
Texture—loamy sand, gravelly loamy sand, or gravelly sandy loam
Content of rock fragments—5 to 35 percent
Reaction—neutral to moderately alkaline

2C horizon:
Hue—7.5YR or 10YR
Value—4 or 5
Chroma—3 to 6
Texture—sand, gravelly sand, or gravelly loamy sand
Content of rock fragments—5 to 35 percent
Reaction—slightly alkaline or moderately alkaline

Ridgeton Series

Typical Pedon

Ridgeton loam, on a slope of 7 percent in a cultivated field on a footslope in Nicollet County, Minnesota; about 200 feet north and 1,550 feet east of the southwest corner of sec. 36, T. 109 N., R. 28 W.; USGS Judson (MN) topographic quadrangle; lat. 44 degrees 11 minutes 46 seconds N. and long. 94 degrees 08 minutes 39 seconds W.; NAD 83:

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—10 to 23 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; a few peds of very dark brown (10YR 2/2); weak very fine and fine subangular blocky structure; friable; many fine and very fine roots; about 2 percent gravel; neutral; gradual wavy boundary.

A2—23 to 29 inches; very dark gray (10YR 3/1) clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; many fine and very fine roots; about 3 percent gravel; neutral; gradual wavy boundary.
AB—29 to 38 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common fine and very fine roots; about 3 percent gravel; neutral; gradual smooth boundary.
Bw—38 to 50 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; common fine and very fine roots; about 4 percent gravel; neutral; gradual wavy boundary.
C—50 to 80 inches; dark yellowish brown (10YR 4/4) loam; massive; friable; few very fine roots; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: More than 24 inches
Depth to carbonates: More than 40 inches
Other features: Some pedons have till below a depth of 40 inches.

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

AB horizon (if it occurs):
Hue—10YR
Value—2 or 3
Chroma—2 or 3
Texture—loam or clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

Bw horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—3 or 4
Texture—loam, clay loam, or sandy loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

C horizon (if it occurs):
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—loam, clay loam, or sandy loam
Content of rock fragments—0 to 10 percent
Reaction—slightly acid to moderately alkaline

Roine Series

Typical Pedon

Roine fine sandy loam, on a slope of 2 percent in a cultivated field on an upland in Clay County, Iowa; about 2,440 feet north and 100 feet west of the southeast corner of sec. 14, T. 96 N., R. 38 W.; USGS Everly (IA) topographic quadrangle; lat. 43

degrees 08 minutes 01 second N. and long. 95 degrees 17 minutes 23 seconds W.; NAD 83:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common very fine to medium roots between peds; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine to medium roots between peds; moderately acid; clear smooth boundary.

Bw1—12 to 22 inches; brown (7.5YR 4/4) fine sandy loam; weak fine and medium subangular blocky structure; friable; common fine and medium roots between peds; slightly acid; gradual smooth boundary.

Bw2—22 to 38 inches; brown (7.5YR 4/4) loamy fine sand; weak fine and medium subangular blocky structure; very friable; common fine and medium roots between peds; slightly acid; gradual smooth boundary.

Bw3—38 to 48 inches; brown (7.5YR 4/4) and yellowish brown (10YR 5/4), stratified loamy fine sand and sandy loam; weak fine and medium subangular blocky structure; very friable; common fine and medium roots; few fine distinct strong brown (7.5YR 5/6) redoximorphic concentrations; common fine prominent grayish brown (10YR 5/2) redoximorphic depletions; neutral; gradual smooth boundary.

2Cg1—48 to 52 inches; grayish brown (10YR 5/2) loam; massive; friable; common fine roots; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; gradual smooth boundary.

2Cg2—52 to 59 inches; grayish brown (10YR 5/2) silt loam; massive; friable; common fine roots; many medium and coarse rounded yellowish red (5YR 5/6) masses of iron; few medium rounded very dark grayish brown (10YR 3/2) iron-manganese nodules; many fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; slightly effervescent; slightly alkaline; gradual smooth boundary.

3Cg3—59 to 76 inches; grayish brown (10YR 5/2) clay loam; massive; firm; common fine and medium rounded yellowish red (5YR 4/6) masses of iron; few fine rounded very pale brown (10YR 8/2) calcium carbonate nodules; about 3 percent gravel; many fine and medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; strongly effervescent; slightly alkaline; gradual smooth boundary.

3Cg4—76 to 80 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine and medium rounded strong brown (7.5YR 4/6) masses of iron; few medium very dark gray (10YR 3/1) iron-manganese nodules; about 3 percent gravel; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 16 inches
Depth to loamy sediments or glacial till: 40 to 60 inches

Ap and A horizons:
- Hue—10YR
- Value—2 or 3
- Chroma—1 to 3
- Texture—loam, fine sandy loam, or sandy loam
- Reaction—moderately acid to neutral

Bw horizon:
- Hue—7.5YR or 10YR
- Value—4 or 5

Chroma—4 to 6
Texture—fine sandy loam, sandy loam, or loamy fine sand
Reaction—moderately acid to neutral

2Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—silt loam or loam
Reaction—slightly alkaline or moderately alkaline

3Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

Rolfe Series

Typical Pedon

Rolfe silty clay loam, 0 to 1 percent slopes, in a depression in a grass field in Dickinson County, Iowa; about 39 feet south and 1,575 feet west of the northeast corner of sec. 13, T. 100 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 29 minutes 18 seconds N. and long. 95 degrees 02 minutes 18 seconds W.; NAD 83:

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
A—7 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
Eg—14 to 19 inches; dark gray (10YR 4/1) silt loam; moderate thin platy structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; slightly acid; clear smooth boundary.
Btg1—19 to 31 inches; dark gray (2.5Y 4/1) silty clay; moderate medium angular and subangular blocky structure; firm; few distinct very dark gray (2.5Y 3/1) clay films on faces of peds; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; gradual smooth boundary.
Btg2—31 to 50 inches; olive gray (5Y 4/2) silty clay; moderate medium angular and subangular blocky structure; firm; few distinct very dark gray (2.5Y 3/1) clay films on faces of peds; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
Btg3—50 to 59 inches; light olive gray (5Y 6/2) silty clay; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few prominent very dark gray (2.5Y 3/1) clay films on faces of peds; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
2Cg—59 to 80 inches; light olive gray (5Y 6/2) clay loam; massive; friable; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 3 percent rock fragments; slightly alkaline.

Range in Characteristics

Depth to carbonates: 42 to 80 inches
Thickness of the mollic epipedon: 10 to 24 inches

Ap or A horizon:
Hue—10YR

Value—2 or 3
Chroma—1 or 2
Texture—silt loam, loam, or silty clay loam
Reaction—strongly acid to neutral

E horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—1 or 2
Texture—silt loam or loam
Reaction—strongly acid to slightly acid

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—1 or 2
Texture—clay, silty clay, or clay loam
Reaction—moderately acid to neutral

2Btg horizon (if it occurs):
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam or clay loam
Reaction—slightly acid or neutral

2BCg or 2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam or clay loam
Reaction—neutral or slightly alkaline in the 2BCg horizon; slightly alkaline or moderately alkaline in the 2Cg horizon

Round Lake Series

Typical Pedon

Round Lake sandy loam, on a slope of 4 percent in a cultivated field on a glacial moraine in Nobles County, Minnesota; about 480 feet south and 1,500 feet east of the northwest corner of sec. 20, T. 104 N., R. 24 W.; USGS Wilmont (MN) topographic quadrangle; lat. 43 degrees 48 minutes 13 seconds N. and long. 95 degrees 47 minutes 12 seconds W.; NAD 83:

Ap—0 to 11 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; common very fine roots; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bw1—11 to 14 inches; dark yellowish brown (10YR 3/4) sandy loam; moderate or weak fine subangular blocky structure; few dark brown (10YR 3/3) streaks on faces of peds; friable; clay bridging between sand grains; common very fine roots; about 4 percent gravel; slightly acid; gradual wavy boundary.

2Bw2—14 to 26 inches; dark brown (7.5YR 3/4) loamy coarse sand; weak medium subangular blocky structure parting to single grain; very friable; clay bridging between sand grains; about 6 percent gravel; neutral; gradual wavy boundary.

2Bk—26 to 35 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; common carbonate coatings on areas of pebbles; few fine prominent

yellowish brown (10YR 5/8) iron concentrations; about 17 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C—35 to 48 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; few fine distinct strong brown (7.5YR 5/6) iron concentrations; about 12 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

3Cg—48 to 80 inches; grayish brown (2.5Y 5/2) silty clay loam with thin strata of silt; massive; common medium prominent strong brown (7.5YR 5/6 and 4/6) iron concentrations; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 12 to 40 inches
Depth to lacustrine deposits or glacial till: 40 to 60 inches

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

Bw horizon:
- Hue—7.5YR or 10YR
- Value—3 or 4
- Chroma—3 or 4
- Texture—sandy loam, coarse sandy loam, or loam
- Reaction—moderately acid to neutral

2Bw horizon (if it occurs):
- Hue—7.5YR or 10YR
- Value—3 or 4
- Chroma—2 to 4
- Texture—loamy coarse sand, coarse sand, loamy sand, or sand or the gravelly analogs of these textures
- Reaction—moderately acid to neutral

2Bk horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5
- Chroma—3 or 4
- Texture—loamy coarse sand, coarse sand, sand, or loamy sand or the gravelly analogs of these textures
- Reaction—slightly alkaline or moderately alkaline

2BC horizon (if it occurs):
- Hue—10YR or 2.5Y
- Value—3 to 5
- Chroma—3 or 4
- Texture—loamy coarse sand, coarse sand, sand, or loamy sand or the gravelly analogs of these textures
- Reaction—slightly acid to slightly alkaline

2C horizon:
- Hue—10YR or 2.5Y
- Value—4 to 7
- Chroma—3 to 6

Texture—coarse sand, sand, gravelly coarse sand, or gravelly sand
Reaction—slightly alkaline or moderately alkaline

3Cg or 3C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—silt loam, silty clay loam, loam, or clay loam
Reaction—slightly alkaline or moderately alkaline

Sac Series

Typical Pedon

Sac silty clay loam, 2 to 5 percent slopes, in a cultivated field on an upland in Clay County, Iowa; about 1,700 feet north and 400 feet west of the southeast corner of sec. 16, T. 95 N., R. 38 W.; USGS Royal (IA) topographic quadrangle; lat. 43 degrees 02 minutes 39 seconds N. and long. 95 degrees 19 minutes 46 seconds W.; NAD 83:

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common very fine and fine roots; common very fine and fine pores; slightly acid; clear smooth boundary.

A—6 to 12 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak medium granular structure; friable; common very fine and fine roots; common very fine and fine pores; slightly acid; gradual smooth boundary.

AB—12 to 16 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; weak fine subangular blocky structure parting to weak medium granular; friable; common very fine and fine roots; common very fine and fine pores; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; slightly acid; gradual smooth boundary.

Bw1—16 to 24 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; common very fine roots; common very fine and fine pores; very few distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; gradual smooth boundary.

Bw2—24 to 32 inches; brown (10YR 4/3) silty clay loam; weak fine and medium subangular blocky structure; friable; common very fine and fine pores; common fine and medium distinct dark yellowish brown (10YR 4/6) redoximorphic concentrations; neutral; abrupt wavy boundary.

2Bw3—32 to 38 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; common very fine and fine pores; few faint brown (10YR 4/3) coatings; common fine prominent grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rounded cobbles; strongly effervescent; slightly alkaline; abrupt wavy boundary.

2Bk1—38 to 46 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure; firm; common very fine and fine pores; common fine and medium very pale brown (10YR 8/2) carbonate masses; common fine distinct grayish brown (10YR 5/2) redoximorphic depletions; about 2 percent rounded mixed cobbles and about 2 percent angular shale pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bk2—46 to 55 inches; yellowish brown (10YR 5/6) clay loam; weak fine prismatic structure; firm; common very fine and fine pores; few prominent yellowish red (5YR 4/6) iron stains; common fine and medium very pale brown (10YR 8/2) carbonate masses; common fine distinct yellowish brown (10YR 5/8) redoximorphic concentrations; common fine prominent grayish brown (2.5Y 5/2) redoximorphic

depletions; about 2 percent rounded mixed cobbles and 3 percent rounded mixed pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2C1—55 to 70 inches; yellowish brown (10YR 5/6) clay loam; massive; firm; common very fine and fine pores; few fine and medium very pale brown (10YR 8/2) carbonate masses; common fine prominent grayish brown (2.5Y 5/2) redoximorphic depletions; about 2 percent rounded mixed cobbles, 2 percent rounded mixed gravel, and 3 percent angular shale fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C2—70 to 80 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; common very fine and fine pores; few fine and medium very pale brown (10YR 8/2) carbonate nodules; common fine and medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; many fine and medium prominent grayish brown (2.5Y 5/2) redoximorphic depletions; about 2 percent rounded mixed cobbles and 2 percent rounded mixed pebbles; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: 20 to 40 inches
Depth to till: 20 to 40 inches

Ap and A horizons:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—silty clay loam
- Reaction—moderately acid or slightly acid

AB or BA horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—2 or 3
- Texture—silty clay loam
- Reaction—moderately acid or slightly acid

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

2Bw horizon:
- Hue—10YR
- Value—4 or 5
- Chroma—3 or 4
- Texture—loam or clay loam
- Reaction—slightly acid to slightly alkaline

2Bk horizon:
- Hue—10YR
- Value—4 or 5
- Chroma—3 to 6
- Texture—clay loam or loam
- Reaction—slightly alkaline or moderately alkaline

2C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

Taxadjunct features: The moderately eroded Sac soils in this survey area do not have a mollic epipedon. These soils are classified as fine-silty, mixed, superactive, mesic Typic Eutrudepts.

Spicer Series

Typical Pedon

Spicer silty clay loam, 0 to 2 percent slopes, in a cultivated field on a glacial lake plain in Blue Earth County, Minnesota; about 860 feet west and 2,610 feet south of the northeast corner of sec. 25, T. 107 N., R. 28 W.; USGS Lake Crystal (MN) topographic quadrangle; lat. 44 degrees 02 minutes 37 seconds N. and long. 94 degrees 07 minutes 53 seconds W.; NAD 83:

Ap—0 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.
A—12 to 16 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; few channel fillings of black (10YR 2/1) and dark gray (10YR 4/1); strongly effervescent; slightly alkaline; gradual irregular boundary.
Bg1—16 to 24 inches; dark gray (5Y 4/1) silt loam; weak fine subangular blocky structure; friable; few olive gray (5Y 5/2) channel fillings; common fine faint dark grayish brown (2.5Y 4/2) Fe concentrations; strongly effervescent; slightly alkaline; clear wavy boundary.
Bg2—24 to 30 inches; olive gray (5Y 5/2) silt loam; weak fine subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/8) Fe concentrations; strongly effervescent; slightly alkaline; clear wavy boundary.
BCg—30 to 40 inches; olive gray (5Y 5/2) silt loam; weak very fine subangular blocky structure; friable; many fine prominent yellowish brown (10YR 5/8) Fe concentrations; strongly effervescent; slightly alkaline; abrupt wavy boundary.
Cg—40 to 60 inches; light olive gray (5Y 6/2) silt loam; weak thin to thick platelike varving; friable; common fine dark (oxides) stains and concretions; many coarse prominent yellowish brown (10YR 5/8) Fe concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Carbonates: In all horizons

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

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5

Chroma—1 or 2
Texture—silty clay loam or silt loam
Reaction—slightly alkaline or moderately alkaline

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silt loam or silty clay loam
Reaction—slightly alkaline or moderately alkaline

Spillville Series

Typical Pedon

Spillville loam, 0 to 2 percent slopes, occasionally flooded, in a grass field on a flood plain in Dickinson County, Iowa; about 2,280 feet west and 385 feet south of the northeast corner of sec. 17, T. 99 N., R. 37 W.; USGS Okoboji (IA) topographic quadrangle; lat. 43 degrees 23 minutes 59 seconds N. and long. 95 degrees 14 minutes 19 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 1 percent rock fragments; neutral; clear smooth boundary.
A1—8 to 35 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 1 percent rock fragments; neutral; clear smooth boundary.
A2—35 to 55 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.
C—55 to 80 inches; dark gray (2.5Y 4/1) loam; massive; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; about 3 percent rock fragments; neutral.

Range in Characteristics

Depth to carbonates: More than 40 inches
Thickness of the mollic epipedon: 40 to 60 inches

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

AC horizon (if it occurs):
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1 or 2
Texture—loam, silt loam, sandy clay loam, fine sandy loam, or sandy loam
Reaction—moderately acid to neutral

C horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—1 to 3

Texture—loam, sandy clay loam, loamy sand, fine sandy loam, or sandy loam
Reaction—moderately acid to neutral

Storden Series

Typical Pedon

Storden loam, in an area of Omsrud-Storden complex, 9 to 14 percent slopes, moderately eroded, in a bromegrass pasture on an upland side slope in Dickinson County, Iowa; about 2,390 feet south and 240 feet east of the northwest corner of sec. 26, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 21 minutes 53 seconds N. and long. 95 degrees 04 minutes 17 seconds W.; NAD 83:

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk1—7 to 19 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; common fine distinct light gray (10YR 7/2) threads of calcium carbonate; common fine distinct yellowish brown (10YR 5/6) and few fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 3 percent rock fragments; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—19 to 44 inches; light olive brown (2.5Y 5/4) loam; moderate fine and medium subangular blocky structure; friable; common fine distinct light gray (10YR 7/2) masses and threads of calcium carbonate; common fine and medium prominent strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) redoximorphic concentrations; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; about 5 percent rock fragments; violently effervescent; moderately alkaline; clear smooth boundary.

C—44 to 80 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine and medium prominent strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Ap or A horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 to 3
Texture—loam
Reaction—slightly alkaline or moderately alkaline

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—loam
Reaction—slightly alkaline or moderately alkaline

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 6
Texture—loam
Reaction—slightly alkaline or moderately alkaline

Talcot Series

Typical Pedon

Talcot clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field on an outwash plain in Clay County, Iowa; about 2,600 feet east and 1,350 feet north of the southwest corner of sec. 27, T. 96 N., R. 35 W.; USGS Silver Lake (IA) topographic quadrangle; lat. 43 degrees 06 minutes 05 seconds N. and long. 94 degrees 57 minutes 47 seconds W.; NAD 83:

Ap—0 to 7 inches; black (N 2/) clay loam, very dark gray (N 3/) dry; weak fine granular structure; friable; common fine and medium roots; strongly effervescent; slightly alkaline; clear smooth boundary.

A—7 to 21 inches; black (N 2/) clay loam, very dark gray (N 3/) dry; weak fine subangular blocky structure; friable; common fine and medium roots; violently effervescent; moderately alkaline; gradual wavy boundary.

AB—21 to 24 inches; very dark gray (5Y 3/1) and dark gray (5Y 4/1) clay loam, olive gray (5Y 5/2) dry; weak fine and medium subangular blocky structure; friable; common fine and medium roots; common black (10YR 2/1) iron-manganese nodules; common yellowish brown (10YR 5/8) iron concretions; common medium faint olive gray (5Y 4/2) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bg—24 to 36 inches; gray (5Y 5/1) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; common black (10YR 2/1) iron-manganese nodules; common yellowish brown (10YR 5/8) iron concretions; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Cg1—36 to 38 inches; dark gray (5Y 4/2) gravelly loamy sand; single grain; loose; common very fine and fine roots; about 15 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Cg2—38 to 62 inches; dark gray (5Y 4/2) gravelly sand; single grain; loose; many fine and medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations and iron concretions; about 25 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2Cg3—62 to 80 inches; olive gray (5Y 4/2) gravelly sand; single grain; loose; about 25 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to contrasting material: 24 to 40 inches

A horizon:
- Hue—10YR, 2.5Y, 5Y, or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—clay loam
- Reaction—slightly alkaline or moderately alkaline

Bg horizon:
- Hue—2.5Y or 5Y
- Value—4 or 5
- Chroma—1 or 2
- Texture—clay loam, silty clay loam, or loam
- Reaction—slightly alkaline or moderately alkaline

2Cg horizon:
- Hue—2.5Y or 5Y
- Value—2 to 6

Chroma—2 or 3
Texture—coarse sand, sand, or loamy sand or the gravelly analogs of these textures
Reaction—slightly alkaline or moderately alkaline

Terril Series

Typical Pedon

Terril loam, 2 to 5 percent slopes, in a grass field on a footslope in Dickinson County, Iowa; about 2,035 feet west and 2,020 feet north of the southeast corner of sec. 2, T. 99 N., R. 36 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 25 minutes 13 seconds N. and long. 95 degrees 03 minutes 36 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
A1—8 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A2—18 to 32 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A3—32 to 42 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
Bw—42 to 50 inches; brown (10YR 4/3) loam; moderate fine and medium subangular blocky structure; friable; common fine distinct very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; neutral; clear smooth boundary.
C1—50 to 70 inches; dark yellowish brown (10YR 4/4) loam; massive; friable; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; many medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; neutral; gradual smooth boundary.
C2—70 to 80 inches; yellowish brown (10YR 5/4) loam; massive; friable; common fine distinct strong brown (7.5YR 4/6) redoximorphic concentrations; many medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Depth to carbonates: More than 40 inches

Ap and A horizons:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam, silt loam, or clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

Bw or BC horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—3 or 4
Texture—loam, clay loam, or sandy loam

Content of rock fragments—0 to 5 percent
Reaction—slightly acid or neutral

C horizon (if it occurs):
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam, clay loam, or sandy clay loam
Content of rock fragments—0 to 5 percent
Reaction—slightly acid to moderately alkaline

Truman Series

Typical Pedon

Truman silt loam, on a slope of 5 percent in a cultivated field on a lacustrine-mantled ground moraine in Blue Earth County, Minnesota; about 2,300 feet south and 1,620 feet east of the northwest corner of sec. 4, T. 107 N., R. 27 W.; USGS Good Thunder (MN) topographic quadrangle; lat. 44 degrees 06 minutes 09 seconds N. and long. 94 degrees 05 minutes 01 second W.; NAD 83:

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.
AB—10 to 14 inches; dark brown (10YR 3/3) silt loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; very friable; few tongues of very dark brown (10YR 2/2); neutral; clear smooth boundary.
Bw1—14 to 20 inches; dark yellowish brown (10YR 3/4) silt loam; dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; very friable; many fine tubular pores; slightly acid; clear smooth boundary.
Bw2—20 to 30 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium prismatic structure parting to weak fine and very fine subangular blocky; very friable; many fine tubular pores; slightly acid; clear smooth boundary.
Bw3—30 to 36 inches; yellowish brown (10YR 5/4) silt loam; weak moderate prismatic structure; very friable; many fine tubular pores; neutral; clear smooth boundary.
BC1—36 to 42 inches; brownish yellow (10YR 6/6) silt loam; weak medium and thick platelike varves; very friable; few fine prominent light brownish gray (10YR 6/2) Fe depletions; strongly effervescent; slightly alkaline; clear smooth boundary.
BC2—42 to 60 inches; light yellowish brown (10YR 6/4) silt loam; weak medium and thick platelike varves; very friable; many fine distinct light brownish gray (10YR 6/2) Fe depletions and many fine prominent yellowish brown (10YR 5/8) Fe concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 18 inches
Depth to carbonates: 18 to 56 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

B horizon:
Hue—10YR

Value—3 to 5
Chroma—3 to 6
Texture—silt loam or silty clay loam
Reaction—slightly acid to moderately alkaline

BC or C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—4 to 6
Texture—silt loam or silty clay loam
Reaction—slightly alkaline or moderately alkaline

Wadena Series

Typical Pedon

Wadena loam, 0 to 2 percent slopes, in a cultivated field on an outwash plain in Dickinson County, Iowa; about 258 feet west and 472 feet south of the northeast corner of sec. 27, T. 98 N., R. 37 W.; USGS Milford (IA) topographic quadrangle; lat. 43 degrees 16 minutes 59 seconds N. and long. 95 degrees 11 minutes 27 seconds W.; NAD 83:

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A—8 to 15 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
Bw1—15 to 20 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; about 3 percent rock fragments; neutral; gradual smooth boundary.
Bw2—20 to 32 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; about 3 percent rock fragments; neutral; clear smooth boundary.
2C1—32 to 45 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grain; loose; about 25 percent rock fragments; neutral; gradual smooth boundary.
2C2—45 to 62 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 20 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2C3—62 to 80 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; about 20 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 12 to 24 inches
Depth to sand and gravel: 24 to 40 inches

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

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 6
Chroma—3 or 4

Texture—loam or clay loam in the upper part; coarse sandy loam, sandy loam, sandy clay loam, or loam in the lower part
Reaction—moderately acid to neutral

2C horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 4
Texture—coarse sand or sand or the gravelly or very gravelly analogs of these textures
Reaction—neutral to moderately alkaline in the upper part; slightly alkaline or moderately alkaline in the lower part

Waldorf Series

Typical Pedon

Waldorf silty clay loam, in a nearly level area in a cultivated field on a lake plain in Blue Earth County, Minnesota; about 300 feet east and 100 feet north of the southwest corner of sec. 27, T. 106 N., R. 29 W.; USGS Willow Creek (MN) topographic quadrangle; lat. 43 degrees 56 minutes 58 seconds N. and long. 94 degrees 18 minutes 29 seconds W.; NAD 83:

Ap—0 to 9 inches; black (N 2/) silty clay loam, very dark gray (N 3/) dry; moderate very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A—9 to 15 inches; black (N 2/) silty clay loam, very dark gray (N 3/) dry; moderate medium and coarse angular blocky structure; firm; neutral; clear smooth boundary.
AB—15 to 20 inches; black (5Y 2/1) silty clay loam; moderate very fine angular blocky structure; firm; few fine faint dark olive gray (5Y 3/2) Fe depletions; neutral; clear irregular boundary.
Bg1—20 to 28 inches; olive gray (5Y 4/2) silty clay loam; weak medium and coarse prismatic structure parting to moderate and strong very fine angular blocky; firm; very dark gray (5Y 3/1) faces of peds; few faint tongues of very dark gray (5Y 3/1); many fine faint dark olive gray (5Y 3/2) Fe depletions; neutral; clear smooth boundary.
Bg2—28 to 35 inches; olive gray (5Y 4/2) silty clay; weak and moderate very fine angular blocky structure; firm; faint dark gray (5Y 4/1) faces of peds; many fine faint olive (5Y 4/3 and 5/3) Fe concentrations; neutral; clear smooth boundary.
Bg3—35 to 45 inches; olive gray (5Y 5/2) silty clay; weak very fine angular blocky structure; friable; faint gray (5Y 5/1) faces of peds; common fine faint olive (5Y 5/3) Fe concentrations; neutral; clear smooth boundary.
Bg4—45 to 53 inches; olive gray (5Y 5/2) silty clay loam; weak medium prismatic structure parting to weak fine angular blocky; few horizontal cleavage planes; many fine faint olive (5Y 5/3) and many fine prominent strong brown (7.5Y 5/6) Fe concentrations; friable; neutral; clear smooth boundary.
Cg1—53 to 62 inches; olive gray (5Y 5/2) silty clay loam; weak thick platy fragments; friable; many fine prominent strong brown (7.5Y 5/6) Fe concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.
Cg2—62 to 80 inches; olive gray (5Y 5/2) silty clay loam; weak thick platy fragments; friable; many fine faint olive (5Y 5/3) and many fine prominent strong brown (7.5YR 5/6) Fe concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 24 inches
Depth to carbonates: 26 to 55 inches

Ap, A, and AB horizons:
Hue—10YR, 2.5Y, 5Y, or N
Value—2 or 3
Chroma—0 or 1
Texture—silty clay or silty clay loam
Reaction—slightly acid or neutral

Bg or Bkg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay, silty clay loam, or clay
Reaction—neutral or slightly alkaline

BCg or Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—silty clay, silty clay loam, clay, or silt loam
Reaction—slightly alkaline or moderately alkaline

Webster Series

Typical Pedon

Webster silty clay loam, 0 to 2 percent slopes, in a pasture on an upland in Dickinson County, Iowa; about 970 feet south and 1,395 feet east of the northwest corner of sec. 30, T. 100 N., R. 35 W.; USGS Spirit Lake (IA) topographic quadrangle; lat. 43 degrees 27 minutes 25 seconds N. and long. 95 degrees 01 minute 38 seconds W.; NAD 83:

Ap—0 to 8 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

A—8 to 20 inches; black (N 2/) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 2 percent rock fragments; neutral; clear smooth boundary.

Bg1—20 to 29 inches; dark gray (2.5Y 4/1) clay loam; moderate medium subangular blocky structure; friable; about 3 percent rock fragments; neutral; gradual smooth boundary.

Bg2—29 to 39 inches; dark gray (5Y 4/1) clay loam; moderate medium subangular blocky structure; friable; about 3 percent rock fragments; neutral; gradual smooth boundary.

BCg—39 to 50 inches; olive gray (5Y 4/2) clay loam; moderate medium subangular blocky structure; friable; about 4 percent rock fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg1—50 to 68 inches; olive gray (5Y 5/2) loam; massive; friable; few prominent light gray (10YR 7/1) masses and threads of calcium carbonate; many medium prominent dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—68 to 80 inches; olive gray (5Y 5/2) loam; massive; friable; few prominent light gray (10YR 7/1) masses and threads of calcium carbonate; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Thickness of the mollic epipedon: 14 to 24 inches

Ap and A horizons:
- Hue—10YR, 2.5Y, or N
- Value—2 or 3
- Chroma—0 or 1
- Texture—clay loam, loam, or silty clay loam
- Reaction—slightly acid or neutral

Bg and BCg horizons:
- Hue—2.5Y or 5Y
- Value—4 or 5
- Chroma—1 or 2
- Texture—clay loam or loam
- Reaction—neutral in the Bg horizon; neutral to moderately alkaline in the BCg horizon

Cg horizon:
- Hue—2.5Y or 5Y
- Value—4 to 6
- Chroma—1 or 2
- Texture—clay loam, loam, fine sandy loam, or sandy loam
- Reaction—slightly alkaline or moderately alkaline

Wilmonton Series

Typical Pedon

Wilmonton silty clay loam, 0 to 2 percent slopes, in a cultivated field on an upland in Dickinson County, Iowa; about 1,290 feet south and 85 feet east of the northwest corner of sec. 25, T. 98 N., R. 38 W.; USGS Lake Park SE (IA) topographic quadrangle; lat. 43 degrees 16 minutes 51 seconds N. and long. 95 degrees 17 minutes 19 seconds W.; NAD 83:

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

2Bw—13 to 23 inches; dark grayish brown (10YR 4/2) clay loam; moderate fine subangular blocky structure; firm; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; neutral; gradual smooth boundary.

2Bk—23 to 34 inches; light olive brown (2.5Y 5/4) clay loam; moderate medium subangular blocky structure; firm; common fine distinct light gray (10YR 7/2) masses of calcium carbonate; common medium distinct yellowish brown (10YR 5/6) redoximorphic concentrations; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; strongly effervescent; moderately alkaline; gradual smooth boundary.

2BC—34 to 55 inches; light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) clay loam; moderate medium subangular blocky structure; firm; common medium prominent reddish brown (5YR 4/4) redoximorphic concentrations; about 1 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

2C1—55 to 66 inches; light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) clay loam; massive; firm; common medium prominent reddish brown (5YR 4/4) and strong brown (7.5YR 4/6) redoximorphic concentrations; about 5 percent rock fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.
2C2—66 to 80 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; common medium prominent reddish brown (5YR 4/4) and strong brown (7.5YR 4/6) redoximorphic concentrations; about 3 percent rock fragments; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 24 inches
Depth to carbonates: 20 to 40 inches

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

2Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay loam or loam
Reaction—slightly acid or neutral

2Bk horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam or clay loam
Reaction—slightly alkaline or moderately alkaline

2BC or 2C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam
Reaction—slightly alkaline or moderately alkaline

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; the relief, or topography; and the length of time that the forces of soil formation have acted on the soil material (Jenny, 1941). Human activities also affect soil formation.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of profile that forms and in extreme cases determines it almost entirely. Finally, time is needed for the transformation of parent material into a soil. Some time is always required for horizon differentiation. A long period generally is required for the development of distinct horizons.

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

Climate

The soils in Dickinson County formed under a variety of climatic conditions. The older soils of MLRA 107A, in the southwest corner of the county, began forming following loess deposition about 12,500 years ago when the climate began to warm and become less humid. This part of Dickinson County was never glaciated during the Cary Glacial Period.

The soils of MLRA 103, which make up most of the county, began forming following the last glacial period in Iowa. During the post-Cary glaciation period, 13,800 to 10,500 years ago, the climate was cool and the vegetation was dominantly conifers (Walker, 1966b). During the period between 10,500 and 8,000 years ago, a warming trend changed the vegetation from conifers to mixed hardwoods. Then, beginning about 8,000 years ago, the climate became much warmer and drier and herbaceous prairie vegetation became dominant. Finally, a change from a dry to a moister climate began about 3,000 years ago (McComb and Loomis, 1944). The soils in the county formed under the influence of this subhumid, midcontinental climate.

A nearly uniform climate presently prevails throughout the survey area. The general climate has had an important overall influence on the characteristics of the soils but has not created major differences among them. The influence of the general climate of the region, however, is modified by local conditions. For example, soils on south-facing slopes formed under a microclimate that is warmer and less humid than the average climate in nearby areas. The climate under which poorly drained or very poorly drained soils in low areas, such as bottom lands or depressions, have been forming is typically wetter and colder than in most of the surrounding areas.

Climate indirectly affects soil formation through the effects of temperature and other climatic factors by influencing plant and animal life in or on the soil. Fluctuations in temperature can increase or reduce the weathering of parent materials by water and air. When these parent materials weather, complex physical and chemical actions take place. Rainfall has an overwhelming effect on the rate of leaching in the soil and on the kinds of plants that grow on the soil.

Living Organisms

All living organisms, including vegetation, animals, bacteria, and fungi, are important factors of soil formation, and plants are especially significant (McComb and Riecken, 1961). Native grasses typically have an abundance of above-ground growth in addition to a myriad of fibrous roots that penetrate the soil to an average depth of 10 to 20 inches. As these plants grow, and, particularly, when they die, they add large amounts of nutrient-enriched organic material to the surface layer and subsoil. Trees absorb essential nutrients from deep within the subsoil and contribute very little organic material to the surface layer. Much of the organic material from dead trees actually remains on the soil surface in the form of fallen leaves, twigs, and branches.

Most of the soils in Dickinson County formed under prairie grasses or a mixture of prairie grasses and water-tolerant plants. Some soils formed strictly under vegetation consisting of water-tolerant plants. Clarion soils formed under prairie grasses. In areas that have not eroded, these soils typically have a dark surface layer that is 10 to 20 inches thick and have a content of organic matter of 3 to 5 percent. Webster soils formed under a mixture of prairie grasses and water-tolerant plants. Okoboji soils formed under water-tolerant plants. These soils typically have a black surface layer that is 20 to more than 30 inches thick and have a very high content of organic matter.

All living organisms, including vegetation, animals, bacteria, and fungi, affect soil formation. The vegetation dominantly determines the color of the surface layer, the content of organic matter, and the nutrients in the soil. Earthworms and other burrowing animals also assist in the development and maintenance of soil porosity. Bacteria and fungi decompose the vegetation and thereby release plant nutrients.

Topography

Relief indirectly influences soil formation through its effect on soil drainage, runoff, and erosion. In the steeper areas, more water runs off the surface and less infiltrates the soil. The higher runoff rate results in less leaching of carbonates and less movement of clay from the surface horizon into the subsoil. The susceptibility to erosion increases as the slope increases. Much of Dickinson County is nearly level to moderately sloping, but small areas, particularly along the major rivers and streams, are steep or very steep.

The aspect of the slope also affects soil formation, especially in the steeper areas. For example, south-facing slopes generally are warmer and drier than north-facing slopes. As a result, they typically support different kinds of vegetation.

The moderately steep to very steep Belview and Omsrud soils, the gently sloping to strongly sloping Clarion soils, and the nearly level and very gently sloping Nicollet soils, all of which formed in the same kind of parent material and under similar vegetation, differ because of differences in topographic position. Slope has a significant effect on the development of the A horizon and the solum. For instance, the A horizon and the solum are generally thicker and darker in a soil in the less sloping areas than they are in a soil in the steeper areas.

The nearly level and depressional soils in Dickinson County commonly have a gray or mottled subsoil resulting from poor aeration and restricted internal drainage.

Okoboji and Webster soils are examples. In the depressional Okoboji soils, water is periodically impounded on the surface, sometimes for weeks or longer. Rolfe soils also are examples of depressional soils that impound water and are very poorly drained. As the Rolfe soils formed, the impounded water percolated through the surface layer, removing clay-sized particles and redepositing them in the subsoil. This movement of clay accelerated the formation of the Rolfe soils. These soils typically have a distinctly silty, light-colored subsurface layer and a gray, clayey subsoil.

The microrelief of the nearly level Coland and Spillville soils on bottom land affects runoff, depth to the water table, and the rate at which new sediments are deposited. Coland soils are in low positions on the landscape, generally some distance from the main stream channel. They are poorly drained and impound water for short periods. Spillville soils are typically slightly higher on the landscape than the Coland soils, are generally closer to the stream channel, and are better drained.

Parent Material

The accumulation of parent material is the first step in the formation of a soil. Most soils formed in material that was transported from the site of the parent material and redeposited at a new location through the action of glacial ice, wind, water, or gravity. The most common kinds of parent material in Dickinson County are glacial drift, loess, eolian sands, alluvium, lacustrine sediments, and organic material.

Glacial drift is rock material transported and deposited by glacial ice, including the material sorted and unsorted by meltwater. It includes till, glacial sediments, and glacial outwash. Till consists of unsorted deposits in which particles range in size from boulders to clay. Glacial sediments are the loamy materials that have been sorted to some extent by water. The fact that these sediments are in potholes or in other low areas on the landscape indicates that some of the sorting and deposition occurred since the time of glaciation as well as during the ice age. Glacial outwash is the sandy and gravelly material sorted by glacial meltwater and deposited in valleys (generally on relatively flat outwash plains) or in other areas where water was concentrated.

The area that is now Dickinson County underwent at least three major episodes of glaciation. These include at least two early Pleistocene glacial stages (previously called the Nebraskan and Kansan but now referred to collectively as the Pre-Illinoian) and the younger Wisconsin glacial stage. The Pre-Illinoian till in Dickinson County is buried in all areas by drift of the Wisconsin glacial stage. Most of the soils in Dickinson County formed in till of the Cary Substage of the Wisconsin glacial period (Ruhe, 1969). This area is often referred to as the Cary Lobe or Des Moines Lobe. Radiocarbon dating indicates that this drift was deposited about 12,500 to 14,000 years ago. Most of the soils of the Cary Substage occur on ground moraines and end moraines. Clarion, Nicollet, and Storden soils formed in till of the Cary Substage. Canisteo, Harps, and Webster soils are in the lower areas on the landscape and formed in loamy sediments and till (Walker, 1966a). Okoboji soils formed in sediments derived from till that in some places eroded from nearby slopes. Estherville and Hawick soils formed in glacial outwash.

Loess is silty material deposited by the wind. Loess consists mainly of silt- and clay-sized particles and small amounts (generally less than 15 percent) of fine and very fine sand. The loess in Dickinson County typically ranges from 20 to 60 inches in thickness and commonly overlies Tazewell-age drift. According to recent geology studies (Prior, 1991), the Wisconsin loess in Iowa ranges in age from about 12,500 to 31,000 years. The loess was transported to the area following extensive erosion of the glacial surface, which filled river valleys with massive amounts of sediment. Although some of the loess is from local sources near the area, most of the material originated from the Missouri River and Big Sioux River valleys.

Eolian soils formed in sandy material deposited by the wind, typically by the prevailing northwest winds. The source of the sands is local in origin, and the deposits are commonly in the uplands, particularly along the Little Sioux River. Dickinson, Dickman, and Bolan soils formed in eolian sands.

Alluvium is sediment deposited by water along rivers and streams, in upland drainageways, in depressional areas, and on stream terraces. The texture of alluvium varies widely because of the differences in the material from which it was derived and the manner in which it was deposited. Coland and Spillville soils formed in alluvium on bottom land that was subject to flooding, typically within large watershed areas. Alluvium that has been transported only a short distance is referred to as local alluvium. Local alluvium retains many of the characteristics of the soils from which it was transported. Local alluvium transported and deposited by the forces of gravity, typically at the base or on footslopes of much steeper slopes, is often referred to as colluvium. Terril soils formed in local alluvium and/or colluvium, commonly downslope from soils that formed in till. Biscay, Cylinder, and Wadena soils formed in loamy alluvium underlain by sand and gravel on stream terraces. The material in which these latter soils formed was mainly deposited by the meltwater from the receding Cary glacial substage.

Lacustrine or glaciolacustrine sediment is typically fine textured, water-sorted material deposited by nearly still waters near the margin of the glacial ice rather than by rapidly moving meltwater. Lacustrine sediments originated as deposits in depressions and troughs on the Cary ice sheet. When the glacial ice melted, the sediments remained in closed depressions surrounded by till, or they stood out in relief as ridges. Lacustrine sediments are typically silty clay loam or silty clay and commonly range from 3 to 5 feet in thickness. Okabena and Waldorf soils are examples of soils that formed in this material.

Many unique areas of organic material, called fens, occur throughout Dickinson County. The Silver Lake Fen State Preserve is in the northwestern part of the county. This preserve is probably the most prominent and well known fen site in Dickinson County. These fens are the products of the seepage of ground water to the surface, typically on steep or very steep slopes. This seepage commonly originates from water-saturated gravel that is underlain by an impermeable layer, such as a denser till. These areas typically have hydrophytic flora and fauna that cannot exist in any other environment. As a result, fens support many plant species considered endangered or threatened in Iowa. Most of the original organic soils in the county, including many of the fen areas, have been artificially drained.

Time

The passage of time enables relief, climate, and plant and animal life to bring about changes in the parent material. If these factors are active for long periods, very similar kinds of soil can form in widely different kinds of parent material. Soil formation, however, is generally interrupted by geologic events that expose new parent materials.

Geologically, the soils of Dickinson County are young. The radiocarbon technique for determining the age of carbonaceous material found in organic deposits and in till has made it possible to determine the approximate age of the soil materials in Iowa. The Cary Substage of the Late Wisconsin glaciation has been determined to be about 13,000 years old. All of the soils that formed in Cary drift in Iowa are no more than 13,000 years old. In much of Iowa, including Dickinson County, geologic erosion has beveled and in places removed material from side slopes and deposited new sediments downslope (Walker, 1966b). Thus, the soils on these side slopes, such as Clarion and Storden soils, are less than 13,000 years old. Further dating and research indicate that these soils are less than 3,000 years old (Walker, 1966b). The sediments

that were washed from the side slopes accumulated downslope. These sediments would have been deposited on the depressional soils, such as Okoboji and Rolfe soils. Some of the alluvium that was deposited at the base of steep side slopes and on bottom land along major rivers and streams is less than 3,000 years old. Terril soils on footslopes and Coland and Spillville soils on bottom land represent some of the younger soils in Dickinson County.

References

Dankert, Wayne N. 1983. Soil survey of Dickinson County, Iowa. U.S. Department of Agriculture, Soil Conservation Service.

Fishel, Richard. 1996. The Oneota culture. Office of the State Archaeologist, University of Iowa. http://www.uiowa.edu/~osa/learn/prehistoric/oneota.htm. Accessed 23 February 2011.

Iowa Department of Transportation. 2009. 2009 transportation map for bicyclists. http://www.iowadotmaps.com/msp/pdf/multi.pdf. Accessed 23 February 2011.

Jenny, Hans. 1941. Factors of soil formation.

McComb, A.L., and W.E. Loomis. 1944. Sub-climax prairie. Torrey Botany Club Bulletin 71: 45-76.

McComb, A.L., and F.F. Riecken. 1961. Effect of vegetation on soils in the forest-prairie region. Recent Advances in Botany, pp. 1627-1631.

National Agricultural Statistics Service. 2009. Iowa county estimates. U.S. Department of Agriculture. http://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/County_Estimates/index. Accessed 23 February 2011.

National Water and Climate Center. 2011. Climate data sets. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.wcc.nrcs.usda.gov/ftpref/support/climate/. Accessed 23 February 2011.

Prior, Jean C. 1991. Landforms of Iowa. Iowa Department of Natural Resources, Iowa Geological Survey Bureau.

Ruhe, Robert V. 1969. Quaternary landscapes in Iowa.

Ruhe, R.V., and P.H. Walker. 1968. Hillslope models and soil formation: I, Open systems. Transactions of the 9th International Congress of Soil Science, Adelaide, Australia, volume 4, pp. 551-560.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

State Historical Society of Iowa. Abbie Gardner Sharp Cabin. [Online image] http://www.iowahistory.org/historic-sites/gardner-cabin/index.html. Accessed 23 February 2011.

Tiffany, Joseph A., and Duane C. Anderson. 1993. The Milford site: A postcontact Oneota village in northwest Iowa. Memoir 27. Plains Anthropologist 38(145): 283-306.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Commerce, Bureau of the Census. 2005. Nonemployer statistics, 2005 mining, Dickinson County, Iowa. http://www.census.gov/epcd/nonemployer/2005/ia/IA059_21.HTM. Accessed 23 February 2011.

United States Department of Commerce, Bureau of the Census. 2009. Dickinson County, Iowa. State and county quickfacts. http://quickfacts.census.gov/qfd/states/19/19059.html. Accessed 23 February 2011.

Walker, Patrick H. 1966a. Post-glacial environments in relation to landscape and soils on the Cary Drift, Iowa. Iowa State University Resource Bulletin 549: 838-875.

Walker, Patrick H. 1966b. Post-glacial erosion and environment changes in central Iowa. Soil and Water Conservation 21: 21-23.

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. 9). 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.

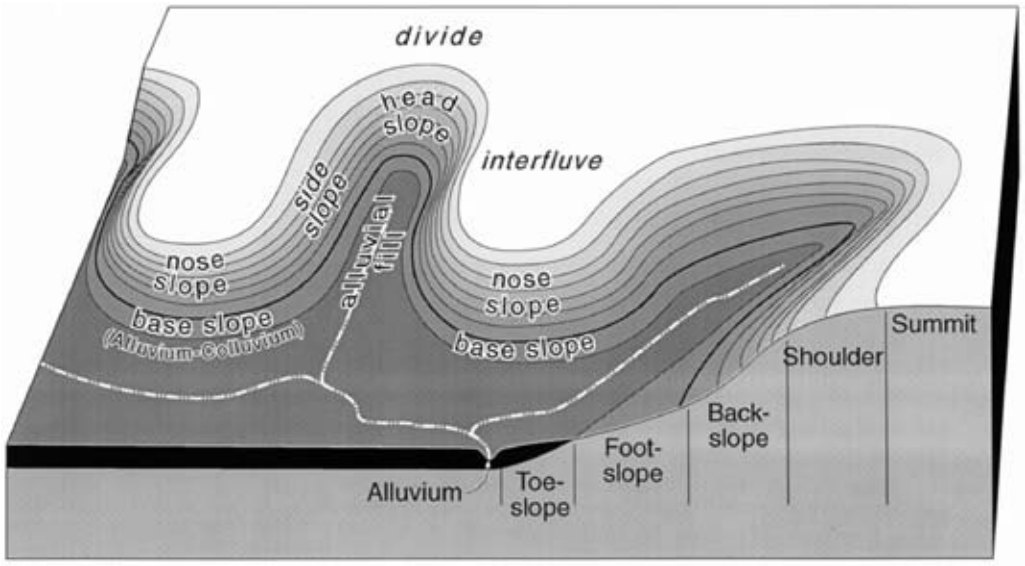

Figure 9.—Landscape relationship of geomorphic components and hillslope positions (modified after Ruhe and Walker, 1968).

Base slope (geomorphology). A geomorphic component of hills (fig. 9) 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.

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. 9); 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. 9). 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. 9). 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. 9).

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. 9); 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.

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. 9). 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. (See Saturated hydraulic conductivity.)

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). The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are very high, 100 or more micrometers per second (14.17 or more inches per hour); high, 10 to 100 micrometers per second (1.417 to 14.17 inches per hour); moderately high, 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour); moderately low, 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour); low, 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour); and very low, less than 0.01 micrometer per second (less than 0.001417 inch per hour). To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

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. All the soils of a given 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. 9). 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. 9). 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. In this survey, the slope classes are as follows:

Nearly level	0 to 2 percent
Gently sloping	2 to 5 percent
Moderately sloping	5 to 9 percent
Strongly sloping	9 to 14 percent
Steep	14 to 25 percent
Very steep	25 percent and higher

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. 9). 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. 9). 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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