



United States
Department of
Agriculture

In cooperation with
the Minnesota Agricultural
Experiment Station

Soil Survey of Meeker County, Minnesota



Natural
Resources
Conservation
Service

Part I



This page intentionally left blank.

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 associated soils called general soil map units. 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 map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** in Part I of this survey 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**. 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. Turn to the **Index to Map Units** in Part I of this survey, which lists the map units by symbol and name and shows the page where each map unit is described.

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

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

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Meeker County Soil and Water Conservation District. Partial funding was provided by the Legislative Commission on Minnesota Resources and by the Meeker County Board of Commissioners.

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.

The United States Department of Agriculture (USDA) prohibits discrimination in all of its programs on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact the USDA's TARGET Center at 202-720-2600 (voice or TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue SW, Washington, DC 20250-9410, or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Cover: This nearly level to gently undulating landscape is in an area of Cosmos, Kandiyohi, Lura, and Strout soils in the southern part of Meeker County.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is <http://www.nrcs.usda.gov> (click on "Technical Resources").

Contents

How to Use This Soil Survey	3
Index to Series	6
Index to Map Units	7
Foreword	11
How This Survey Was Made	13
General Nature of the Survey Area	14
Tables:	
Temperature and Precipitation	17
Freeze Dates in Spring and Fall	18
Growing Season	18
General Soil Map Units	19
1. Canisteo-Okoboji-Nicollet Association	19
2. Clarion-Hamel-Storden Association	19
3. Harps-Nicollet-Webster Association	20
4. Cokato-Storden-Muskego Association	20
5. Swedegrove-Grovecity-Lundlake Association	21
6. Wadenill-Swedegrove-Muskego Association	21
7. Koronis-Forestcity-Houghton Association	22
8. Koronis-Houghton-Forestcity Association	22
9. Cosmos-Kandiyohi-Corvuso Association	23
10. Cosmos-Strout-Kandiyohi Association	24
11. Danielson-Newlondon-Strout Association	25
12. Collinwood-Waldorf-Shorewood Association	25
13. Madelia-Truman-Kingston Association	25
14. Sparta-Darfur-Litchfield Association	26
15. Kanaranzi-Estherville-Biscay Association	27
16. Fieldon-Litchfield-Dassel Association	27
17. Hawick-Estherville Association	28
18. Cohoctah-Muskego-Estherville Association	29
Formation and Classification of the Soils	31
Tables:	
Classification of the Soils	40
Acreage and Proportionate Extent of the Soils	42
Soil Series and Detailed Soil Map Units	45
References	159
Glossary	161

Index to Series

Angus series	46	Klossner series	98
Arkton series	47	Koronis series	105
Barry series	48	Lester series	110
Biscay series	49	Le Sueur series	112
Blue Earth series	50	Litchfield series	113
Bold series	51	Lundlake series	115
Calco series	53	Lura series	116
Canisteo series	54	Madelia series	117
Chelsea series	57	Marcellon series	118
Clarion series	58	Mayer series	119
Cohoctah series	60	Medo series	121
Cokato series	61	Minneopa series	122
Collinwood series	63	Muskego series	124
Cordova series	65	Newlondon series	126
Corvuso series	66	Nicollet series	128
Cosmos series	69	Okoboji series	129
Crowriver series	70	Omsrud series	130
Cylinder series	72	Reedslake series	131
Danielson series	73	Rohrbeck series	133
Darfur series	74	Rolfe series	134
Dassel series	75	Seaforth series	135
Dickman series	76	Shorewood series	136
Estherville series	78	Sparta series	138
Fieldon series	79	Spicer series	140
Forestcity series	81	Storden series	141
Gardencity series	82	Strout series	143
Glencoe series	84	Sunburg series	144
Granby series	85	Swanlake series	146
Grovecity series	87	Swedegrove series	147
Hamel series	88	Truman series	148
Harps series	90	Uniongrove series	150
Havelock series	91	Wadena series	151
Hawick series	92	Wadenill series	152
Houghton series	94	Waldorf series	154
Kanaranzi series	95	Webster series	155
Kandiyohi series	96	Zook series	157
Kingston series	97		

Index to Map Units

8B—Sparta loamy sand, 1 to 6 percent slopes	139	211—Lura silty clay, depressional, 0 to 1 percent slopes	117
8C—Sparta loamy sand, 6 to 12 percent slopes	139	229—Waldorf silty clay loam, 0 to 2 percent slopes	155
8D—Sparta loamy sand, 12 to 25 percent slopes	139	239—Le Sueur clay loam, 1 to 3 percent slopes	113
35—Blue Earth mucky silt loam, 0 to 1 percent slopes	51	281—Darfur loam, 0 to 2 percent slopes	75
39A—Wadena loam, 0 to 2 percent slopes	152	286B—Shorewood silty clay loam, 3 to 6 percent slopes	137
41A—Estherville sandy loam, 0 to 2 percent slopes	79	311C2—Shorewood silty clay, 6 to 12 percent slopes, eroded	137
85—Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded	54	327A—Dickman sandy loam, 0 to 2 percent slopes	77
86—Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes	56	327B—Dickman sandy loam, 2 to 6 percent slopes	77
96B—Collinwood silty clay loam, 3 to 6 percent slopes	64	399—Biscay loam, depressional, 0 to 1 percent slopes	49
101B—Truman silt loam, 2 to 6 percent slopes	149	415—Kananranzi loam, 0 to 3 percent slopes	95
102B—Clarion loam, moderately fine substratum, 2 to 5 percent slopes	58	423—Seaforth loam, 1 to 3 percent slopes	136
106C2—Lester loam, 6 to 12 percent slopes, eroded	110	461B—Koronis loam, 2 to 6 percent slopes	106
112—Harps clay loam, 0 to 2 percent slopes	90	461C2—Koronis loam, 6 to 12 percent slopes, eroded	106
113—Webster clay loam, 0 to 2 percent slopes	156	511—Marcellon loam, 0 to 3 percent slopes	119
114—Glencoe clay loam, depressional, 0 to 1 percent slopes	85	523—Houghton muck, depressional, 0 to 1 percent slopes	94
129—Cylinder loam, 0 to 1 percent slopes	73	525—Muskego muck, depressional, 0 to 1 percent slopes	124
130—Nicollet clay loam, 1 to 3 percent slopes	129	539—Klossner muck, depressional, 0 to 1 percent slopes	99
134—Okoboji silty clay loam, depressional, 0 to 1 percent slopes	130	548—Medo muck, depressional, 0 to 1 percent slopes	121
136—Madelia silty clay loam, 0 to 2 percent slopes	118	610—Calco silty clay loam, 0 to 1 percent slopes, frequently flooded	54
140—Spicer silty clay loam, 0 to 2 percent slopes	141	611D—Hawick gravelly sandy loam, 12 to 25 percent slopes	93
143B—Chelsea loamy fine sand, 1 to 6 percent slopes	57	612B—Wadenill loam, 2 to 6 percent slopes	153
178—Granby fine sandy loam, 0 to 1 percent slopes	86	613—Grovecity loam, 1 to 3 percent slopes	88
181—Litchfield loamy fine sand, 0 to 2 percent slopes	114	664—Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded	157
183—Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes	76	740—Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes	89
197—Kingston silty clay loam, 1 to 3 percent slopes	98	804B—Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes	107
		804C2—Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded	107

804D2—Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded	108	1098—Biscay-Biscay, depressional, complex, 0 to 2 percent slopes	50
804E—Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes	109	1099—Granby loamy fine sand, very wet, 0 to 1 percent slopes	87
805C2—Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded	145	1100—Nicollet silty clay loam, 1 to 3 percent slopes	129
805D2—Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded	145	1101—Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes	156
807D2—Koronis-Sunburg complex, 12 to 18 percent slopes, eroded	109	1159B—Strout-Arkton complex, 2 to 6 percent slopes	144
875B—Estherville-Hawick complex, 2 to 6 percent slopes	79	1161—Barry loam, 0 to 2 percent slopes	48
875C—Hawick-Estherville complex, 6 to 12 percent slopes	93	1162A—Kandiyohi clay, 0 to 2 percent slopes	97
887B—Clarion-Swanlake complex, 2 to 6 percent slopes	59	1162B—Kandiyohi clay, 2 to 5 percent slopes	97
899—Harps-Okoboji, depressional, complex, 0 to 2 percent slopes	91	1163—Cohoctah loam, 0 to 2 percent slopes, frequently flooded	61
909C2—Bold-Truman complex, 6 to 12 percent slopes, eroded	52	1165—Lundlake silty clay loam, depressional, 0 to 1 percent slopes	115
909D2—Bold-Truman complex, 12 to 18 percent slopes, eroded	52	1168—Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes	147
920B—Clarion-Storden-Hawick complex, 2 to 6 percent slopes	59	1169—Corvuso-Lura, depressional, complex, 0 to 2 percent slopes	67
945D2—Lester-Storden complex, 12 to 18 percent slopes, eroded	111	1171C—Newlondon-Strout complex, 6 to 12 percent slopes, eroded	127
945E—Lester-Storden complex, 18 to 40 percent slopes	111	1171D—Newlondon-Strout complex, 12 to 18 percent slopes, eroded	127
956—Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes	56	1172C—Sparta-Gardencity complex, 6 to 12 percent slopes	140
960C2—Storden-Omsrud complex, 6 to 12 percent slopes, eroded	142	1173—Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded	125
960D2—Storden-Omsrud complex, 12 to 18 percent slopes, eroded	142	1174—Danielson clay loam, 1 to 3 percent slopes	74
978—Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes	66	1175—Swedegrove loam, 0 to 2 percent slopes ...	148
1015—Udipsamments (cut and fill land)	149	1176—Litchfield sandy loam, 0 to 2 percent slopes	114
1016—Udorthents, loamy (cut and fill land)	150	1177C—Gardencity-Bold complex, 6 to 12 percent slopes, eroded	83
1030—Pits, gravel-Udipsamments complex	131	1178—Uniongrove loam, 0 to 2 percent slopes	151
1080—Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes	100	1183—Crowriver loam, 0 to 2 percent slopes	71
1096—Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes	80	1184—Corvuso silty clay loam, 0 to 2 percent slopes	68
1097—Mayer-Biscay, depressional, complex, 0 to 2 percent slopes	120	1185—Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes	84
		1186—Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes	82

1192—Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes	71	1356—Water, miscellaneous	155
1193—Cosmos silty clay, 0 to 2 percent slopes	70	1362B—Angus loam, 2 to 5 percent slopes	47
1197—Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded	61	1383A—Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes	138
1198B—Rohrbeck-Koronis complex, 1 to 6 percent slopes	133	1384—Minneopa loam, 0 to 2 percent slopes	123
1199—Klossner and Lundlake soils, ponded	100	1385—Havelock loam, 0 to 2 percent slopes, frequently flooded	92
1203—Muskego, Blue Earth, and Houghton soils, ponded	125	1387A—Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes	65
1204B—Reedslake loam, 2 to 5 percent slopes	132	1391B—Wadenill-Sunburg complex, 2 to 6 percent slopes	153
1213C—Cokato-Storden complex, 6 to 12 percent slopes, eroded	62	1406—Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes	122
1220C—Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded	63	1801B—Gardencity very fine sandy loam, 2 to 6 percent slopes	84
		W—Water	155

This page intentionally left blank.

Foreword

This soil survey contains information that can be used in land-planning programs in Meeker County, Minnesota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it 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 survey 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 survey to help them understand, protect, and enhance the environment.

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

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

William Hunt
State Conservationist
Natural Resources Conservation Service

This page intentionally left blank.

Soil Survey of Meeker County, Minnesota

By Robert A. Lueth, Natural Resources Conservation Service

Fieldwork by Robert A. Lueth and Douglas E. Miller, Natural Resources Conservation Service, and Norman D. Kuhlman, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

How This Survey Was Made

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

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of soil-vegetation-landscape relationships, 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. They 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. Some interpretations are modified 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 a high 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 do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better 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

Meeker County is near the center of the southern half of Minnesota (fig. 1). It has a total land area of 457,100 acres. About 4,840 acres of this total is water. Litchfield, the largest community and the county seat, is near the center of the county. In 1992, the population of Meeker County was 21,030 and that of Litchfield was 6,082.

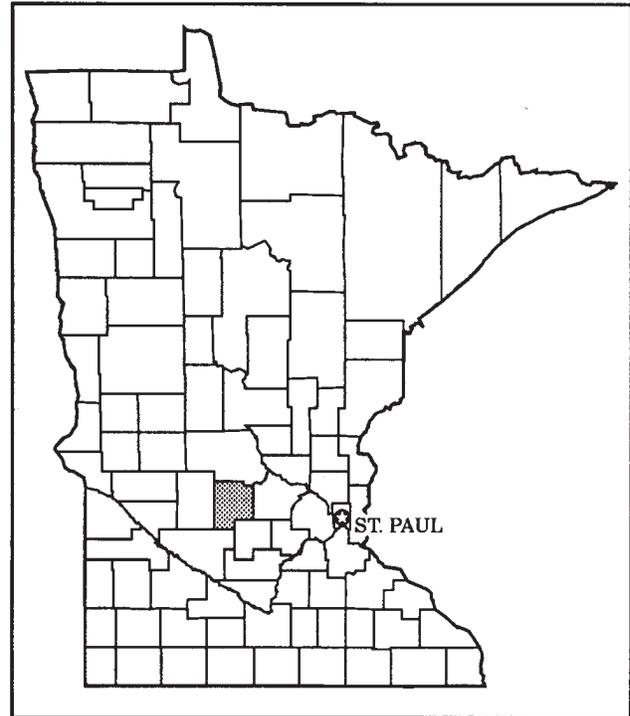


Figure 1.—Location of Meeker County in Minnesota.

History

The Lakota Indians inhabited the survey area when the first European settlers arrived. Meeker County was established in 1856, the same year settlement began. The county was named for B.B. Meeker of St. Anthony, one of the town's first settlers. At that time the western part of the county was part of a vast prairie characterized by tall prairie grasses as high as a man's shoulder (Lamson). The eastern half of the county formed part of the western boundary of the "Big Woods." The prairie and woodlands include numerous lakes and streams and marshes. The soils in the county, which formed in young glacial deposits, were for the most part highly productive. As a result, farming enterprises developed. About 75 percent of the area is cropland. The principal crops are corn and soybeans. Minor acreages of oats, hay, and specialty crops, such as peas, sweet corn, and sugar beets, are also grown. The major livestock produced in the county are hogs, dairy cattle, and poultry, particularly turkeys.

Soils of Meeker County

The soils in Meeker County are very deep and dark or moderately dark. Slopes are mostly gently sloping but range from nearly level to very steep. The soils formed in silty and clayey glacial lacustrine sediments; in loamy, silty, and clayey glacial till; and in glacial outwash with a thin mantle of loamy sediment. Native vegetation in the southwestern part of the county was tall prairie grasses, except in closed depressions. Except in closed depressions, the southeastern and northern parts of the county and areas bordering lakes and streams supported mixed northern hardwoods. Nearly all of the depressions in the county are lakes or marshes covered with reeds, sedges, and other wetland species.

Physiography, Drainage, and Geology

Metamorphic and igneous rocks, some of the earth's oldest rocks, form the lowermost geologic unit in Meeker County. The rocks are mainly granites, gneisses, and schists of Precambrian age.

In the northern part of the county, a thin layer of fine grained sedimentary rock lies above the igneous and metamorphic rocks. Cretaceous shale is the uppermost bedrock layer in most of the county, but this layer is absent in a diagonal belt making up most of Swede Grove and Manannah Townships in the northwestern part of the county (Sims, 1970).

The bedrock is covered to a depth between 200 and as much as 400 feet by glacial deposits. Meeker County lies in an area where several glaciers advanced and retreated during the great ice age. The ice age is referred to by geologists as the Pleistocene Epoch of the Quaternary period. The ice age began about 2 million years ago and ended about 10,000 years ago. As the ice melted, sediment carried on and in the ice was deposited as moraines, outwash plains, stream terraces, and lake plains. Unsorted sediments of loamy to clayey material containing cobbles and stones were deposited in moraines. In places, meltwater from the glaciers carried sediment beyond the borders of the moraines. The meltwater sorted the glacial sediment and deposited gravelly and sandy sediments on outwash plains and stream terraces. Mostly silty and clayey sediments were deposited in lakes. When they dried up, these lakes became lake plains.

The topography of the moraines is disordered and complex. It is characterized by knolls and hills of irregular shape and size intermingled with swales and numerous closed depressions. The moraines are in

the northern and southern parts of the county. Most of the lakes in the county are within moraines.

The central part of the county consists of glacial outwash plains and glacial lake plains of mostly silty and clayey sediment. Narrow discontinuous stream terraces or benches occur along the North Fork and Middle Fork of the Crow River and along the South Fork of the Crow River in the southeastern part of the county.

Relief ranges from 50 feet to about 100 feet on the moraines in the eastern part of the county, in a small area near Lake Koronis in the northwestern part of the county, and in a small area in the west-central part of the county. Relief in the other morainic areas ranges from 5 feet to less than 50 feet. The outwash plains, stream terraces, and lake plains have relief of generally less than 20 feet. The highest elevation in the county is about 1,250 feet. This elevation occurs in the northeastern and northwestern parts of the county. The lowest elevation is about 1,000 feet at the point where the North Fork of the Crow River leaves the county.

Meeker County is predominantly drained by the North and South Forks of the Crow River. A small area in the northeastern part of the county is drained by the Clearwater River system.

The North Fork of the Crow River enters the county from Lake Koronis in the northwestern part of the county and winds its way southeastward through the northern part of the county. About a mile east of the village of Lundlake, it is joined by the Middle Fork, which enters the county from Kandiyohi County. Near Manannah the North Fork also receives a tributary that is the outlet of Acton and Hope Lakes in the west-central part of the county. Other main tributaries to the North Fork are Jewitt Creek, which is the outlet of Lake Ripley and joins the North Fork about 2½ miles west of the village of Forest City, and Eagle Creek, which is the outlet of Lake Francis, Lake Washington, and Lake Stella in the southeastern part of the county and the outlet of Swan, Collinwood, and other lakes. These tributaries enter the North Fork near the Wright County line a few miles east of Kingston.

The South Fork of the Crow River flows through the southern part of the county. Its largest tributary is the outlet of Cedar, Willie, and Harding Lakes (Lindholm and others, 1974).

Climate

Meeker County is cold in winter and quite hot in summer. Occasional cool spells occur in summer. Precipitation frequently occurs as snowstorms during

the winter and as showers, which are often heavy, during the warmer months, when warm, moist air moves in from the south. The total annual rainfall is normally adequate for corn, soybeans, and small grain.

The three tables at the end of this section provide climate information for the survey area as recorded at Litchfield in the period 1961 to 1990.

In winter, the average temperature is 15 degrees F and the average daily minimum temperature is 5 degrees. The lowest temperature on record, which occurred at Litchfield on January 9, 1977, is -37 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest temperature, which occurred at Litchfield on August 1, 1988, is 104 degrees.

Growing degree days 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 27.55 inches. Of this, 20.47 inches, or about 74 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall on record was 6.08 inches at Litchfield on June 17, 1957. Thunderstorms occur on about 35 days each year, and most occur in June.

The average seasonal snowfall is 39.7 inches. The greatest snow depth at any one time during the period of record was 36 inches. On an average, 14 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 18 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 69 percent of the time possible in summer and 51 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 10 miles per hour, in April.

Temperature and Precipitation
(Recorded in the period 1961-90 at Litchfield, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	21.0	0.9	10.9	47	-30	0	0.72	0.24	1.17	2	8.3
February---	27.2	6.6	16.9	51	-26	1	.76	.22	1.23	2	6.9
March-----	39.6	20.4	30.0	69	-14	37	1.56	.79	2.23	3	9.0
April-----	57.5	34.5	46.0	85	13	226	2.41	1.14	3.51	5	1.4
May-----	71.4	46.4	58.9	92	26	585	3.24	1.96	4.39	6	.0
June-----	80.3	56.1	68.2	96	38	845	4.70	2.49	6.65	7	.0
July-----	84.6	61.3	73.0	98	46	982	3.83	1.92	5.49	6	.0
August-----	81.7	58.4	70.1	96	41	923	3.31	1.67	4.74	5	.0
September--	72.3	48.5	60.4	92	27	611	2.98	1.56	4.22	5	.0
October----	60.4	37.7	49.1	84	17	295	1.99	.61	3.24	3	.1
November---	40.7	23.4	32.1	66	-6	41	1.27	.40	2.05	3	6.3
December---	25.1	7.8	16.5	49	-23	1	.78	.28	1.19	2	7.6
Yearly:											
Average---	55.2	33.5	44.3	---	---	---	---	---	---	---	---
Extreme---	104	-37	---	99	-31	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,548	27.55	21.57	32.91	49	39.7

* 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).

Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Litchfield, Minnesota)

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. 23	May 8	May 18
2 years in 10 later than--	Apr. 19	May 3	May 13
5 years in 10 later than--	Apr. 10	Apr. 23	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 2	Sept. 20	Sept. 14
2 years in 10 earlier than--	Oct. 7	Sept. 26	Sept. 19
5 years in 10 earlier than--	Oct. 18	Oct. 8	Sept. 29

Growing Season

(Recorded in the period 1961-90 at Litchfield, Minnesota)

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	162	140	125
8 years in 10	170	149	133
5 years in 10	184	165	146
2 years in 10	198	180	160
1 year in 10	205	189	168

General Soil Map Units

The general soil map in this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit 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 unit 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general soil map units in this survey have been grouped for broad interpretive purposes. The broad groups and the map units in each group are described on the following pages.

Organic Soils and Nearly Level to Moderately Steep, Loamy Soils That Formed in Till; on Moraines

1. Canisteo-Okoboji-Nicollet Association

Setting

Landform: Moraines

Position on the landform: Nearly level areas and rims of depressions, depressions, and low summits and backslopes

Slope range: 0 to 3 percent

Composition

Percent of survey area: 3

Extent of components in the association:
Canisteo and similar soils—32 percent

Okoboji and similar soils—23 percent
Nicollet and similar soils—11 percent
Soils of minor extent—34 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam

Okoboji

Drainage class: Very poorly drained

Parent material: Lacustrine deposits over till

Surface texture: Silty clay loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam

Minor Soils

- Clarion and similar soils
- Storden and similar soils
- Swanlake and similar soils
- Muskego and similar soils

2. Clarion-Hamel-Storden Association

Setting

Landform: Moraines

Position on the landform: Backslopes and summits of low hills, footslopes and narrow drainageways, and shoulders

Slope range: 0 to 12 percent

Composition

Percent of survey area: 7

Extent of components in the association:
Clarion and similar soils—34 percent
Hamel and similar soils—17 percent
Storden and similar soils—12 percent
Soils of minor extent—37 percent

Soil Properties and Qualities

Clarion

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Hamel

Drainage class: Poorly drained

Parent material: Colluvium over till

Surface texture: Loam

Storden

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Minor Soils

- Glencoe and similar soils
- Klossner and similar soils
- Muskego and similar soils
- Canisteo and similar soils
- Nicollet and similar soils

3. Harps-Nicollet-Webster Association

Setting

Landform: Moraines

Position on the landform: Rims of depressions, low summits and backslopes, and footslopes and shallow drainageways

Slope range: 0 to 3 percent

Composition

Percent of survey area: 6

Extent of components in the association (fig. 2):

- Harps and similar soils—32 percent
- Nicollet and similar soils—15 percent
- Webster and similar soils—15 percent
- Soils of minor extent—38 percent

Soil Properties and Qualities

Harps

Drainage class: Poorly drained

Parent material: Till

Surface texture: Clay loam

Nicollet

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Silty clay loam

Webster

Drainage class: Poorly drained

Parent material: Till

Surface texture: Silty clay loam

Minor Soils

- Okoboji and similar soils
- Seaforth and similar soils
- Clarion and similar soils
- Swanlake and similar soils

4. Cokato-Storden-Muskego Association

Setting

Landform: Moraines

Position on the landform: Backslopes and summits, shoulders, and large depressions

Slope range: 0 to 12 percent

Composition

Percent of survey area: 13

Extent of components in the association:

- Cokato and similar soils—25 percent
- Storden and similar soils—20 percent
- Muskego and similar soils—18 percent
- Soils of minor extent—37 percent

Soil Properties and Qualities

Cokato

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Storden

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Muskego

Drainage class: Very poorly drained

Parent material: Organic materials and coprogenous earth

Surface texture: Muck

Minor Soils

- Le Sueur and similar soils
- Hamel and similar soils
- Glencoe and similar soils
- Okoboji and similar soils

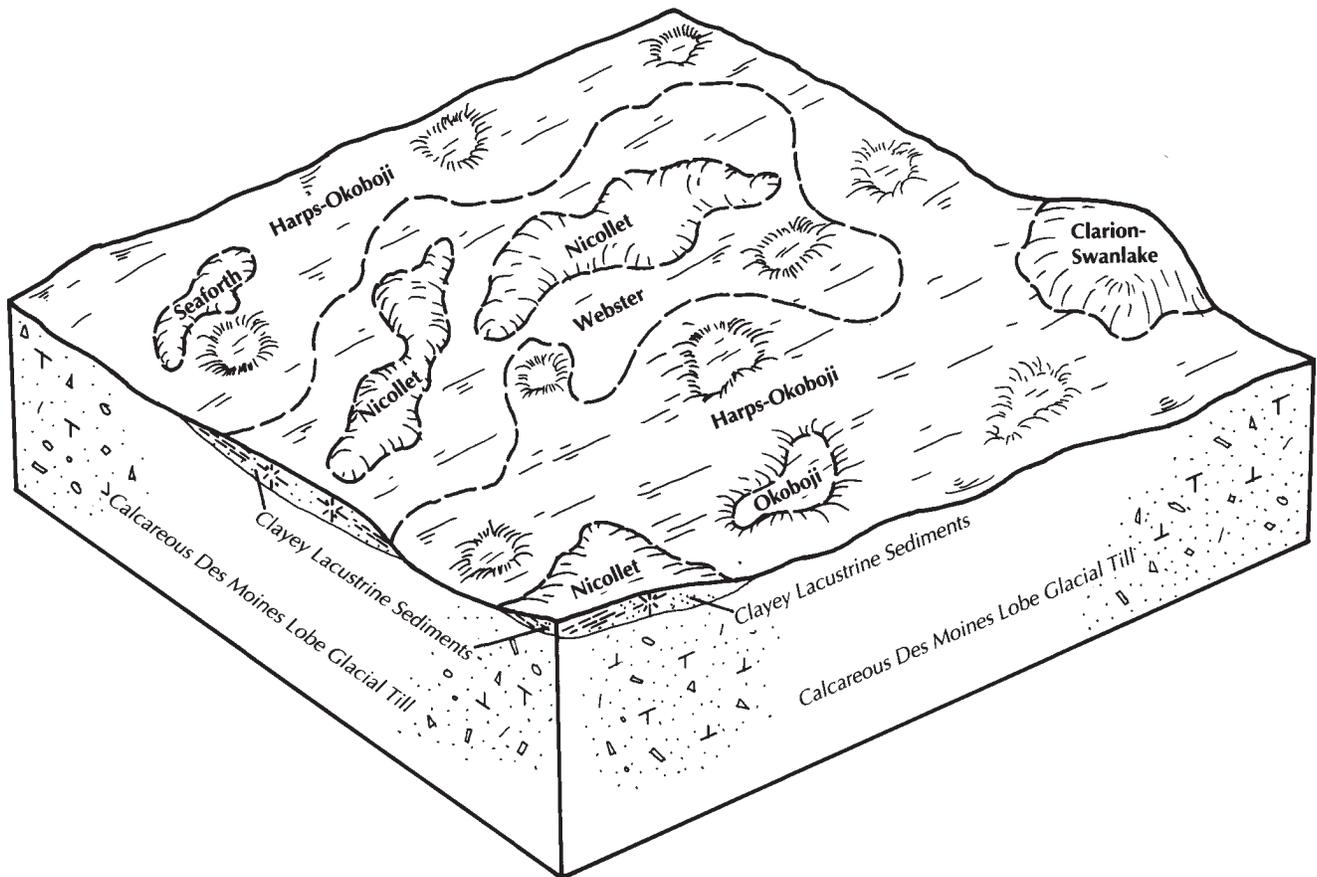


Figure 2.—Typical pattern of soils and parent material in the Harps-Nicollet-Webster association.

5. Swedegrove-Grovecity-Lundlake Association

Setting

Landform: Moraines

Position on the landform: Rims of depressions, summits on low hills, and depressions

Slope range: 0 to 3 percent

Composition

Percent of survey area: 3

Extent of components in the association:

Swedegrove and similar soils—28 percent

Grovecity and similar soils—27 percent

Lundlake and similar soils—20 percent

Soils of minor extent—25 percent

Soil Properties and Qualities

Swedegrove

Drainage class: Poorly drained

Parent material: Till

Surface texture: Loam

Grovecity

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Loam

Lundlake

Drainage class: Very poorly drained

Parent material: Till

Surface texture: Silty clay loam

Minor Soils

- Wadenill and similar soils
- Sunburg and similar soils
- Uniongrove and similar soils
- Klossner and similar soils

6. Wadenill-Swedegrove-Muskego Association

Setting

Landform: Moraines

Position on the landform: Backslopes and summits, rims of depressions, and large depressions
Slope range: 0 to 12 percent

Composition

Percent of survey area: 10

Extent of components in the association:

- Wadenill and similar soils—25 percent
- Swedegrove and similar soils—20 percent
- Muskego and similar soils—13 percent
- Soils of minor extent—42 percent

Soil Properties and Qualities

Wadenill

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Swedegrove

Drainage class: Poorly drained
Parent material: Till
Surface texture: Loam

Muskego

Drainage class: Very poorly drained
Parent material: Organic materials and coprogenous earth
Surface texture: Muck

Minor Soils

- Sunburg and similar soils
- Grovecity and similar soils
- Uniongrove and similar soils

7. Koronis-Forestcity-Houghton Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits, footslopes and narrow drainageways, and large depressions
Slope range: 0 to 12 percent

Composition

Percent of survey area: 19

Extent of components in the association (fig. 3):

- Koronis and similar soils—32 percent
- Forestcity and similar soils—21 percent
- Houghton and similar soils—11 percent
- Soils of minor extent—36 percent

Soil Properties and Qualities

Koronis

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Forestcity

Drainage class: Poorly drained
Parent material: Local alluvium over till
Surface texture: Fine sandy loam

Houghton

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

Minor Soils

- Lundlake and similar soils
- Marcellon and similar soils
- Shorewood and similar soils
- Sparta and similar soils

8. Koronis-Houghton-Forestcity Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits, large depressions, and footslopes and narrow drainageways
Slope range: 0 to 18 percent

Composition

Percent of survey area: 4

Extent of components in the association:

- Koronis and similar soils—49 percent
- Houghton and similar soils—14 percent
- Forestcity and similar soils—14 percent
- Soils of minor extent—23 percent

Soil Properties and Qualities

Koronis

Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam

Houghton

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

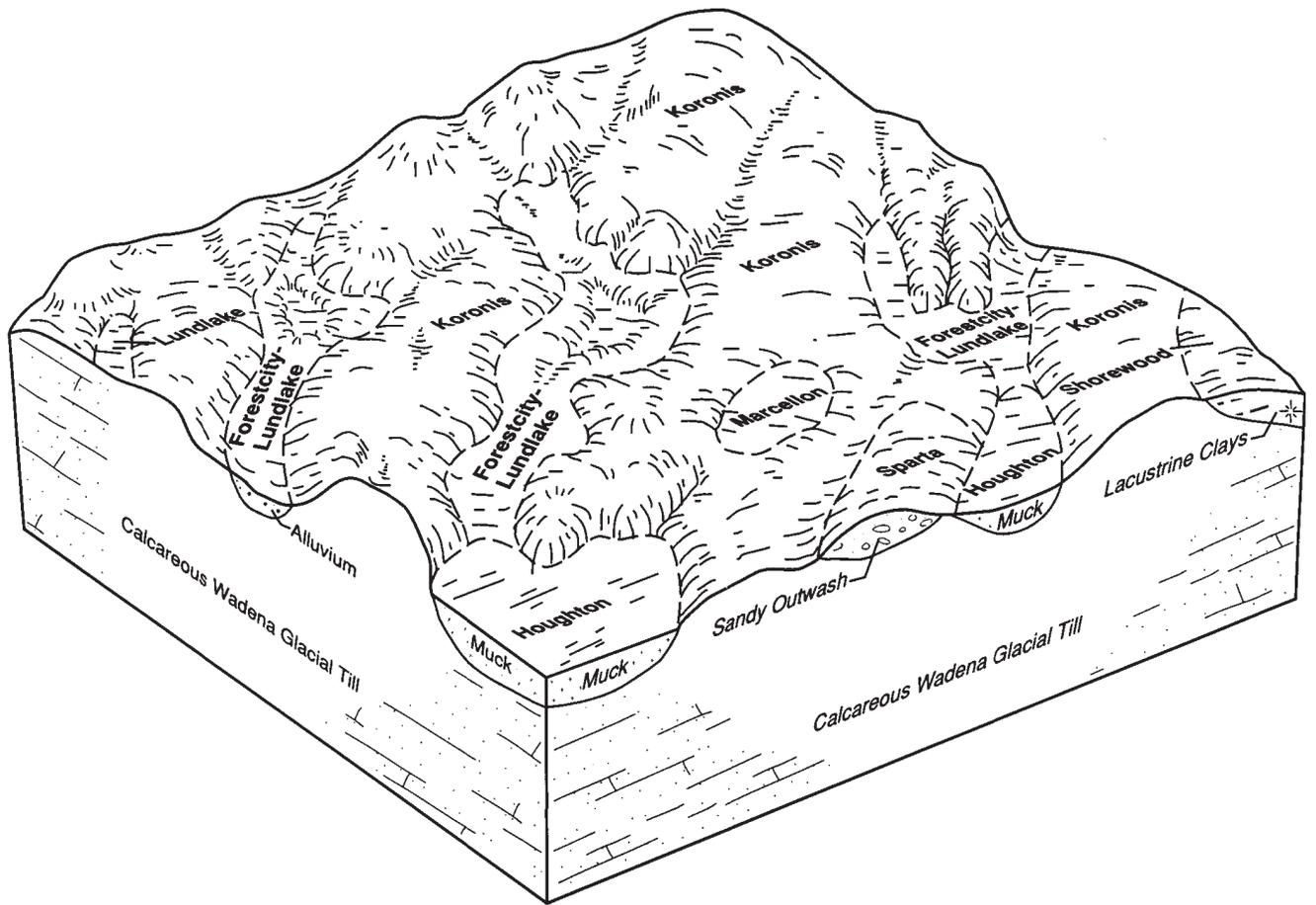


Figure 3.—Typical pattern of soils and parent material in the Koronis-Forestcity-Houghton association.

Forestcity

Drainage class: Poorly drained
Parent material: Local alluvium over till
Surface texture: Fine sandy loam

Minor Soils

- Okoboji and similar soils
- Klossner and similar soils
- Muskego and similar soils
- Marcellon and similar soils

Nearly Level to Moderately Steep, Silty, Clayey, and Loamy Soils That Formed in Till; on Moraines

9. Cosmos-Kandiyohi-Corvuso Association

Setting

Landform: Moraines

Position on the landform: Drainageways and flats, backslopes and low summits, and rims of depressions

Slope range: 0 to 5 percent

Composition

Percent of survey area: 3

Extent of components in the association (fig. 4):

- Cosmos and similar soils—30 percent
- Kandiyohi and similar soils—24 percent
- Corvuso and similar soils—18 percent
- Soils of minor extent—28 percent

Soil Properties and Qualities

Cosmos

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silty clay

Kandiyohi

Drainage class: Somewhat poorly drained

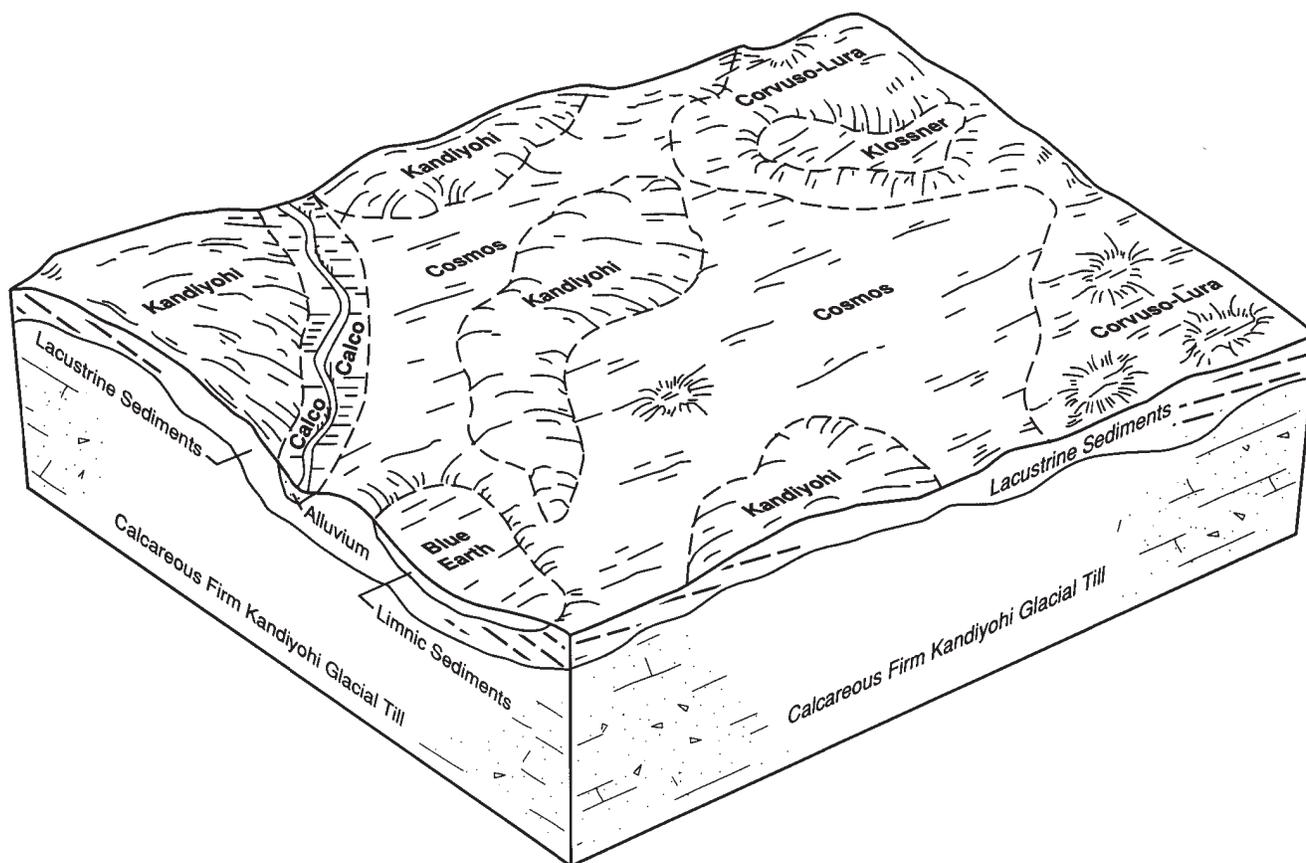


Figure 4.—Typical pattern of soils and parent material in the Cosmos-Kandiyohi-Corvuso association.

Parent material: Glaciolacustrine deposits over till
Surface texture: Clay

Corvuso

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Clay loam

Minor Soils

- Lura and similar soils
- Klossner and similar soils
- Blue Earth and similar soils
- Calco and similar soils

10. Cosmos-Strout-Kandiyohi Association

Setting

Landform: Moraines
Position on the landform: Drainageways and flats;
 backslopes and summits
Slope range: 0 to 6 percent

Composition

Percent of survey area: 6
Extent of components in the association:
 Cosmos and similar soils—33 percent
 Strout and similar soils—25 percent
 Kandiyohi and similar soils—15 percent
 Soils of minor extent—27 percent

Soil Properties and Qualities

Cosmos

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silty clay

Strout

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Clay

Kandiyohi

Drainage class: Somewhat poorly drained
Parent material: Glaciolacustrine deposits over till

Surface texture: Clay

Minor Soils

- Lura and similar soils
- Muskego and similar soils
- Newlondon and similar soils

11. Danielson-Newlondon-Strout Association

Setting

Landform: Moraines

Position on the landform: Footslopes and narrow drainageways, shoulders and backslopes, and summits

Slope range: 1 to 18 percent

Composition

Percent of survey area: 3

Extent of components in the association:

- Danielson and similar soils—27 percent
- Newlondon and similar soils—25 percent
- Strout and similar soils—24 percent
- Soils of minor extent—24 percent

Soil Properties and Qualities

Danielson

Drainage class: Poorly drained

Parent material: Colluvium over till

Surface texture: Clay loam

Newlondon

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Clay loam

Strout

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Clay

Minor Soils

- Klossner and similar soils
- Lura and similar soils
- Blue Earth and similar soils
- Muskego and similar soils

Nearly Level to Strongly Sloping, Silty Soils That Formed in Lacustrine Deposits; on Lake Plains

12. Collinwood-Waldorf-Shorewood Association

Setting

Landform: Lake plains

Position on the landform: Backslopes and low summits; drainageways and flats

Slope range: 0 to 6 percent

Composition

Percent of survey area: 2

Extent of components in the association:

- Collinwood and similar soils—43 percent
- Waldorf and similar soils—25 percent
- Shorewood and similar soils—22 percent
- Soils of minor extent—10 percent

Soil Properties and Qualities

Collinwood

Drainage class: Moderately well drained

Parent material: Lacustrine deposits

Surface texture: Silty clay loam

Waldorf

Drainage class: Poorly drained

Parent material: Lacustrine deposits

Surface texture: Silty clay loam

Shorewood

Drainage class: Somewhat poorly drained and moderately well drained

Parent material: Lacustrine deposits

Surface texture: Silty clay loam

Minor Soils

- Klossner and similar soils
- Okoboji and similar soils
- Truman and similar soils

13. Madelia-Truman-Kingston Association

Setting

Landform: Lake plains

Position on the landform: Flats and drainageways, backslopes and summits, and rises

Slope range: 0 to 12 percent

Composition

Percent of survey area: 3

Extent of components in the association (fig. 5):

- Madelia and similar soils—31 percent
- Truman and similar soils—19 percent
- Kingston and similar soils—17 percent
- Soils of minor extent—33 percent

Soil Properties and Qualities

Madelia

Drainage class: Poorly drained

Parent material: Lacustrine deposits

Surface texture: Silty clay loam

Truman

Drainage class: Well drained

Parent material: Lacustrine deposits

Surface texture: Silt loam

Kingston

Drainage class: Moderately well drained

Parent material: Lacustrine deposits

Surface texture: Silty clay loam

Minor Soils

- Okoboji and similar soils
- Darfur and similar soils
- Gardencity and similar soils
- Bold and similar soils

Nearly Level to Hilly, Loamy and Sandy Soils; on Outwash Plains, Terraces, and Deltas

14. Sparta-Darfur-Litchfield Association

Setting

Landform: Outwash plains, terraces, and deltas

Position on the landform: Summits and backslopes, drainageways, and flats and slight rises

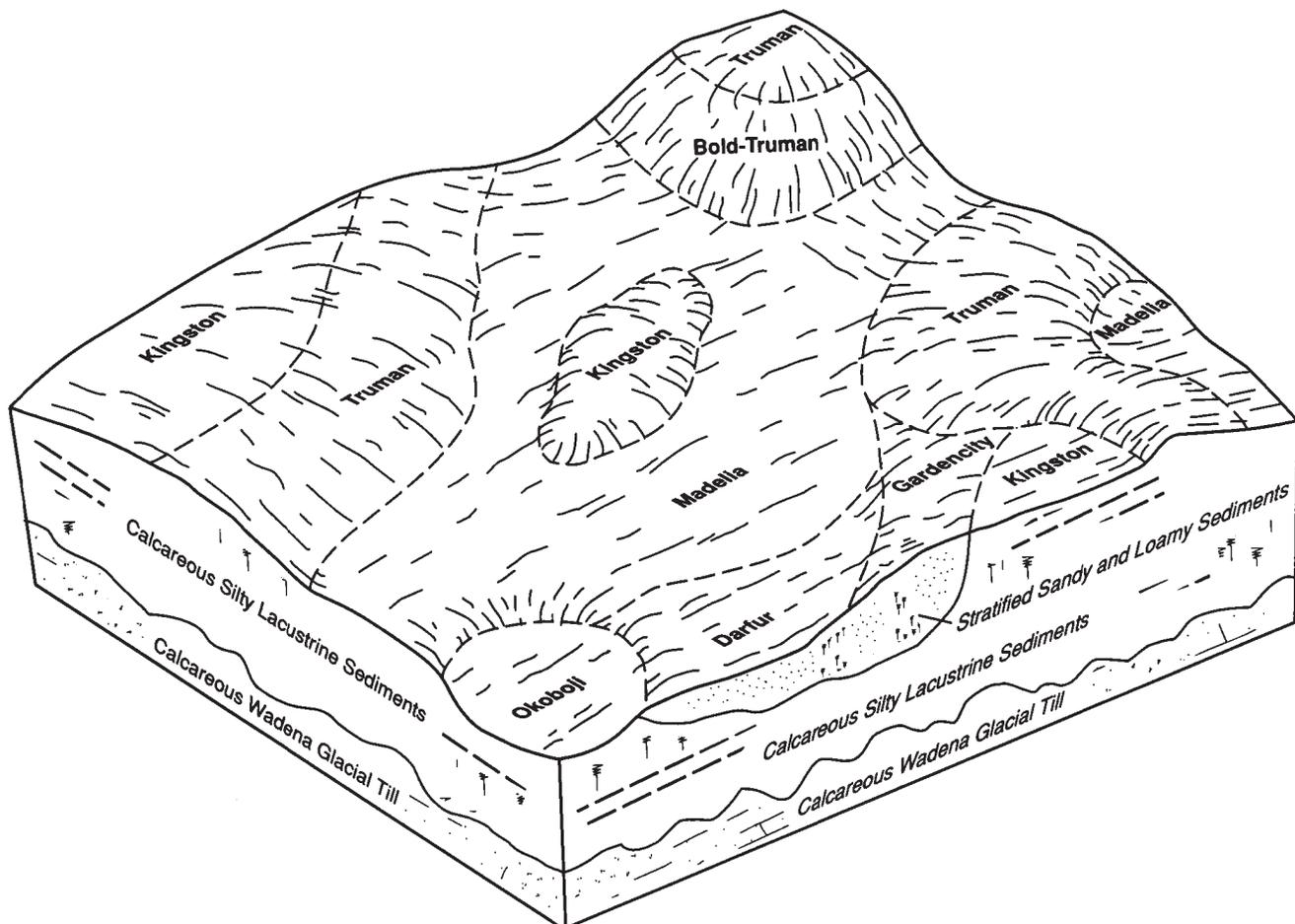


Figure 5.—Typical pattern of soils and parent material in the Madelia-Truman-Kingston association.

Slope range: 0 to 6 percent

Composition

Percent of survey area: 4

Extent of components in the association:

- Sparta and similar soils—41 percent
- Darfur and similar soils—28 percent
- Litchfield and similar soils—15 percent
- Soils of minor extent—16 percent

Soil Properties and Qualities

Sparta

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Loamy sand

Darfur

Drainage class: Poorly drained

Parent material: Glacial outwash

Surface texture: Loam

Litchfield

Drainage class: Moderately well drained

Parent material: Glacial outwash

Surface texture: Loamy fine sand

Minor Soils

- Klossner and similar soils
- Darfur and similar soils
- Cylinder and similar soils
- Gardencity and similar soils

15. Kanaranzi-Estherville-Biscay Association

Setting

Landform: Outwash plains and terraces

Position on the landform: Slight rises, backslopes, flats, and drainageways

Slope range: 0 to 6 percent

Composition

Percent of survey area: 5

Extent of components in the association (fig. 6):

- Kanaranzi and similar soils—38 percent
- Estherville and similar soils—17 percent
- Biscay and similar soils—17 percent
- Soils of minor extent—28 percent

Soil Properties and Qualities

Kanaranzi

Drainage class: Well drained

Parent material: Glacial outwash

Surface texture: Loam

Estherville

Drainage class: Somewhat excessively drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Biscay

Drainage class: Poorly drained

Parent material: Glacial outwash

Surface texture: Loam

Minor Soils

- Klossner and similar soils
- Dassel and similar soils
- Cylinder and similar soils
- Wadena and similar soils
- Hawick and similar soils

16. Fieldon-Litchfield-Dassel Association

Setting

Landform: Outwash plains, terraces, and deltas

Position on the landform: Rims of depressions, flats, and shallow depressions

Slope range: 0 to 2 percent

Composition

Percent of survey area: 5

Extent of components in the association (fig. 7):

- Fieldon and similar soils—26 percent
- Litchfield and similar soils—16 percent
- Dassel and similar soils—15 percent
- Soils of minor extent—43 percent

Soil Properties and Qualities

Fieldon

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits or glacial outwash

Surface texture: Loam

Litchfield

Drainage class: Moderately well drained

Parent material: Glacial outwash

Surface texture: Loamy fine sand

Dassel

Drainage class: Very poorly drained

Parent material: Glaciolacustrine deposits or glacial outwash

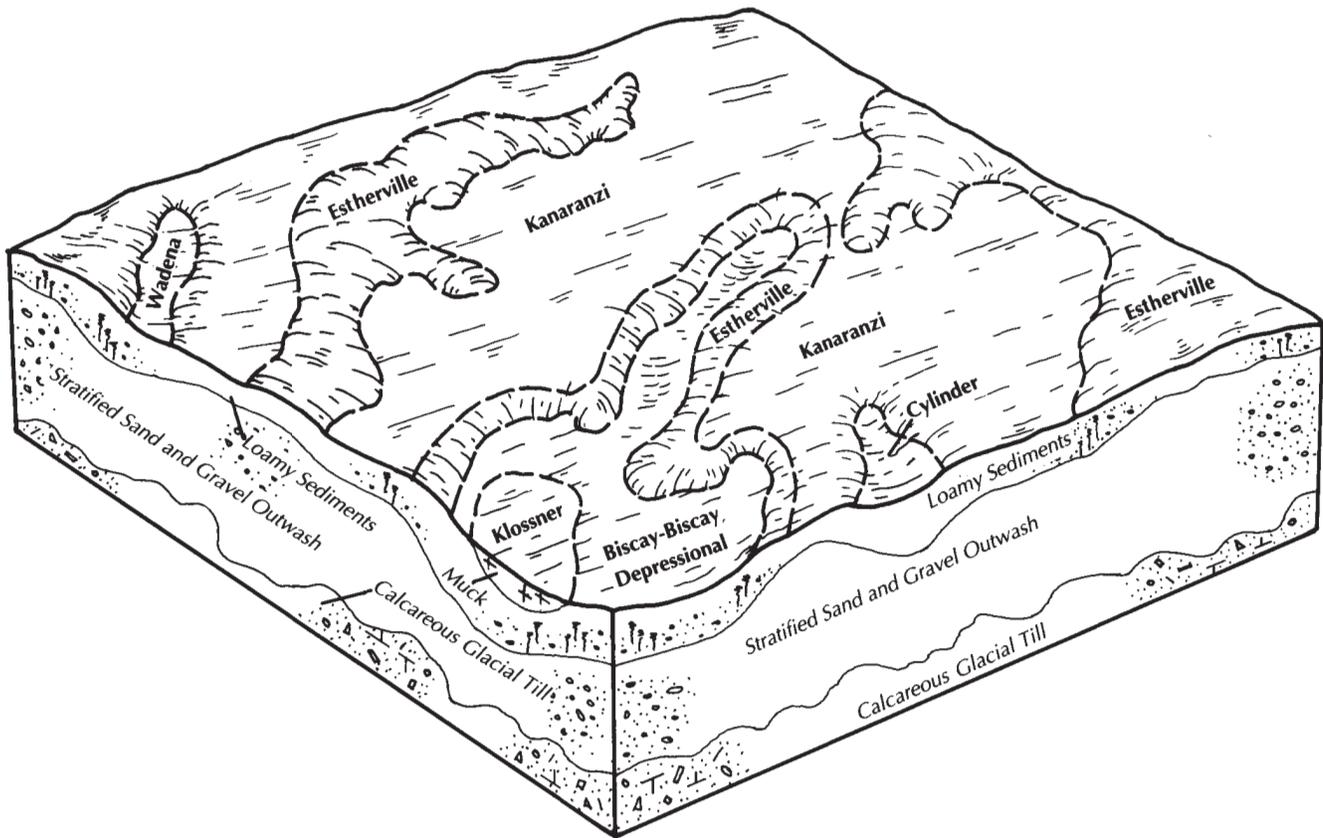


Figure 6.—Typical pattern of soils and parent material in the Kanaranzi-Estherville-Biscay association.

Surface texture: Mucky fine sandy loam

Minor Soils

- Sparta and similar soils
- Dickman and similar soils
- Minneopa and similar soils
- Biscay and similar soils
- Darfur and similar soils
- Granby and similar soils
- Klossner and similar soils

17. Hawick-Estherville Association

Setting

Landform: Outwash plains and terraces

Position on the landform: Shoulders, backslopes, and summits

Slope range: 0 to 18 percent

Composition

Percent of survey area: 1

Extent of components in the association:

- Hawick and similar soils—48 percent
- Estherville and similar soils—37 percent
- Soils of minor extent—15 percent

Soil Properties and Qualities

Hawick

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Estherville

Drainage class: Somewhat excessively drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Minor Soils

- Muskego and similar soils
- Cylinder and similar soils
- Sparta and similar soils

Soils on Flood Plains and Terraces

18. Cohoctah-Muskego-Estherville Association

Setting

Landform: Flood plains and terraces
Position on the landform: Flats, depressions, and backslopes and summits
Slope range: 0 to 6 percent

Composition

Percent of survey area: 3
Extent of components in the association:
 Cohoctah and similar soils—47 percent
 Muskego and similar soils—16 percent
 Estherville and similar soils—13 percent
 Soils of minor extent—24 percent

Soil Properties and Qualities

Cohoctah

Drainage class: Poorly drained
Parent material: Alluvium
Surface texture: Loam

Muskego

Drainage class: Very poorly drained
Parent material: Organic materials and coprogenous earth
Surface texture: Muck

Estherville

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- Zook and similar soils
- Sparta and similar soils

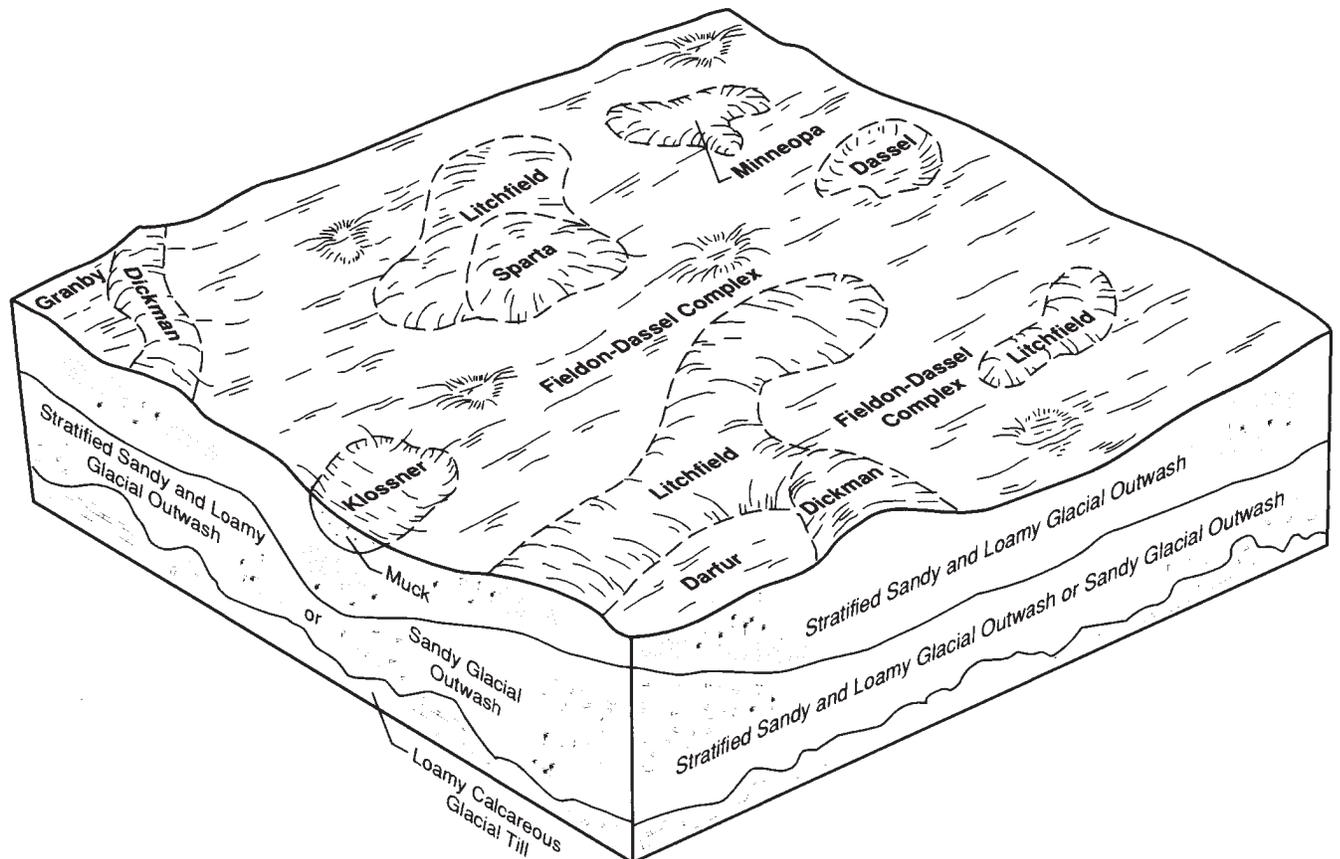


Figure 7.—Typical pattern of soils and parent material in the Fieldon-Litchfield-Dassel association.

This page intentionally left blank.

Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Formation of the Soils

Soils form through processes generated by the interaction of five factors—parent material, climate, plant and animal life, landscape setting, and time. The interaction of these factors generates complex chemical, physical, and biological processes, many of which are mutually dependent. As a result of the multitude of processes in effect over time, definitive layers or horizons form in the soil. These layers are described under the heading “Processes of Soil Formation.”

Parent Material

Parent material is the physical medium within which the soil develops. Parent material largely determines important physical properties of the soil, such as the ability to store water for plants and the ability to transmit water. Parent material also largely determines the ability to supply important plant nutrients, such as calcium, phosphorus, and potassium. These physical and chemical properties are related, to a large extent, to the proportion of sand, silt, and clay in the parent material. Soils that formed in parent materials high in silt, for example, have a high capacity to store water for plants. Soils that formed in parent materials high in clay and silt have a high capacity to store nutrients for plants. Soils that formed in parent materials high in sand have a low capacity to store both water and nutrients.

The soils of Meeker County had their beginnings in water and ice. Glacial ice from northern and western sources have covered the survey area many times. The glacial deposits mantle the underlying shale and granitic bedrock to a depth of 200 to 400 feet. As the glaciers melted, they left behind a variety of deposits. These include glacial till, glaciolacustrine deposits, and glacial outwash (see map, Surface Geology).

Glacial till is the most common parent material in the county. Glacial till is a term used by geologists to describe sediment that was deposited by the melting

of glacial ice. It is an unsorted mixture of clay, silt, sand, gravel, cobbles, and boulders. The presence of cobbles and stones is one of the main features of glacial till. Deposits of glacial till are referred to as moraines.

Much of the history of early glaciations is obscure. The more recent glaciations took place between 10,000 and 75,000 years ago, a glacial period during which most of Minnesota and nearby states and all of Meeker County were covered a number of times by glacial ice. Glaciations that took place during this time are collectively known as the Late Wisconsin glaciation.

Four kinds of glacial till are recognized in Meeker County, but only three have provided parent material for the formation of soil.

A brownish, loamy to gravelly sediment is exposed near the surface of a number of gravel pits in the northern part of the county. The age of this sediment, mostly glacial outwash, is unclear. The sediment appears to have originated in the northeastern part of the state because the deposits have coarse fragments derived from granitic rocks that occur in that region. Soils that formed in this brownish sediment are in just a few areas in the county.

The soils in the county that formed in glacial till formed in three different glacial deposits. Soil scientists and geologists recognize some subtle color differences between the three tills, but in general the tills have an olive brown, or buff, color where they are exposed on cut banks on slopes. The first of these glacial tills was deposited by ice that came from the north and west and buried older glacial deposits. This glacier, the age of which is uncertain, deposited a loamy to clayey till that is rich in shale. The glacier that deposited this shaly till probably covered the entire county, but it is buried in most places by glacial tills that arrived later. It is known by geologists as Kandiyohi till and provided the parent material for most of the soils in the southwestern part of the county. Most of the soils in associations 10 and 11 (described under the heading “General Soil Map Units”) formed in Kandiyohi till. Corvuso, Cosmos, Kandiyohi, Newlondon, and Strout soils are examples.

The shale-rich Kandiyohi till is covered in most of

the county by glacial till that has as its main features a high content of sand and many cobbles and stones. This glacial till is believed to have been deposited sometime before 34,000 years ago (Ojakangas and Matsch, 1982). It came from the north and is believed to blanket all of the county, except for areas of the Kandiyohi till in the west-central part of the county. This sandy loam deposit is known by geologists as Granite Falls till, a deposit of the Wadena lobe of the late Wisconsin glaciation. Most of the soils in associations 5, 6, 7, and 8 formed in Granite Falls till. Crowriver, Forestcity, Grovecity, Koronis, Lundlake, Sunburg, Swedegrove, Uniongrove, and Wadenill soils are examples.

The last glaciation to enter the survey area deposited a loamy sediment known as New Ulm till. This till is intermediate between Kandiyohi and Wadena till in content of clay, sand, and rock. The glacier that brought this sediment is known as the Des Moines lobe of the late Wisconsin glaciation. It is believed to have arrived in the area about 14,000 years ago. The Des Moines lobe arrived from the northwest. It entered the western part of the county in Cosmos and Danielson Townships and continued southward into Renville County, where a sublobe (known as the Grantsburg) began to flow northeastward and re-entered the county from the south in Cedar Mills Township. Meeker County lies on the western edge of the Grantsburg lobe. The Des Moines lobe eventually covered all of east-central Minnesota. The Grantsburg sublobe covered the southeastern part of the county (Cedar Mills, Collinwood, and Ellsworth Townships and the eastern part of Dassel and Kingston Townships). East of Kingston, near the Wright County line, the ice crossed the North Fork of the Crow River, which was an outlet for glacial meltwater flowing eastward to the Mississippi River. The ice continued to flow about a mile northward. At that point the ice swung eastward into Wright County. Most of the soils in associations 1, 2, 3, and 4 formed in New Ulm till. Canisteo, Clarion, Cordova, Glencoe, Harps, Le Sueur, Lester, Nicollet, Rolfe, Storden, and Webster soils are examples.

The melting of glaciers produced large amounts of meltwater. The volume of meltwater was enormous, and large amounts of glacial sediment washed out of the melting glacial ice. The ability to carry sediment is dependent upon the energy with which the water flows. Where the water flows rapidly, a larger volume of sediment and the larger particles can be carried. Meltwater carried large amounts of sediment away from the glacial ice front. Much of the smaller silt and clay particles were transported to streams and rivers

and carried far downstream. In places the silts and clays were carried to lakes and ponds.

Coarse textured sediment deposited by glacial meltwater is known as glacial outwash. Only large sand and gravel particles were heavy enough to resist the high energy of the large amounts of water generated by the melting glaciers. Glacial outwash that may have been generated by the glaciers that deposited the Kandiyohi and Granite Falls till is buried by deposits of New Ulm till or other sediments.

Meltwater from the Des Moines lobe carved shallow channels eastward to the Mississippi River. A large outwash plain, referred to as the Darwin sand plain, was deposited near the center of the county—the northern part of Ellsworth and Greenleaf Townships and the southern part of Darwin and Litchfield Townships—by this meltwater. The coarser material, sand and gravel, was laid down in alternating layers at the front of the ice sheet. This coarse textured glacial outwash lies mostly south of U.S. Highway 12 between Darwin and Litchfield. It provides a source of sand and gravel (fig. 8). North of Highway 12 the soils are mostly underlain by sand. During the last stages of deposition, a thin discontinuous mantle of loamy sediment, commonly 1 to 3 feet thick, was laid on top of the coarse sediment. Most of the soils in associations 14, 15, and 16 formed in this outwash sediment. Biscay, Chelsea, Dickman, Esterville, Granby, Hawick, Kanaranzi, Litchfield, Mayer, Minneopa, and Sparta soils formed in glacial outwash.

For some time after the Des Moines glaciation crossed the glacial Crow River, deposits of glacial till formed an effective dam that blocked the eastward flow of meltwater and sediment. In the northeastern part of the county, meltwater seeking an outlet spread across the lower lying areas and eventually formed a large glacial lake with many arms and bays. This glacial lake occupied large areas in Forest City, Harvey, and Kingston Townships. The great energy of the glacial meltwater was absorbed in the glacial lake. In the quiet water of the glacial lake the meltwaters were unable to hold their load of sediment in suspension; even small particles, such as clay and silt, did not remain in suspension but settled to the bottom of the lake. The sediments deposited in glacial lakes are called glaciolacustrine deposits. These deposits in Meeker County are estimated to be as much as 25 feet thick in places. Clays settled in the deeper and quieter parts of the lake. Where the lake was more shallow or there was some movement of water, dominantly silt-sized particles settled to the floor of the lake. In places where streams entered the lake, the lighter weight clays were carried to the deeper parts of



Figure 8.—A gravel and sand pit in an area of Pits, gravel-Udipsamments complex.

the lake. In the shallower parts of the lakes and near the mouths of the former streams, beds of sandy, silty, and loamy sediment were deposited in alternating strata. Most of the soils in associations 12 and 13 formed in lacustrine sediments. Collinwood, Okoboji, Shorewood, Spicer, and Waldorf soils formed in clay lacustrine deposits. Bold, Kingston, and Madelia soils formed in silty lacustrine deposits. Gardencity, Darfur, and Fieldon soils formed in the stratified deposits.

At about the time the large glacial lake was forming in Forest City, Harvey, and Kingston Townships, a shallow lake appears to have formed in the southwestern part of the county. This lake was possibly created as a result of the Grantsburg sublobe flowing northeastward across Cedar Mills Township

and forming a natural dam blocking the drainage of meltwater to the east. The lacustrine sediments deposited in the shallow lake were mostly clay and silt. The nearby clayey till was a good source of both. The sediments are mostly less than 5 feet thick. Most of the soils in association 9 formed in these thin lacustrine sediments and in the underlying clayey till. Lura soils formed in these lacustrine sediments. In many places these sediments form the upper part of the Corvuso, Cosmos, and Kandiyohi soils.

Ice-walled lakes and collapsed outwash plains are other forms of glacial deposits in Meeker County. These features occur in the eastern part of the county on the edge of the Grantsburg glacier. In this area, glacial lakes formed on the surface of stagnant ice.

Stagnant ice is a term used to describe a condition where ice ceases to flow and the cessation of flow is followed by slow melting of the sediment-laden ice. Meltwater laden with sediment held in suspension flowed into lows in the ice-streams, shallow lakes, and ponds.

The streams carried the lighter weight silts and clays to low areas on the landscape (ponds and shallow lakes) or carried them away from the ice field. The heavier particles, such as sand and gravel, mostly remained near the stream channels, but some of these were carried to lakes and ponds also.

As the glacier melted, the ice forming the beds of streams and the walls of ponds and lakes collapsed onto and in places became incorporated into the underlying ice and sediment. As a result, many of the former streams, lakes, and ponds are no longer in evidence; the postglacial landscape is made up of a disordered assortment of knolls, swales, and closed depressions. Those meltwater sediments that survived the collapse of the glacier are perched at the highest elevations on the local landscape. Examples of ice-walled lakes and ponds and streams on the former surface of the glacial ice are throughout the eastern part of the county. Shorewood soils formed in clayey sediment deposited in the lakes and ponds. They are in areas characterized by smooth-sided knolls and hills. Estherville and Hawick soils formed in the sandy and gravelly sediment deposited near streams and in some of the lakes and ponds. They are in areas characterized by undulating to rolling landscapes containing scattered depressions. The soils in association 17 formed in these collapsed sandy and gravelly sediments.

The final stage in the deposition of parent material in Meeker County was the deposition of alluvium along flood plains. Most of the landscape development of stream valleys took place during the last stages of glacial melting. Since the melting of the last glacier about 10,000 years ago, there has been little alteration of the topography. Streams are narrow and have cut but a few tens of feet below the surrounding landscape. During the many centuries since the retreat of the glaciers, the North Fork of the Crow River has meandered across its flood plain. The accompanying shifting pattern of sedimentation resulted in highly stratified alluvium. Where the water flow was slower, the finer particles fell to the valley floor. Backwaters and channels received a thin layer of silty and clayey sediment as much as 5 feet in thickness. The sediments nearer to the stream are more sandy. Most of the sediments deposited on the present-day flood plain have as their source the nearby constantly eroding river banks. The present Crow River drainage

system is oversized for the amount of water it now carries. Many of the soils in association 18 formed in these recently deposited alluvial sediments. Cohoctah soils formed in sandy and loamy deposits nearest the river. Calco and Zook soils formed in silty and clayey deposits in backwater areas farther from the stream.

Climate

Climate influences soil formation by providing moisture and heat necessary for the weathering of parent material and for the growth of organisms. Water dissolves soluble materials and transports them along with organic material to other parts of the soil. Temperature and water affect the rate of chemical and physical reactions. These reactions are slower at freezing than at a higher temperature. Moisture and temperature affect the kinds of plants that grow on the soil. They also are important to animal life, which helps to convert dead vegetation to humus and plant nutrients. Further, the rate at which organic matter decays or accumulates in the soil is influenced by moisture and temperature along with vegetation. Because of the cold winters, soil-forming factors are mostly inactive in Meeker County for about 5 months of the year.

Climate is nearly uniform throughout the county, but some local differences in the soils are caused by parent material and landscape setting.

Topography

Topography, or landscape setting, refers to the location of the soil on the landscape. Landscape setting affects soil formation by its influence on the amount of runoff (or run-on) that will determine, along with infiltration rates and permeability of the parent material, the amount of water that enters or passes through the soil. Storden, Clarion, Nicollet, Webster, and Glencoe soils formed in the same parent material—New Ulm till. Differences in the characteristics of these soils are mostly the result of processes related to landscape position. Landscape position affects the amount of rainfall and snowmelt that runs off the soil and the relative amount that enters the soil. Storden soils, which are on the most convex parts of side slopes on knolls, have a high runoff rate; that is, a relatively small amount of rainfall and snowmelt is able to enter these soils. Clarion soils, which are on the less convex parts of knolls and hills, have a lower runoff rate. Thus more water infiltrates the soil and percolates through it. Nicollet soils are on the nearly level, slightly convex summits of hills or slight rises in broad nearly level areas. These soils have a lower runoff rate than the Clarion soils and thus have a higher rate of water infiltration. Webster soils, in

nearly level, plane or slightly concave positions, are subject to only a small amount of runoff and thus have a high rate of water infiltration. In most years so much water enters the Webster soils that they commonly become saturated for parts of the growing season. Glencoe soils are in closed depressions, the lowest areas on the landscape relative to adjacent soils. The Glencoe soils receive runoff from adjacent soils as well as rain that falls directly into the depressions. They are naturally saturated for nearly the entire growing season and have standing water on the surface for part of the season. Extreme differences in the amount of water in the soil affect the kinds and intensity of biological and chemical processes that operate in the soil. Different species of plants and different kinds of micro-organisms live where moisture is high than on dry sites where moisture is relatively low. Many tree species do not grow well where water is at or near the surface for much of the growing season. Reeds and sedges, however, require sites that have water at or near the surface during the same period.

Living Organisms

Plants and animals provide organic matter for the formation of soil humus. The stems, leaves, and roots of plants provide most of the organic matter. The species of plants and animals are influenced by the interacting factors of parent material, setting, and climate. Micro-organisms affected by these same factors transform organic matter into humus.

Plants influence soil chemistry. For example, soils that formed under prairie plants are less acid than those that formed under trees. Vegetation influences the rate at which clay is transferred from the surface layer to the subsoil. This rate influences the kinds of layers or horizons that form in a soil. Vegetation also influences the rate at which nutrients, such as calcium carbonate, are leached from the soil. Because of a greater loss of calcium carbonate, forest soils are relatively more acid than soils that formed in the same parent material under prairie vegetation.

Time

Time as a soil-forming factor is a measurement of how long the parent materials are exposed to the atmosphere. Soils in some parts of the world have been weathering for a million years or more. Soils that have been exposed to the soil-forming processes for a long time may have been leached of most of their nutrients. Also, their clay particles may have been altered to types of clay or other compounds that have little capacity to store nutrients for plants. Soil scientists consider these soils to be strongly

weathered, or “old.” In Meeker County, the soils have been exposed to the soil-forming processes for a relatively short period of time. In addition, the cold winter temperatures in Meeker County stop many of the soil-forming processes. Because some processes are active for only about 7 months of the year, the rate at which the soils form is reduced. The soils in Meeker County have been subject to soil-forming processes for only 8,000 to 10,000 years. These soils are considered “young” soils because most of them still retain large amounts of nutrients for plants and have the capacity to store large amounts of nutrients. Relatively small amounts of fertilizer are needed to provide nutrients for the optimum growth of plants.

Processes of Soil Formation

Soils are the product of soil-forming processes that act upon parent material over a period of time. As a result of these processes, specific soils have distinct kinds of horizons or layers. These include the surface layer, subsurface layer, subsoil, and underlying material. Soil scientists refer to these layers as A, E, B, and C horizons, respectively.

In this survey area, the surface layer is a layer of organic matter accumulation. It includes what is commonly known as the plow layer but in many soils extends much deeper into the soil.

The subsurface layer is the layer immediately below the surface layer. It is a layer in which clay and organic matter have been removed and a concentration of sand and silt particles of quartz and other minerals resistant to weathering are left behind (see fig. 14 in the section “Soil Series and Detailed Soil Map Units”).

The subsoil is a layer that has undergone some alteration that changed it from the parent material. Some of the most common alterations are the removal of calcium and magnesium carbonate, the addition of clay and organic matter, and the coating of hydroxides of iron or evidence that iron hydroxides have been reduced and removed (see fig. 15 in the section “Soil Series and Detailed Soil Map Units”).

Underlying material is unaltered parent material that has been minimally affected by the soil-forming processes.

After the glaciers melted about 10,000 years ago, soil did not exist. Parent materials were calcareous, or limy, to the surface. One of the important first steps in forming soil from calcareous parent material is the removal of calcium and magnesium carbonate. Calcium and magnesium are abundant in the glacial till and lacustrine deposits in which many of the soils formed. Water is an essential element in the removal of calcium and magnesium. Water passing through

organic matter combines with organic compounds to form weak acids, such as carbonic acid. These acid waters percolate downward through the parent material and carry the calcium and magnesium downward in solution. The degree of leaching is largely related to the amount of water passing through the soil.

Storden soils, in strongly convex positions on knolls and hills, have been leached to only a small extent because these landscape positions shed water so rapidly that little water is available to leach the carbonates at a rate faster than the parent material erodes. As a result, calcium and magnesium carbonates are present just as they were when soil formation began (see fig. 17 in the section "Soil Series and Detailed Soil Map Units"). Clarion, Cokato, and Lester soils on the less convex parts of the knolls and hills have a lower runoff rate than the soils in convex positions. Thus they are commonly leached of carbonates to a depth of 18 to 30 inches (see fig. 15 in the section "Soil Series and Detailed Soil Map Units"). Newlondon soils in Kandiyohi till and Sunburg soils in Wadena till are in the same landscape positions as the Storden soils, which formed in New Ulm till. These soils have lost little calcium and magnesium carbonate since soil formation began 10,000 years ago.

In nearly level areas (characterized by Webster soils), drainageways (characterized by Hamel soils), or depressions (characterized by Glencoe soils), runoff from nearby slopes and much of the rainfall that falls on the site are available to leach carbonates. In these settings, particularly in drainageways, the leaching of carbonates is at its maximum. Carbonates are commonly leached to a depth of 5 to more than 6 feet in these areas. Danielson, Forestcity, and Hamel soils, which formed in Kandiyohi, Granite Falls, and New Ulm till, respectively, are examples of deeply leached soils in drainageways on glacial moraines.

Soils on glacial outwash plains that are underlain by sand are mostly leached of carbonates to a depth of about 5 to more than 10 feet. These soils had a relatively small amount of carbonates to begin with. Also, because water can move rapidly downward through these soils, the carbonates and other salts were easily removed. Sparta and Dickman soils are examples of soils that are underlain by sand and are deeply leached of carbonates.

Additional important processes of soil formation are those that affect the color of the subsoil. These processes involve the formation of iron hydroxides. These compounds of iron, oxygen, and water have a significant effect on the color of the subsoil and the underlying parent material. During the early stages of weathering, chemical and physical reactions in the

presence of air and water began to take place in the parent material. These processes released iron oxides from soil minerals. The oxides combined with water to form compounds called iron hydroxides. The iron hydroxides in settings where oxygen is relatively abundant are formed by a process called oxidation. The relative abundance of oxygen is closely related to the duration of saturation. It also is determined by how near to the soil surface the saturation occurs. In soils that are never saturated or are saturated for only a very short period, iron hydroxides coat the mineral grains, thus giving the developing subsoil a distinct brownish color. This process is much the same as the rusting of the blade of a steel shovel left out in the rain.

Clarion and Storden soils on the backslopes of hills and Nicollet soils on slight rises have a relative abundance of oxygen for the formation of iron hydroxides, and thus these soils commonly have a brownish subsoil. A brownish subsoil is common in soils, such as Kanaranzi soils, that formed in loamy or sandy material underlain by sand and gravel. Soils that have a brownish subsoil are considered by soil scientists to be well drained or moderately well drained (see figs. 12 and 13 in the section "Soil Series and Detailed Soil Map Units").

Webster soils in nearly level areas and Glencoe soils in closed depressions have a limited availability of oxygen during much or all of the growing season. In these settings the soil is saturated at the surface or within a few feet of the surface for much of the time during which the soil-forming processes are active. On these sites the processes that modify soil colors involve a condition of limited oxygen rather than one of an abundance of oxygen. The iron hydroxides in these areas were produced by a process called reduction. They have less oxygen in their chemical structure. Because of the differing chemical structure of the hydroxides that formed in the saturated soil environment, these hydroxides are mobile. The mobile hydroxides are carried by percolating water and gradually are moved downward into the subsoil or the underlying parent material. The part of the developing subsoil and underlying parent material that is stripped of the mobile iron hydroxides develops a grayish color. The iron hydroxides accumulate in the lower part of the soil and in the upper part of the parent material as red and orange blotches, called iron concentrations. These concentrations occur in root channels and pockets where air was more available.

Soils that have a gray subsoil are considered poorly drained or very poorly drained. Webster soils are poorly drained, and Glencoe soils are very poorly drained. Other examples of poorly drained soils are Cosmos soils that formed in Kandiyohi till (see fig. 11

in the section “Soil Series and Detailed Soil Map Units”). Very poorly drained soils include Lura soils that formed in Kandiyohi till and Lundlake soils that formed in Wadena till. All of these soils formed in settings where the oxygen availability is limited. Among the identifying features of these soils are a gray subsoil and gray parent material.

The removal of iron compounds and carbonates from minerals and rock particles leaves behind minerals that are weakened and can be easily weathered and transformed. As time goes by, an insoluble residue of secondary minerals accumulates, and some of this residue tends to recrystallize and form clays.

As iron and aluminum are weathered and carbonates and other very soluble compounds are removed, a subsoil layer begins to form below a very thin surface layer. In time, depending on the amount of water entering the soil, the thickness of the subsoil increases to as much as 3 or 4 feet in some places.

As soil formation progressed, the processes of forming iron hydroxides (oxidation-reduction) and calcium carbonate leaching became less important. Processes influenced by vegetation as modified by climate and by landscape position became dominant.

The earliest dominant higher forms of plant life to grow on the soil were alder and spruce. It is believed that the spruce forest became established even before the melting of the ice fields was complete. The dominance of spruce was short-lived, however, because as the glacial ice retreated northward to Canada and beyond, the climate soon became warm and dry. The major imprint of vegetation appears to have occurred within the last 7,000 years, when prairie vegetation invaded the area as part of a broad peninsula projecting eastward into western Wisconsin. This invasion of prairie vegetation pushed the woodlands to the east.

Prairie plants produce an abundance of organic matter. If a trench is excavated in the soil so that the soil layers can be viewed, one can see that the roots of prairie plants grow mostly in the upper foot of the soil. Over a period of many years, the decaying of plants, particularly of the roots, has produced at the soil surface an accumulation of dark organic material called humus. Big bluestem, little bluestem, and prairie cordgrass were dominant grass species near the time of European settlement, except in wet closed depressions, where reeds and sedges dominated.

In areas where oxygen was abundant in the soil all year long in most years, the humus accumulated slowly. In these places the dark surface layer at the time of settlement is estimated to have varied in thickness from about 12 to 18 inches. Strout, Wadenill,

and Clarion soils formed under tall grass prairie in Kandiyohi till, Granite Falls till, and New Ulm till, respectively. In landscape settings that are saturated for long periods on the glacial moraines, such as nearly level areas and closed depressions, less oxygen is available to oxidize or “burn” the humus. As a result, the humus accumulates to a greater thickness in these areas than in areas where the soil is saturated for shorter periods. In the nearly level areas, the thickness of the dark layers ranges from about 14 to 24 inches. The poorly drained Cosmos, Uniongrove, and Webster soils formed under tall prairie grasses in nearly level areas. These soils formed in Kandiyohi till, Granite Falls till, and New Ulm till, respectively.

The larger depressions remain saturated all year if they are not artificially drained. Water stands on the soil surface for at least part of the growing season. The first plants and animals to become part of the soil in the shallow lakes and ponds were algae and diatoms. The decayed remnants of these plants and animals are referred to as limnic sediments. These sediments accumulated to a thickness of many feet in places. In time, water-tolerant plants, such as reeds and sedges, began to encroach into the ponds and lakes. The abundance of moisture promoted a dense growth. Organic matter accumulated rapidly because little oxygen was available to promote the decay of the reeds and sedges when they died. Many former ponds and shallow lakes are now filled with soils that formed in the thick organic deposits of partially decomposed reeds and sedges. Muskego soils are examples (see fig. 16 in the section “Soil Series and Detailed Soil Map Units”). The upper part of these soils is muck derived from reeds and sedges, and the lower part is limnic sediments derived from the skeletons of microscopic plants.

About 4,000 years ago, the climate began to cool and become more moist and the northern hardwoods known as the “Big Woods” began to spread westward. The Big Woods may have only invaded the survey area within the last 500 to 1,000 years.

Soil temperatures vary depending upon the degree of exposure of the soil surface to the sun. South-facing slopes are warmer and dryer than north-facing slopes. The north-facing aspects of the steeper parts of hills, the north and east sides of lakes and large marshes, and areas near the larger streams have a slightly cooler and moister microclimate than other areas. This small difference in local climate was apparently sufficient to allow trees to compete with prairie grasses. From these cool moist sites, the woodland expanded into the naturally warmer and dryer nearby areas. Tree seedlings were dispersed across the

landscape by birds and mammals. It is believed that scattered areas of woodland persisted through the earlier warm period. In contrast with the scattered woodlands that occurred over the centuries since the onset of cooling, woodland has replaced much of the tall grass prairies in much of the county. The expansion of the woodland did not proceed uniformly, however, because prairie fires often burned the woodland and allowed the prairie vegetation to dominate for a short time.

The westward expansion of woodland was interrupted by the arrival of European settlers. At that time, except for areas mostly around the north and east sides of lakes and large marshes, areas in the western part of the county were still prairie. Prairie also persisted in places in the eastern part of the county on soils that are dominantly poorly drained, such as Uniongrove soils, or that have a low capacity to store moisture. Many of the common hardwoods do not compete well with soils that are saturated for long periods. Further, the poorly drained soils are nearly level and thus do not have the advantage of a northern aspect, which provides soils on relatively steep slopes with a cooler microclimate. Also, trees do not compete well with prairie grass when the soil has a low capacity to store moisture. Grasses are able to withstand the long dry summers that are common in the survey area, but tree seedlings tend to die under similar conditions. Soils that hindered the advance of woodland are those that are shallow to sand or gravelly sand, such as Sparta, Dickman, and Estherville soils.

With the invasion of the hardwoods, the characteristics of the soils that formed under the tall grass prairie began to change in response to processes that occur under woodland vegetation. In contrast to prairie plants, forests produce little organic matter below ground level. Instead, the organic matter tends to accumulate at the soil surface. Additionally, the litter of leaves and decaying limbs and trunks of trees is more acid than prairie vegetation in areas of the same parent material. Thus, moisture percolating through decaying forest vegetation became more acid than under prairie vegetation. This acid condition caused clay and organic matter and certain other minerals to be carried downward into the subsoil. The dark surface layer that formed during the earlier warmer and dry time began to thin as clay, organic matter, and other minerals were removed. A thin bleached subsurface layer began to form just below the thinning dark surface soil. The downward migrating clay and organic matter removed from the subsurface layer accumulated in the subsoil. Subsoil development in forest soils, particularly evident in soils that formed

in loamy or clayey material, is believed to relate to wetting and drying of the soil in addition to the accumulation of clay. The formation of cracks in the subsoil provides pathways that allow moisture to carry the waxy material downward, where it is precipitated in pores, in channels, and on the surfaces of nearly cubical or rectangular blocky structural forms.

In general, forest soils have a black or very dark brown surface layer that is 2 to 3 inches thick; an ashy gray or grayish brown subsurface layer 5 to 10 inches thick that is low in clay and organic matter; and a dense subsoil layer that features blocky structures covered with patches of dark waxy coatings of clay and organic matter that were leached from the subsurface layer.

Most of the soils that supported trees at the time of early settlement have not been wooded long enough for the formation of a true forest soil. Most of the soils on the formerly wooded slopes in the eastern half of the county are considered transitional between prairie soils and forest soils. Before tillage was begun, the prairie-forest soils commonly had a black or very dark brown or very dark gray surface layer 4 to 10 inches thick (which is also characteristic of prairie soils) underlain by layers characteristic of forest soils, including a thin, ashy gray or grayish brown subsurface layer 3 to 4 inches thick and a subsoil with accumulations of clay on fairly strongly developed structural blocks. In places the subsurface layer is indistinct.

When the settlers began to till these prairie-forest soils, the surface layer and subsurface layer were mixed. In a few years the tilled layer developed the dark grayish brown hue (dry color) characteristic of soils that formed under both prairie and forest vegetation. Koronis and Lester soils are examples of prairie-forest soils. These soils are on many of the cultivated hills in the eastern part of the county. Koronis and Lester soils are associated with Sunburg and Storden soils, respectively. The Sunburg and Storden soils are on the upper convex and steeper parts of slopes.

One of the most important soil-forming processes in the county is the formation of "high lime" areas on rims of depressions. The rims are simply the result of calcium and magnesium carbonate and other compounds moving laterally and upward from the soils in depressions to the surrounding elevated rims. This process takes place during the normally dry summer months. The carbonates and other compounds are carried in both lateral and upward directions by soil moisture migrating from wet soil to dryer soil. Where moisture encounters dry soil, it can no longer carry the

lime and associated compounds, and thus these materials precipitate near the soil surface.

Human activity influences soil formation in many ways. Tillage exposes the soil to air, thereby accelerating the oxidation of organic matter. Erosion of the surface layer has been accelerated on some steeply sloping soils because of tillage, and areas below these slopes have received deposits of eroded material. Artificial drainage affects soil formation by allowing water to leach carbonates and salts from the “high lime” soils.

Changes in vegetation, such as those that took place in the original Big Woods and the tall grass prairie, may also affect soil formation.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). 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 table “Classification of the Soils” in Parts I and II of this publication shows the classification of the soils in the survey area. 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 Aquoll (*Aqu*, meaning water, 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 Endoaquolls (*Endo*, meaning within, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typical subgroup. Other subgroups are intergrades or extragrades. The typical 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. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Endoaquolls.

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, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Endoaquolls.

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.

Classification of the Soils

Soil name	Family or higher taxonomic class
Angus-----	Mollic Hapludalfs, fine-loamy, mixed, mesic
Arkton-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Barry-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Biscay-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Blue Earth-----	Mollic Fluvaquents, fine-silty, mixed (calcareous), mesic
Bold-----	Typic Udorthents, coarse-silty, mixed (calcareous), mesic
Calco-----	Cumulic Haplaquolls, fine-silty, mixed (calcareous), mesic
Canisteo-----	Typic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Chelsea-----	Argic Udipsamments, mixed, mesic
Clarion-----	Typic Hapludolls, fine-loamy, mixed, mesic
Cohoctah-----	Fluvaquentic Endoaquolls, coarse-loamy, mixed, mesic
Cokato-----	Typic Argiudolls, fine-loamy, mixed, mesic
Collinwood-----	Aquertic Hapludolls, fine, montmorillonitic, mesic
Cordova-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Corvuso-----	Typic Calciaquolls, fine, mesic
Cosmos-----	Vertic Epiaquolls, fine, montmorillonitic, mesic
Crowriver-----	Typic Calciaquolls, coarse-loamy, mesic
Cylinder-----	Aquic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Danielson-----	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Darfur-----	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dassel-----	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dickman-----	Typic Hapludolls, sandy, mixed, mesic
Estherville-----	Typic Hapludolls, sandy, mixed, mesic
Fieldon-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Forestcity-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Gardencity-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Glencoe-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Granby-----	Typic Endoaquolls, sandy, mixed, mesic
Grovecity-----	Aquic Hapludolls, coarse-loamy, mixed, mesic
Hamel-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Harps-----	Typic Calciaquolls, fine-loamy, mesic
Havelock-----	Cumulic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Hawick-----	Entic Hapludolls, sandy, mixed, mesic
Houghton-----	Typic Medisaprists, euic, mesic
Kanaranzi-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Kandiyohi-----	Aquertic Hapludolls, fine, montmorillonitic, mesic
Kingston-----	Aquic Hapludolls, fine-silty, mixed, mesic
Klossner-----	Terric Medisaprists, loamy, mixed, euic, mesic
Koronis-----	Mollic Hapludalfs, fine-loamy, mixed, mesic
Lester-----	Mollic Hapludalfs, fine-loamy, mixed, mesic
Le Sueur-----	Aquic Argiudolls, fine-loamy, mixed, mesic
Litchfield-----	Aquic Hapludolls, sandy, mixed, mesic
Lundlake-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Lura-----	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Madelia-----	Typic Endoaquolls, fine-silty, mixed, mesic
Marcellon-----	Aquic Argiudolls, fine-loamy, mixed, mesic
Mayer-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic
Medo-----	Terric Medisaprists, loamy, mixed, euic, mesic
Minneopa-----	Aquic Hapludolls, sandy, mixed, mesic
Muskego-----	Limnic Medisaprists, coprogenous, euic, mesic
Newlondon-----	Aquic Eutrochrepts, fine-loamy, mixed, mesic
Nicollet-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Okoboji-----	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Omsrud-----	Typic Hapludolls, fine-loamy, mixed, mesic
Reedslake-----	Typic Argiudolls, fine-loamy, mixed, mesic
Rohrbeck-----	Arenic Hapludalfs, loamy, mixed, mesic
Rolfe-----	Typic Argialbolls, fine, montmorillonitic, mesic
Seaforth-----	Aquic Calciudolls, fine-loamy, mixed, mesic
Shorewood-----	Aquertic Argiudolls, fine, montmorillonitic, mesic
Sparta-----	Entic Hapludolls, sandy, mixed, mesic
Spicer-----	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Storden-----	Typic Eutrochrepts, fine-loamy, mixed, mesic
Strout-----	Vertic Hapludolls, fine, montmorillonitic, mesic
Sunburg-----	Typic Udorthents, coarse-loamy, mixed (calcareous), mesic

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Swanlake-----	Typic Calcudolls, fine-loamy, mixed, mesic
Swedegrove-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Truman-----	Typic Hapludolls, fine-silty, mixed, mesic
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Uniongrove-----	Typic Endoaquolls, coarse-loamy, mixed, mesic
Wadena-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Wadenill-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Waldorf-----	Vertic Epiaquolls, fine, montmorillonitic, mesic
Webster-----	Typic Endoaquolls, fine-loamy, mixed, mesic
Zook-----	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
8B	Sparta loamy sand, 1 to 6 percent slopes-----	3,361	0.8
8C	Sparta loamy sand, 6 to 12 percent slopes-----	992	0.2
8D	Sparta loamy sand, 12 to 25 percent slopes-----	547	0.1
35	Blue Earth mucky silt loam, 0 to 1 percent slopes-----	1,195	0.3
39A	Wadena loam, 0 to 2 percent slopes-----	1,234	0.3
41A	Estherville sandy loam, 0 to 2 percent slopes-----	5,820	1.4
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded-----	1,320	0.3
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes-----	2,709	0.7
96B	Collinwood silty clay loam, 3 to 6 percent slopes-----	1,555	0.4
101B	Truman silt loam, 2 to 6 percent slopes-----	2,339	0.6
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes-----	4,787	1.2
106C2	Lester loam, 6 to 12 percent slopes, eroded-----	1,737	0.4
112	Harps clay loam, 0 to 2 percent slopes-----	1,317	0.3
113	Webster clay loam, 0 to 2 percent slopes-----	4,327	1.0
114	Glencoe clay loam, depressional, 0 to 1 percent slopes-----	1,610	0.4
129	Cylinder loam, 0 to 1 percent slopes-----	1,088	0.3
130	Nicollet clay loam, 1 to 3 percent slopes-----	3,798	0.9
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes-----	3,246	0.8
136	Madelia silty clay loam, 0 to 2 percent slopes-----	2,750	0.7
140	Spicer silty clay loam, 0 to 2 percent slopes-----	2,800	0.7
143B	Chelsea loamy fine sand, 1 to 6 percent slopes-----	762	0.2
178	Granby fine sandy loam, 0 to 1 percent slopes-----	1,196	0.3
181	Litchfield loamy fine sand, 0 to 2 percent slopes-----	3,836	0.9
183	Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes-----	323	*
197	Kingston silty clay loam, 1 to 3 percent slopes-----	3,512	0.9
211	Lura silty clay, depressional, 0 to 1 percent slopes-----	2,933	0.7
229	Waldorf silty clay loam, 0 to 2 percent slopes-----	2,728	0.7
239	Le Sueur clay loam, 1 to 3 percent slopes-----	1,823	0.4
281	Darfur loam, 0 to 2 percent slopes-----	2,363	0.6
286B	Shorewood silty clay loam, 3 to 6 percent slopes-----	1,299	0.3
311C2	Shorewood silty clay, 6 to 12 percent slopes, eroded-----	827	0.2
327A	Dickman sandy loam, 0 to 2 percent slopes-----	3,671	0.9
327B	Dickman sandy loam, 2 to 6 percent slopes-----	1,599	0.4
399	Biscay loam, depressional, 0 to 1 percent slopes-----	442	0.1
415	Kanaranzi loam, 0 to 3 percent slopes-----	4,409	1.1
423	Seaforth loam, 1 to 3 percent slopes-----	1,909	0.5
461B	Koronis loam, 2 to 6 percent slopes-----	19,382	4.7
461C2	Koronis loam, 6 to 12 percent slopes, eroded-----	8,792	2.1
511	Marcellon loam, 0 to 3 percent slopes-----	7,567	1.8
523	Houghton muck, depressional, 0 to 1 percent slopes-----	441	0.1
525	Muskego muck, depressional, 0 to 1 percent slopes-----	1,047	0.3
539	Klossner muck, depressional, 0 to 1 percent slopes-----	3,920	0.9
548	Medo muck, depressional, 0 to 1 percent slopes-----	600	0.1
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded-----	1,178	0.3
611D	Hawick gravelly sandy loam, 12 to 25 percent slopes-----	1,128	0.3
612B	Wadenill loam, 2 to 6 percent slopes-----	6,564	1.6
613	Grovecity loam, 1 to 3 percent slopes-----	5,545	1.3
664	Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded-----	586	0.1
740	Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes-----	6,903	1.7
804B	Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes-----	1,168	0.3
804C2	Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded-----	1,997	0.5
804D2	Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded-----	1,021	0.2
804E	Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes-----	1,509	0.4
805C2	Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded-----	4,222	1.0
805D2	Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded-----	1,105	0.3
807D2	Koronis-Sunburg complex, 12 to 18 percent slopes, eroded-----	2,674	0.6
875B	Estherville-Hawick complex, 2 to 6 percent slopes-----	7,229	1.8
875C	Hawick-Estherville complex, 6 to 12 percent slopes-----	1,980	0.5
887B	Clarion-Swanlake complex, 2 to 6 percent slopes-----	7,263	1.8
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes-----	4,467	1.1
909C2	Bold-Truman complex, 6 to 12 percent slopes, eroded-----	954	0.2
909D2	Bold-Truman complex, 12 to 18 percent slopes, eroded-----	325	*

See footnote at end of table.

Acres and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes-----	1,011	0.2
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded-----	1,003	0.2
945E	Lester-Storden complex, 18 to 40 percent slopes-----	1,595	0.4
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes-----	9,838	2.4
960C2	Storden-Omsrud complex, 6 to 12 percent slopes, eroded-----	9,805	2.4
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded-----	4,655	1.1
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes-----	683	0.2
1015	Udipsamments (cut and fill land)-----	558	0.1
1016	Udortheents, loamy (cut and fill land)-----	788	0.2
1030	Pits, gravel-Udipsamments complex-----	558	0.1
1080	Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes-----	6,223	1.5
1096	Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes-----	4,302	1.0
1097	Mayer-Biscay, depressional, complex, 0 to 2 percent slopes-----	5,668	1.4
1098	Biscay-Biscay, depressional, complex, 0 to 2 percent slopes-----	3,134	0.8
1099	Granby loamy fine sand, very wet, 0 to 1 percent slopes-----	621	0.2
1100	Nicollet silty clay loam, 1 to 3 percent slopes-----	4,560	1.1
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes-----	5,287	1.3
1159B	Strout-Arkton complex, 2 to 6 percent slopes-----	4,769	1.2
1161	Barry loam, 0 to 2 percent slopes-----	3,609	0.9
1162A	Kandiyohi clay, 0 to 2 percent slopes-----	4,506	1.1
1162B	Kandiyohi clay, 2 to 5 percent slopes-----	4,013	1.0
1163	Cohoctah loam, 0 to 2 percent slopes, frequently flooded-----	3,743	0.9
1165	Lundlake silty clay loam, depressional, 0 to 1 percent slopes-----	3,236	0.8
1168	Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes-----	9,982	2.4
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes-----	3,724	0.9
1171C	Newlondon-Strout complex, 6 to 12 percent slopes, eroded-----	4,596	1.1
1171D	Newlondon-Strout complex, 12 to 18 percent slopes, eroded-----	1,074	0.3
1172C	Sparta-Gardencity complex, 6 to 12 percent slopes-----	445	0.1
1173	Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded-----	3,398	0.8
1174	Danielson clay loam, 1 to 3 percent slopes-----	4,900	1.2
1175	Swedegrove loam, 0 to 2 percent slopes-----	4,889	1.2
1176	Litchfield sandy loam, 0 to 2 percent slopes-----	1,009	0.2
1177C	Gardencity-Bold complex, 6 to 12 percent slopes, eroded-----	501	0.1
1178	Uniongrove loam, 0 to 2 percent slopes-----	8,365	2.0
1183	Crowriver loam, 0 to 2 percent slopes-----	5,911	1.4
1184	Corvuso silty clay loam, 0 to 2 percent slopes-----	2,320	0.6
1185	Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes-----	729	0.2
1186	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes-----	8,250	2.0
1192	Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes-----	1,714	0.4
1193	Cosmos silty clay, 0 to 2 percent slopes-----	7,598	1.8
1197	Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded-----	598	0.1
1198B	Rohrbeck-Koronis complex, 1 to 6 percent slopes-----	1,355	0.3
1199	Klossner and Lundlake soils, ponded-----	5,478	1.3
1203	Muskego, Blue Earth, and Houghton soils, ponded-----	21,417	5.2
1204B	Reedslake loam, 2 to 5 percent slopes-----	10,856	2.6
1213C	Cokato-Storden complex, 6 to 12 percent slopes, eroded-----	4,298	1.0
1220C	Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded-----	1,490	0.4
1356	Water, miscellaneous-----	85	*
1362B	Angus loam, 2 to 5 percent slopes-----	2,019	0.5
1383A	Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes-----	817	0.2
1384	Minneopa loam, 0 to 2 percent slopes-----	2,575	0.6
1385	Havelock loam, 0 to 2 percent slopes, frequently flooded-----	31	*
1387A	Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes-----	1,580	0.4
1391B	Wadenill-Sunburg complex, 2 to 6 percent slopes-----	4,971	1.2
1406	Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes-----	3,699	0.9
1801B	Gardencity very fine sandy loam, 2 to 6 percent slopes-----	1,971	0.5
W	Water-----	13,800	3.3
	Total-----	412,900	100.0

* Less than 0.1 percent.

This page intentionally left blank.

Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each series description is followed by descriptions of the associated detailed soil map units.

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units 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. More information about each map unit is given in Part II of this survey.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas 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 "included" areas that belong to other taxonomic classes.

Most included 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, inclusions. They may

or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting inclusions. 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 included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the soil 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 included areas 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 segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, 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. The principal hazards and limitations to be considered in planning for specific uses are described in Part II of this survey.

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, 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, moderately fine substratum, 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 complexes or undifferentiated groups.

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. Clarion-Swanlake complex, 2 to 6 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits component of the Pits, gravel-Udipsamments complex is an example.

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of this survey gives the acreage and proportionate extent of each map unit. Other tables (see Contents) 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 or miscellaneous areas.

Angus Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 5 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Mollic Hapludalfs

Typical Pedon

Angus loam, 2 to 5 percent slopes, 650 feet east and 350 feet south of the northwest corner of sec. 11, T. 118 N., R. 30 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam,

grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 20 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure parting to moderate medium subangular blocky; firm; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common dark brown (10YR 3/3) clay films on faces of peds and in pores; about 3 percent gravel; moderately acid; clear smooth boundary.

Bt2—20 to 29 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure; friable; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common very dark grayish brown (10YR 3/2) clay films in root channels; about 3 percent gravel; moderately acid; gradual smooth boundary.

Bw—29 to 35 inches; light olive brown (2.5Y 5/4) loam; moderate coarse subangular blocky structure; friable; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bk—35 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; friable; about 3 percent gravel; about 1 percent cobbles and stones; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 54 inches

Thickness of the mollic epipedon: 6 to 10 inches

A horizon:

Hue—10YR

Value—2 or 3 moist; 5 or 6 dry

Chroma—1 to 3

Texture—loam or clay loam

Content of rock fragments—1 to 8 percent gravel;
0 to 1 percent cobbles and stones

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Content of rock fragments—1 to 8 percent gravel;
1 to 2 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—4

Texture—loam
 Content of rock fragments—1 to 9 percent gravel;
 1 to 4 percent cobbles and stones

1362B—Angus loam, 2 to 5 percent slopes

Composition

Angus and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Arkton Series

Depth class: Very deep
Drainage class: Moderately well drained

Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 4 to 6 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Arkton clay loam, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 1,700 feet west and 550 feet south of the northeast corner of sec. 12, T. 117 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 25 inches; light olive brown (2.5Y 5/4) clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk2—25 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse prismatic structure parting to moderate fine angular blocky; firm; common coarse distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; few dark yellowish brown (10YR 4/6) iron concentrations in ped interiors; few black (10YR 2/1) concentrations of manganese; about 1 percent gravel; about 4 percent cobbles; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 12 inches

Ap horizon:

Hue—10YR or 2.5Y
 Value—2 or 3
 Chroma—1 or 2
 Texture—clay loam
 Content of rock fragments—1 to 2 percent gravel;
 0 to 4 percent cobbles and stones

Bk horizon:

Hue—2.5Y
 Value—4 or 5

Chroma—2 to 4
 Texture—clay, silty clay, or clay loam
 Content of rock fragments—1 to 5 percent gravel;
 1 to 4 percent cobbles and stones

Barry Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, mesic
 Typic Argiaquolls

Typical Pedon

Barry loam, 0 to 2 percent slopes, 2,450 feet south and 150 feet east of the northwest corner of sec. 9, T. 121 N., R. 31 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

Btg1—11 to 15 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few very dark gray (10YR 3/1) clay films on faces of peds and in pores; 2 percent gravel; neutral; 1 percent cobbles; clear smooth boundary.

Btg2—15 to 28 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few very dark gray (10YR 3/1) clay films on faces of peds and in pores; 4 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

Bkg1—28 to 33 inches; olive gray (5Y 5/2) sandy clay loam; weak medium subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few very dark gray (10YR 3/1) clay films in pores; 3 percent gravel; 1 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—33 to 60 inches; light olive gray (5Y 6/2) sandy loam; weak coarse subangular blocky structure; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; few dark brown (7.5YR

4/4) concentrations of manganese; about 4 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches
Thickness of the mollic epipedon: 10 to 15 inches

A horizon:

Hue—neutral, 10YR, or 2.5Y
 Value—2 or 3
 Chroma—0 or 1
 Texture—loam
 Content of rock fragments—1 to 3 percent gravel;
 1 to 2 percent cobbles and stones

Btg horizon:

Hue—5Y or 2.5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—loam or sandy clay loam
 Content of rock fragments—3 to 6 percent gravel;
 2 to 5 percent cobbles and stones

Bkg horizon:

Hue—5Y
 Value—5 or 6
 Chroma—1 or 2
 Texture—fine sandy loam or sandy loam; thin horizons of loam in some pedons
 Content of rock fragments—4 to 8 percent gravel;
 2 to 6 percent cobbles and stones

1161—Barry loam, 0 to 2 percent slopes

Composition

Barry and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.0 to 2.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Lundlake and similar soils
- Marcellon and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Biscay Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Moderate in the loamy mantle and very rapid in the sandy and gravelly underlying material

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Endoaquolls

Typical Pedon

Biscay loam, in an area of Biscay-Biscay, depressional, complex, 0 to 2 percent slopes, 3,000 feet south and 1,600 feet east of the northwest corner of sec. 36, T. 121 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) loam; weak very fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

A1—9 to 16 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A2—16 to 20 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Bg—20 to 25 inches; olive gray (5Y 5/2) loam; weak fine subangular blocky structure; very friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; common olive gray (5Y 4/2) organic coatings on faces of peds; neutral; clear smooth boundary.

2Cg1—25 to 36 inches; olive gray (5Y 4/2) gravelly coarse sand; single grain; loose; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 20 percent gravel; neutral; clear smooth boundary.

2Cg2—36 to 60 inches; olive gray (5Y 5/2) gravelly coarse sand; single grain; loose; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 25 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the loamy mantle: Commonly 20 to 28 inches; ranges from 20 to 40 inches

Thickness of the mollic epipedon: 16 to 24 inches

A horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—loam, mucky loam, or clay loam

Content of rock fragments—0 to 2 percent gravel

Bg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—0 to 5 percent gravel

2C horizon:

Hue—5Y

Value—4 or 5

Chroma—1 or 2

Texture—stratified loamy coarse sand, loamy sand, coarse sand, or sand or the gravelly analogs of these textures

Content of rock fragments—5 to 50 percent gravel

399—Biscay loam, depressional, 0 to 1 percent slopes

Composition

Biscay and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on outwash plains and terraces

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.0 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1098—Biscay-Biscay, depressional, complex, 0 to 2 percent slopes

Composition

Biscay and similar soils: About 70 percent
 Biscay, depressional, and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Biscay—flats and swales on outwash plains and terraces; Biscay, depressional—depressions on outwash plains and terraces

Slope range: Biscay—0 to 2 percent; Biscay, depressional—0 to 1 percent

Component Description

Biscay

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Biscay, depressional

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.1 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Lake beds and moraines
Parent material: Coprogenous earth
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silt loam, 0 to 1 percent slopes, 1,050 feet west and 200 feet south of the northeast corner of sec. 2, T. 117 N., R. 31 W.

Ap—0 to 8 inches; very dark gray (N 3/0) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak very fine granular structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; common fine roots; 2 percent snail shells and snail-shell fragments; violently effervescent; slightly alkaline; clear smooth boundary.

C1—8 to 20 inches; black (10YR 2/1) mucky silt loam (coprogenous earth), dark gray (5Y 4/1) dry; weak thick platy structure; very friable; few fine prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 4 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

C2—20 to 36 inches; very dark gray (5Y 3/1) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak thick platy structure; very friable; few medium prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 5 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

C3—36 to 60 inches; black (10YR 2/1) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak thick platy structure; friable; few fine prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 5 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the coprogenous earth: 30 to 60 inches

Carbonates: At the surface

Content of rock fragments: 0 to 8 percent snail-shell fragments

Ap horizon:

Hue—10YR, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—mucky silt loam or muck

C horizon:

Hue—10YR to 5Y

Value—2 to 4

Chroma—1 or 2

Texture—silt loam, silty clay loam, loam, or the mucky analogs of these textures

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

Composition

Blue Earth and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Lake beds

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Coprogenous earth

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)

Content of organic matter in the surface layer: About 17.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Bold Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Lake plains, outwash plains, and terraces

Parent material: Lacustrine deposits

Slope range: 6 to 18 percent

Taxonomic classification: Coarse-silty, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Bold silt loam, in an area of Bold-Truman complex, 6 to 12 percent slopes, eroded, 200 feet west and 56 feet north of the southeast corner of sec. 20, T. 120 N., R. 29 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; cloddy; very friable; slightly effervescent; neutral; clear smooth boundary.

Bk1—7 to 20 inches; light olive brown (2.5Y 5/4) silt loam; weak coarse subangular blocky structure; very friable; very few white (10YR 8/2) threads and masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—20 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; weak thin platy structure; very friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; few white (10YR 8/2) threads and masses of calcium carbonate; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 10 inches

A horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—silt loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—silt loam

909C2—Bold-Truman complex, 6 to 12 percent slopes, eroded

Composition

Bold and similar soils: About 55 percent

Truman and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains

Position on the landform: Bold—shoulders and summits; Truman—summits and backslopes

Slope range: 6 to 12 percent

Component Description

Bold

Surface layer texture: Silt loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)

Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Truman

Surface layer texture: Silt loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

909D2—Bold-Truman complex, 12 to 18 percent slopes, eroded

Composition

Bold and similar soils: About 65 percent

Truman and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains

Position on the landform: Bold—backslopes and shoulders; Truman—backslopes
Slope range: 12 to 18 percent

Component Description

Bold

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Truman

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Calco Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent

Taxonomic classification: Fine-silty, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Calco silty clay loam, 0 to 1 percent slopes, frequently flooded, 2,400 feet south and 650 feet east of the northwest corner of sec. 12, T. 117 N., R. 32 W.

A1—0 to 6 inches; very dark gray (N 3/0) silty clay loam; weak fine granular structure; friable; strongly effervescent; slightly alkaline; clear smooth boundary.

A2—6 to 17 inches; black (N 2/0) silty clay loam; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg1—17 to 26 inches; very dark gray (5Y 3/1) silty clay loam; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg2—26 to 39 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg3—39 to 48 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bg4—48 to 55 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg—55 to 60 inches; dark gray (5Y 4/1) clay loam; weak coarse subangular blocky structure; friable; common medium prominent olive brown (2.5Y 4/4) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 40 to more than 60 inches

A horizon:

Hue—10YR, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silt loam or silty clay loam

Bg horizon:

Hue—5Y or neutral

Value—3
 Chroma—0 or 1
 Texture—silty clay loam

Cg horizon:

Hue—5Y or neutral
 Value—4
 Chroma—0 or 1
 Texture—mainly silty clay loam; loam, clay loam,
 or silty clay loam below a depth of 40 inches

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

Composition

Calco and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Occasional (fig. 9)
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

610—Calco silty clay loam, 0 to 1 percent slopes, frequently flooded

Composition

Calco and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 13.1 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Canisteo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed (calcareous), mesic Typic Endoaquolls



Figure 9.—An area of Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded, during flood stage.

Typical Pedon

Canisteo clay loam, in an area of Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes, 2,550 feet west and 75 feet north of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; slightly effervescent; slightly alkaline; clear smooth boundary.

A—8 to 17 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

AB—17 to 23 inches; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular

blocky; friable; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg1—23 to 32 inches; dark gray (5Y 4/1) clay loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many very dark gray (5Y 3/1) organic coatings on faces of peds; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—32 to 41 inches; olive gray (5Y 5/2) clay loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones;

strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—41 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure; friable; many medium prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 14 to 24 inches

A horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—clay loam or silty clay loam

Content of rock fragments—1 to 5 percent gravel;
0 to 1 percent cobbles and stones

Bkg horizon, upper part:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

Content of rock fragments—2 to 4 percent gravel;
2 to 4 percent cobbles and stones

Bkg horizon, lower part:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—clay loam or loam

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

86—Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

956—Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 65 percent

Glencoe and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Canisteo—rims of depressions and flats on moraines; Glencoe—depressions on moraines

Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent

Component Description

Canisteo

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

Glencoe

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Chelsea Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 1 to 6 percent
Taxonomic classification: Mixed, mesic Argic Udipsamments

Typical Pedon

Chelsea loamy fine sand, 1 to 6 percent slopes, 1,300 feet north and 1,600 feet east of the southwest corner of sec. 11, T. 119 N., R. 30 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.
 E—6 to 10 inches; dark brown (10YR 4/3) loamy fine

sand; weak very fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.
 E&Bt—10 to 60 inches; loamy fine sand, brown (10YR 5/3) in the upper part and pale brown (10YR 6/3) in the lower part (E); weak fine subangular blocky structure; very friable; discontinuous bands of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) fine sandy loam and loamy fine sand 1/2 inch to 2 inches thick; few very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; slightly acid.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

A horizon:

Hue—10YR
 Value—3
 Chroma—1 to 3
 Texture—loamy fine sand

E horizon:

Hue—10YR
 Value—4 to 6
 Chroma—2 to 6
 Texture—fine sand or loamy fine sand

E&Bt horizon (Bt part):

Hue—10YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—loamy fine sand or fine sandy loam

143B—Chelsea loamy fine sand, 1 to 6 percent slopes**Composition**

Chelsea and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 1 to 6 percent

Component Description

Surface layer texture: Loamy fine sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)

Content of organic matter in the surface layer: About 0.75 percent (low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Granby and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Clarion Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 5 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Typic Hapludolls

Typical Pedon

Clarion loam, in an area of Clarion-Swanlake complex, 2 to 6 percent slopes, 1,400 feet west and 1,500 feet north of the southeast corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; abrupt smooth boundary.

Bw1—11 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; very many brown (10YR 4/3) organic coatings on faces of peds and in pores; 1 percent gravel; 2 percent cobbles and stones; slightly acid; gradual smooth boundary.

Bw2—23 to 30 inches; light olive brown (2.5Y 5/4) clay loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; very many brown (10YR 4/3) organic

coatings on faces of peds and in pores; 2 percent gravel; 2 percent cobbles and stones; neutral; clear smooth boundary.

Bk—30 to 60 inches; weak coarse subangular blocky structure parting to weak thin platy; friable; light yellowish brown (2.5Y 6/4) loam; few fine prominent olive (5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Content of rock fragments—1 to 4 percent gravel;
1 to 4 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—4

Texture—loam

Content of rock fragments—3 to 5 percent gravel;
3 to 5 percent cobbles and stones

102B—Clarion loam, moderately fine substratum, 2 to 5 percent slopes

Composition

Clarion and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

887B—Clarion-Swanlake complex, 2 to 6 percent slopes

Composition

Clarion and similar soils: About 70 percent
 Swanlake and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Clarion—summits and backslopes; Swanlake—shoulders and summits
Slope range: Clarion—2 to 5 percent; Swanlake—4 to 6 percent

Component Description

Clarion

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet

Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

Swanlake

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

920B—Clarion-Storden-Hawick complex, 2 to 6 percent slopes

Composition

Clarion and similar soils: About 50 percent
 Storden and similar soils: About 20 percent
 Hawick and similar soils: About 15 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Clarion—summits and backslopes; Storden and Hawick—shoulders and summits
Slope range: Clarion—2 to 5 percent; Storden—4 to 6 percent; Hawick—2 to 6 percent

Component Description

Clarion

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)

Content of organic matter in the surface layer: About 4.5 percent (high)

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)

Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cohoctah Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed, mesic Fluvaquentic Endoaquolls

Taxonomic features: The Cohoctah soil in map unit 1197 has a mollic epipedon more than 24 inches thick.

Typical Pedon

Cohoctah loam, 0 to 2 percent slopes, frequently flooded, 850 feet east and 475 feet south of the northwest corner of sec. 12, T. 120 N., R. 31 W.

A1—0 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; very friable; common fine roots; strongly effervescent; slightly alkaline; clear smooth boundary.

A2—17 to 22 inches; very dark gray (5Y 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; few fine prominent olive brown (2.5Y 4/4) iron concentrations; few fine roots; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg—22 to 60 inches; stratified black (10YR 2/1) and dark gray (5Y 3/1 and 4/1) loamy fine sand and gray (5Y 6/1) fine sand; weak very fine subangular blocky structure in the finer textured parts; very friable; common fine prominent dark yellowish brown (10YR 4/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches

Thickness of the mollic epipedon: 10 to 24 inches

Ap horizon (if it occurs):

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or fine sandy loam

A horizon:

Hue—neutral, 5Y, or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—fine sandy loam, sandy loam, or loam

Cg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—2 to 6

Chroma—1 or 2

Texture—stratified sand and fine sand and the loamy analogs of these textures; sandy loam, fine sandy loam, and very fine sandy loam; or silt loam that contains less than 20 percent clay

Content of rock fragments—0 to 5 percent gravel; a small amount of shell fragments in some pedons

1163—Cohoctah loam, 0 to 2 percent slopes, frequently flooded

Composition

Cohoctah and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 80 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 7.4 inches (moderate)

Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1197—Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded

Composition

Cohoctah and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)

Content of organic matter in the surface layer: About 9 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cokato Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 6 to 12 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Typic Argiudolls

Typical Pedon

Cokato loam, in an area of Cokato-Storden complex, 6 to 12 percent slopes, eroded, 1,000 feet east and 1,700 feet north of the southwest corner of sec. 26, T. 118 N., R. 30 W.

A1—0 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A2—12 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear smooth boundary.

Bt1—16 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; common very dark brown (10YR 2/2) clay films in pores and on faces of peds; about 2 percent gravel; neutral; clear smooth boundary.

Bt2—25 to 35 inches; light olive brown (2.5Y 5/4) clay loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; few very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; about 2 percent gravel; neutral; clear smooth boundary.

Bt3—35 to 41 inches; light olive brown (2.5Y 5/4) clay loam; moderate coarse subangular blocky structure; friable; few fine distinct light brownish gray (2.5Y 6/2) relict iron depletions; few very dark brown (10YR 2/2) clay films in pores and channels and on faces of peds; about 2 percent gravel; about 1 percent cobbles; neutral; clear wavy boundary.

Bk—41 to 60 inches; light olive brown (2.5Y 5/4) and light yellowish brown (2.5Y 6/3) loam; weak coarse subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/8) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 3 percent gravel; about 1 percent cobbles; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—4

Texture—loam or clay loam

Content of rock fragments—1 to 3 percent gravel;
0 to 4 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—loam

Content of rock fragments—3 to 5 percent gravel;
1 to 3 percent cobbles and stones

1213C—Cokato-Storden complex, 6 to 12 percent slopes, eroded

Composition

Cokato and similar soils: About 70 percent

Storden and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Cokato—summits and
backslopes; Storden—shoulders and summits

Slope range: 6 to 12 percent

Component Description

Cokato

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 10.3 inches (high)

Content of organic matter in the surface layer: About 4
percent (high)

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Hamel and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1220C—Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Cokato and similar soils: About 55 percent
 Storden and similar soils: About 20 percent
 Hawick and similar soils: About 15 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Cokato—summits and backslopes; Storden and Hawick—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Cokato

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)

Content of organic matter in the surface layer: About 4 percent (high)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Hamel and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Collinwood Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Slow

Landform: Lake plains

Parent material: Lacustrine deposits

Slope range: 0 to 6 percent

Taxonomic classification: Fine, montmorillonitic, mesic
Aquertic Hapludolls

Typical Pedon

Collinwood silty clay loam, 3 to 6 percent slopes, 500 feet south and 2,100 feet east of the northwest corner of sec. 24, T. 120 N., R. 30 W.

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

A—8 to 16 inches; very dark grayish brown (2.5Y 3/2) and very dark brown (10YR 2/2) silty clay; strong fine angular blocky structure parting to strong very fine angular blocky; firm; slightly acid; clear smooth boundary.

Bw1—16 to 24 inches; dark grayish brown (2.5Y 4/2) and very dark grayish brown (2.5Y 3/2) silty clay; strong fine prismatic structure parting to moderate very fine angular blocky; firm; neutral; clear smooth boundary.

Bw2—24 to 32 inches; light olive brown (2.5Y 5/4) and olive brown (2.5Y 4/4) silty clay loam; moderate medium prismatic structure parting to moderate very fine angular blocky; firm; few fine faint grayish brown (2.5Y 5/2) iron depletions; neutral; clear smooth boundary.

C1—32 to 38 inches; light yellowish brown (2.5Y 6/4) silty clay loam; weak coarse prismatic structure parting to moderate coarse subangular blocky; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations and few light brownish gray (2.5Y 6/2) iron depletions; strongly effervescent; slightly alkaline; clear smooth boundary.

C2—38 to 60 inches; light yellowish brown (2.5Y 6/4), stratified silty clay loam and silt loam; weak coarse subangular blocky structure parting to weak thin platy; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations and few light brownish gray (2.5Y 6/2) iron depletions; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 46 inches

Thickness of the mollic epipedon: 14 to 24 inches

Other features: In some pedons the C horizon consists of alternating strata of silty clay and silty clay loam and silt loam.

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silty clay loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—silty clay, clay, or silty clay loam (content of clay averages 35 to 55 percent)

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—silty clay, clay, or silty clay loam

96B—Collinwood silty clay loam, 3 to 6 percent slopes

Composition

Collinwood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains

Position on the landform: Summits and backslopes

Slope range: 3 to 6 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1387A—Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes

Composition

Collinwood and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)

Content of organic matter in the surface layer: About 6.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Rolfe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cordova Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Typic Argiaquolls

Typical Pedon

Cordova clay loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 1,525 feet north and 1,150 feet east of the southwest corner of sec. 1, T. 118 N., R. 29 W.

Ap—0 to 11 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine angular blocky structure; friable; slightly acid; clear smooth boundary.

AE—11 to 15 inches; very dark gray (N 3/0) clay loam, gray (N 5/0) dry; moderate fine angular blocky structure; friable; common white (10YR 8/2) sand coatings on faces of peds and in pores; 1 percent gravel; slightly acid; clear smooth boundary.

Btg1—15 to 24 inches; olive gray (5Y 4/2) clay loam; moderate fine prismatic structure; firm; common very dark grayish brown (2.5Y 3/2) clay films on faces of peds; common white (10YR 8/2) sand coatings on faces of peds and in pores; 1 percent gravel; slightly acid; clear smooth boundary.

Btg2—24 to 33 inches; olive gray (5Y 5/2) clay loam; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common fine distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; 2 percent gravel; slightly acid; clear smooth boundary.

Btg3—33 to 39 inches; light olive gray (5Y 6/2) clay loam; weak coarse prismatic structure parting to weak coarse subangular blocky; firm; common fine distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; 2 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.

Bkg—39 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; firm; many medium distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches

Thickness of the mollic epipedon: 10 to 24 inches

A horizon:

Hue—neutral or 10YR
 Value—2 or 3
 Chroma—0 or 1
 Texture—clay loam
 Content of rock fragments—0 to 2 percent gravel;
 0 to 2 percent cobbles and stones

Btg horizon:

Hue—5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam or clay loam
 Content of rock fragments—1 to 4 percent gravel;
 1 to 3 percent cobbles and stones

Bkg horizon:

Hue—5Y
 Value—5 or 6
 Chroma—2
 Texture—loam or clay loam
 Content of rock fragments—2 to 4 percent gravel;
 2 to 4 percent cobbles and stones

978—Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes

Composition

Cordova and similar soils: About 60 percent
 Rolfe and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Cordova—drainageways and flats; Rolfe—depressions

Slope range: Cordova—0 to 2 percent; Rolfe—0 to 1 percent

Component Description

Cordova

Surface layer texture: Clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

Rolfe

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Corvuso Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, mesic Typic Calciaquolls

Typical Pedon

Corvuso clay loam, in an area of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes, 2,200 feet west and 50 feet south of the northeast corner of sec. 34, T. 117 N., R. 32 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, black (N 2/0) dry; weak fine angular blocky structure;

friable; about 1 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak—8 to 11 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; carbonates disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg1—11 to 15 inches; gray (5Y 5/1) clay; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; common threads and masses of calcium carbonate disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg2—15 to 28 inches; olive gray (5Y 5/2) clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; common threads and masses of calcium carbonate disseminated throughout; 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2BCg—28 to 60 inches; olive gray (5Y 5/2) clay loam; weak medium prismatic structure parting to weak fine angular blocky; very firm; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; few threads and masses of calcium carbonate; 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 12 to 24 inches

Thickness of lacustrine deposits: 15 to 60 inches

Ap horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—clay loam or silty clay loam

Content of rock fragments—0 to 1 percent gravel

Ak horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—silty clay, silty clay loam, or clay loam

Content of rock fragments—0 to 1 percent gravel

Bkg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay loam, silty clay, or clay

Content of rock fragments—0 to 4 percent gravel;
0 to 2 percent cobbles and stones

2BCg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam, silty clay, or clay

Content of rock fragments—1 to 4 percent gravel;
1 to 2 percent cobbles and stones

1169—Corvuso-Lura, depressional, complex, 0 to 2 percent slopes

Composition

Corvuso and similar soils: About 60 percent

Lura and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Corvuso—rims of depressions and flats; Lura—depressions (fig. 10)

Slope range: Corvuso—0 to 2 percent; Lura—0 to 1 percent

Component Description

Corvuso

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)

Content of organic matter in the surface layer: About 5.5 percent (high)

Lura

Surface layer texture: Silty clay

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long



Figure 10.—The soil in the ponded areas in this field is the Lura component of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes. The ponding reduces crop yields in areas of this map unit.

Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)

Content of organic matter in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandiyohi and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1184—Corvuso silty clay loam, 0 to 2 percent slopes

Composition

Corvuso and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 8.6 inches (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cosmos Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic classification: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Cosmos silty clay, 0 to 2 percent slopes (fig. 11), 425 feet east and 110 feet north of the southwest corner of sec. 23, T. 117 N., R. 32 W.

Ap—0 to 7 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; abrupt smooth boundary.

A—7 to 15 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

ABg—15 to 20 inches; very dark gray (10YR 3/1) silty clay, dark gray (N 4/0) dry; strong medium angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

Btg—20 to 30 inches; olive gray (5Y 5/2) silty clay; weak coarse prismatic structure parting to strong very fine angular blocky; firm; common olive gray (5Y 4/2) clay films on faces of peds; few light gray or gray (10YR 6/1) crystals of gypsum; neutral; clear broken boundary.

Btkg—30 to 36 inches; olive gray (5Y 5/2) silty clay; moderate very coarse prismatic structure parting to strong fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many olive gray (5Y 4/2) stress surfaces on faces of peds; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear broken boundary.

2Bkg—36 to 60 inches; olive gray (5Y 5/2) clay loam; moderate fine angular blocky structure; firm; many medium prominent dark yellowish brown (10YR 4/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; many stress surfaces on faces of peds; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of lacustrine sediment: 24 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

A horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

Content of rock fragments—0 to 1 percent gravel

Btg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay, clay, or silty clay loam

Content of rock fragments—0 to 1 percent gravel

Btkg horizon:

Hue—2.5Y or 5Y

Chroma—5 or 6

Value—2

Texture—silty clay, clay, or silty clay loam

Content of rock fragments—0 to 1 percent gravel; 0 to 1 percent cobbles

2Bkg horizon:

Hue—5Y

Value—5 or 6

Chroma—2

Texture—silty clay, clay, silty clay loam, or clay loam

Content of rock fragments—2 to 4 percent gravel;
1 to 3 percent cobbles and stones**1193—Cosmos silty clay, 0 to 2 percent slopes****Composition**

Cosmos and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Drainageways and flats on moraines*Slope range:* 0 to 2 percent**Component Description***Surface layer texture:* Silty clay*Depth to bedrock:* Greater than 60 inches*Drainage class:* Poorly drained*Dominant parent material:* Glaciolacustrine deposits over till*Flooding:* None*Depth to the water table:* 0.5 foot to 1.5 feet*Kind of water table:* Perched*Available water capacity to 60 inches or root-limiting layer:* About 9.2 inches (high)*Content of organic matter in the surface layer:* About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Corvuso and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Crowriver Series*Depth class:* Very deep*Drainage class:* Poorly drained*Permeability:* Moderately rapid*Landform:* Moraines*Parent material:* Till*Slope range:* 0 to 2 percent*Taxonomic classification:* Coarse-loamy, mesic Typic Calciaquolls**Typical Pedon**

Crowriver fine sandy loam, in an area of Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes, 200 feet south and 1,100 feet west of the northeast corner of sec. 29, T. 121 N., R. 32 W.

Apk—0 to 9 inches; black (N 2/0) fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; secondary lime disseminated throughout; 1 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Ak—9 to 13 inches; black (N 2/0) fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; secondary lime disseminated throughout; 1 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

ABk—13 to 17 inches; dark gray (10YR 4/1) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; few light olive gray (5Y 6/2) carbonate coatings on faces of peds; 2 percent gravel; 4 percent cobbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg1—17 to 29 inches; light olive gray (5Y 6/2) fine sandy loam; weak medium subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 6 percent cobbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—29 to 45 inches; light olive gray (5Y 6/2) fine sandy loam; weak medium subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly

throughout the horizon; about 3 percent gravel; 8 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—45 to 60 inches; light olive gray (5Y 6/2) fine sandy loam; weak coarse subangular blocky structure parting to weak thin platy; very friable; many medium prominent yellowish brown (10YR 5/8) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 4 percent gravel; 8 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 10 to 16 inches

Ak horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—fine sandy loam or loam

Content of rock fragments—1 to 3 percent gravel;
1 to 3 percent cobbles and stones

Bkg horizon, upper part:

Hue—2.5Y, 5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

Texture—loam, fine sandy loam, sandy loam, or
sandy clay loam

Content of rock fragments—3 to 7 percent gravel;
3 to 6 percent cobbles and stones

Bkg horizon, lower part:

Hue—5Y or 2.5Y

Value—5 or 6

Chroma—2 or 3

Texture—fine sandy loam, sandy loam, or loam
high in sand

Content of rock fragments—3 to 8 percent gravel;
3 to 8 percent cobbles and stones

1183—Crowriver loam, 0 to 2 percent slopes

Composition

Crowriver and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)

Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils
- Swedegrove and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1192—Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes

Composition

Crowriver and similar soils: About 70 percent

Lundlake and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Crowriver—rims of depressions and flats; Lundlake—depressions

Slope range: Crowriver—0 to 2 percent; Lundlake—0 to 1 percent

Component Description

Crowriver

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None**Depth to the water table:** 0.5 foot to 1.5 feet**Kind of water table:** Apparent**Available water capacity to 60 inches or root-limiting layer:** About 8.2 inches (moderate)**Content of organic matter in the surface layer:** About 5 percent (high)**Lundlake****Surface layer texture:** Loam**Depth to bedrock:** Greater than 80 inches**Drainage class:** Very poorly drained**Dominant parent material:** Till**Flooding:** None**Seasonal high water table:** 1.0 foot above to 0.5 foot below the surface**Kind of water table:** Apparent**Ponding duration:** Very long**Available water capacity to 60 inches or root-limiting layer:** About 9.8 inches (high)**Content of organic matter in the surface layer:** About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cylinder Series**Depth class:** Very deep**Drainage class:** Somewhat poorly drained**Permeability:** Moderate in the loamy mantle and very rapid in the underlying sand and gravel**Landform:** Outwash plains and terraces**Parent material:** Glacial outwash**Slope range:** 0 to 1 percent**Taxonomic classification:** Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls**Typical Pedon**

Cylinder loam, 0 to 1 percent slopes, 1,500 feet north and 1,600 feet west of the southeast corner of sec. 8, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; 1 percent gravel; slightly acid; clear smooth boundary.

A—10 to 15 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; 1 percent gravel; slightly acid; clear smooth boundary.

Bw1—15 to 31 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine distinct olive brown (2.5Y 4/4) iron concentrations; 1 percent gravel; slightly acid; clear smooth boundary.

2Bw2—31 to 40 inches; light brownish gray (2.5Y 6/2) gravelly sand; single grain; loose; many medium distinct light olive brown (2.5Y 5/6) and common yellowish brown (10YR 5/6) iron concentrations; 20 percent gravel; neutral; clear smooth boundary.

2Bk—40 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand; single grain; loose; 20 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on the underside of pebbles and fragments of very coarse sand; slightly effervescent; slightly alkaline.

Range in Characteristics**Depth to carbonates:** 24 to 48 inches**Thickness of the loamy mantle:** 24 to 40 inches**Thickness of the mollic epipedon:** 14 to 24 inches**A horizon:**

Hue—10YR

Value—2

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 1 percent

Bw horizon:

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—2

Texture—loam

Content of rock fragments—0 to 2 percent gravel

2Bk horizon:

Hue—2.5Y

Value—3 to 6

Chroma—2 to 6

Texture—stratified sand, coarse sand, or the gravelly or very gravelly analogs of these textures

Content of rock fragments—0 to 50 percent gravel

129—Cylinder loam, 0 to 1 percent slopes

Composition

Cylinder and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2 to 4 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 6.9 inches (moderate)

Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Wadena and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Danielson Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Colluvium over till

Slope range: 1 to 3 percent

Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Epiaquolls

Typical Pedon

Danielson clay loam, 1 to 3 percent slopes, 1,700 feet south and 400 feet west of the northeast corner of sec. 14, T. 118 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine angular blocky clods; friable; neutral; clear smooth boundary.

A1—9 to 19 inches; black (N 2/0) silty clay, very dark gray (N 2/0) dry; moderate very fine angular blocky structure; friable; neutral; gradual smooth boundary.

A2—19 to 31 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

AB—31 to 36 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

Bg1—36 to 51 inches; dark gray (5Y 4/1) silty clay; moderate medium prismatic structure parting to strong fine angular blocky; firm; neutral; clear smooth boundary.

2Bg2—51 to 60 inches; strong medium prismatic structure parting to strong fine angular blocky; firm; olive gray (5Y 5/2) silty clay loam; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; neutral; about 1 percent gravel; about 1 percent cobbles and stones.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

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

Ap horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—clay loam or silty clay loam

A horizons:

Hue—neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam, silty clay, or silty clay loam

Bg horizon:

Hue—5Y

Value—4 or 5
 Chroma—1 or 2
 Texture—silty clay, clay, or silty clay loam
 Content of rock fragments—0 to 1 percent gravel

2Bg or 2BC horizon (if it occurs):

Hue—5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—silty clay, silty clay loam, clay, or clay loam
 Content of rock fragments—1 to 5 percent gravel;
 2 to 4 percent cobbles and stones

1174—Danielson clay loam, 1 to 3 percent slopes

Composition

Danielson and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Drainageways on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Poorly drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Strout and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Darfur Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Darfur loam, 0 to 2 percent slopes, 1,450 feet south and 150 feet west of the northeast corner of sec. 1, T. 119 N., R. 31 W.

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

A—10 to 19 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

AB—19 to 23 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg1—23 to 30 inches; olive gray (5Y 4/2) very fine sandy loam; weak fine subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; clear smooth boundary.

Bg2—30 to 39 inches; olive gray (5Y 5/2) loamy very fine sand; weak fine subangular blocky structure; very friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; neutral; clear smooth boundary.

Cg—39 to 60 inches; olive gray (5Y 5/2) very fine sand; single grain; loose; few fine distinct olive (5Y 5/4) iron concentrations; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 14 to 24 inches

Ap horizon:

Hue—10YR or neutral
 Value—2 or 3

Chroma—0 or 1
Texture—loam

A horizons:

Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or very fine sandy loam

Bg horizon:

Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, very fine sandy loam, or fine sandy loam or stratified with fine sand, fine sandy loam, very fine sand, very fine sandy loam, sand, or sandy loam

Cg horizon:

Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—fine sand, loamy fine sand, very fine sand, or loamy very fine sand or stratified with sandy loam, fine sandy loam, very fine sandy loam, or loam

281—Darfur loam, 0 to 2 percent slopes**Composition**

Darfur and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on outwash plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter in the surface layer: About 6.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in

the “Soil Properties” section in Part II of this publication.

Inclusions

- Dassel and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dassel Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid in the upper mantle; rapid in the lower part of the subsoil and in the underlying material

Landform: Deltas, outwash plains, and terraces

Parent material: Glaciolacustrine deposits or glacial outwash

Slope range: 0 to 1 percent

Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes, 2,425 feet north and 1,875 feet east of the southwest corner of sec. 13, T. 121 N., R. 31 W.

- Ap—0 to 6 inches; black (N 2/0) mucky fine sandy loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; very friable; common fine prominent gray (5Y 6/1) iron depletions; slightly acid; clear smooth boundary.
- A1—6 to 14 inches; black (N 2/0) very fine sandy loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; common fine prominent dark brown (7.5YR 4/4) iron concentrations; slightly acid; clear smooth boundary.
- A2—14 to 23 inches; very dark gray (10YR 3/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
- Bgw—23 to 31 inches; olive gray (5Y 5/2) loamy very fine sand; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
- Cg—31 to 60 inches; olive gray (5Y 5/2) fine sand; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:

Hue—10YR or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—mucky fine sandy loam, loam, or fine sandy loam

Bg horizon:

Hue—5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—dominantly stratified loamy very fine sand, very fine sandy loam, or fine sandy loam; subhorizons that are dominantly fine sand, loamy fine sand, or fine sandy loam or the very fine sand and medium sand analogs of these textures in some pedons

Cg horizon:

Hue—5Y, 5GY, 5G, or 5BG
 Value—4 to 6
 Chroma—1 or 2
 Texture—fine sand, loamy fine sand, very fine sand, or loamy very fine sand or stratified; subhorizons that are dominantly fine sand, loamy fine sand, or fine sandy loam or the very fine sand and medium sand analogs of these textures in stratified pedons

183—Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes

Composition

Dassel and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Depressions on outwash plains and deltas
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 8.6 inches (moderate)

Content of organic matter in the surface layer: About 11.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dickman Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Rapid

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 6 percent

Taxonomic classification: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickman sandy loam, 0 to 2 percent slopes, 2,450 feet north and 1,800 feet east of the southwest corner of sec. 12, T. 120 N., R. 31 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; 1 percent gravel; moderately acid; clear smooth boundary.

AB—12 to 15 inches; dark brown (10YR 3/3) sandy loam; weak very fine subangular blocky structure; very friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; 1 percent gravel; slightly acid; clear smooth boundary.

Bw1—15 to 18 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; common dark brown (10YR 3/3) organic

coatings on faces of peds; 1 percent gravel; slightly acid; clear smooth boundary.

2Bw2—18 to 25 inches; dark brown (10YR 4/3) loamy sand; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few dark brown (10YR 3/3) organic coatings on faces of peds; 10 percent gravel; slightly acid; clear smooth boundary.

2BC—25 to 36 inches; dark brown (10YR 4/3) sand; weak fine subangular blocky structure; very friable; 10 percent gravel; neutral; abrupt smooth boundary.

2C—36 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; 10 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: Greater than 30 inches

Thickness of the loamy mantle: 12 to 20 inches

Thickness of the mollic epipedon: 10 to 20 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—7.5YR or 10YR

Value—3 or 4

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—0 to 10 percent gravel

2Bw horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—2 to 4

Texture—loamy sand, fine sand, sand, or coarse sand

Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—coarse sand, sand, or fine sand

Content of rock fragments—0 to 15 percent gravel

327A—Dickman sandy loam, 0 to 2 percent slopes

Composition

Dickman and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.4 inches (low)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

327B—Dickman sandy loam, 2 to 6 percent slopes

Composition

Dickman and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.4 inches (low)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Litchfield and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Estherville Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Moderately rapid in the loamy mantle and very rapid in the underlying sand and gravel

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 12 percent

Taxonomic classification: Sandy, mixed, mesic Typic Hapludolls

Taxadjunct features: The Estherville soil in map unit 875C is shallower to carbonates (13 inches) than is defined as the range for the series.

Typical Pedon

Estherville sandy loam, 0 to 2 percent slopes, 1,500 feet west and 200 feet north of the southeast corner of sec. 31, T. 121 N., R. 31 W.

Ap—0 to 6 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very friable; few fine roots; 2 percent gravel; neutral; clear smooth boundary.

A—6 to 12 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry;

moderate medium subangular blocky structure; very friable; 2 percent gravel; neutral; clear smooth boundary.

Bw1—12 to 15 inches; dark brown (10YR 3/3) sandy loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; 5 percent gravel; slightly acid; abrupt wavy boundary.

2Bw2—15 to 27 inches; dark brown (10YR 4/3) sand; weak medium subangular blocky structure; loose; 10 percent gravel; neutral; abrupt smooth boundary.

2Bk1—27 to 38 inches; grayish brown (10YR 5/2) gravelly coarse sand; single grain; loose; 25 percent gravel (common shale fragments); common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

2Bk2—38 to 60 inches; dark brown (7.5YR 4/4) gravelly coarse sand; single grain; loose; 20 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches

Thickness of the loamy mantle: 12 to 20 inches

Thickness of the mollic epipedon: 8 to 18 inches

A horizon:

Hue—10YR

Value—2

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—3 or 4

Chroma—3 or 4

Texture—sandy loam or coarse sandy loam

Content of rock fragments—2 to 10 percent gravel

2Bw and 2Bk horizons:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 to 4

Texture—sand, coarse sand, or gravelly coarse sand

Content of rock fragments—15 to 35 percent gravel

41A—Estherville sandy loam, 0 to 2 percent slopes

Composition

Estherville and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

875B—Estherville-Hawick complex, 2 to 6 percent slopes

Composition

Estherville and similar soils: About 60 percent
Hawick and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Estherville

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

Hawick

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Fieldon Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately rapid in the upper mantle; rapid in the lower part of the subsoil and in the underlying material
Landform: Deltas and outwash plains
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Fieldon loam, in an area of Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes, 2,000 feet north and 2,000 feet west of the southeast corner of sec. 1, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (N 2/0) loam; weak fine subangular blocky structure; very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) loam; weak fine subangular blocky structure; very friable; violently effervescent; moderately alkaline; clear smooth boundary.

Bg—14 to 20 inches; dark gray (10YR 4/1) loam; weak fine subangular blocky structure; very friable; violently effervescent; moderately alkaline; clear smooth boundary.

Cg1—20 to 26 inches; light olive gray (5Y 6/2) very fine sandy loam; weak fine subangular blocky structure; very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg2—26 to 32 inches; light olive gray (5Y 6/2) loamy very fine sand; weak medium subangular blocky structure; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg3—32 to 60 inches; stratified, light olive gray (5Y 6/2) and gray (5Y 6/1) loamy very fine sand and fine sand; weak fine subangular blocky structure; very friable; common medium prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 14 to 24 inches

Ap horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—loam

A horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—loam or fine sandy loam

Bg horizon:

Hue—5Y to 10YR

Value—4 to 6

Chroma—1 or 2

Texture—stratified silt loam, loam, very fine sandy loam, loamy very fine sand, or loamy fine sand

Cg horizon:

Hue—5Y

Value—5 or 6

Chroma—1 or 2

Texture—stratified fine sand, loamy fine sand, fine sandy loam, or the very fine sand analogs of these textures

1096—Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes

Composition

Fieldon and similar soils: About 70 percent

Dassel and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and deltas

Position on the landform: Fieldon—flats and drainageways; Dassel—depressions

Slope range: Fieldon—0 to 2 percent; Dassel—0 to 1 percent

Component Description

Fieldon

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 6.8 inches (moderate)

Content of organic matter in the surface layer: About 6.5 percent (high)

Dassel

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)

Content of organic matter in the surface layer: About 11.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Forestcity Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Local alluvium over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Forestcity fine sandy loam, in an area of Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes, 2,550 feet east and 2,550 feet south of the northwest corner of sec. 34, T. 121 N., R. 29 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

A1—10 to 22 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; slightly acid; clear smooth boundary.

A2—22 to 36 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; very friable; black (N 2/0) coatings of organic matter on many ped

faces; about 1 percent gravel; slightly acid; gradual smooth boundary.

AB—36 to 43 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine prismatic structure parting to moderate fine angular blocky; friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; about 2 percent gravel; slightly acid; clear smooth boundary.

2Btg1—43 to 48 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 4 percent gravel; about 1 percent cobbles; moderately acid; gradual smooth boundary.

2Btg2—48 to 60 inches; olive gray (5Y 5/2) sandy clay loam; moderate coarse prismatic structure parting to moderate coarse angular blocky; friable; common fine distinct light olive brown (2.5Y 5/4) iron concentrations; very many very dark gray (10YR 3/1) clay films on faces of peds and in pores; few fine faint light gray (5Y 6/1) iron depletions; about 6 percent gravel; about 2 percent cobbles; slightly acid; clear smooth boundary.

2Btg3—60 to 65 inches; light olive gray (5Y 6/2) sandy loam; weak coarse prismatic structure parting to weak coarse subangular blocky; very friable; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; common very dark gray (10YR 3/1) clay films on faces of peds; about 6 percent gravel; about 3 percent cobbles; very slightly effervescent; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Thickness of the mollic epipedon: 24 to 54 inches

Other features: Some pedons have a 2Bg or 2Bkg horizon.

Ap or A1 horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Content of rock fragments—0 to 2 percent gravel; 0 to 2 percent cobbles and stones

A2 horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam, sandy clay loam, or clay loam

Content of rock fragments—0 to 2 percent gravel;
0 to 2 percent cobbles and stones

2Btg horizon:

Hue—10YR, 2.5Y, or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam
Content of rock fragments—2 to 6 percent gravel;
2 to 4 percent cobbles and stones

**1186—Forestcity-Lundlake, depressional,
complex, 0 to 3 percent slopes**

Composition

Forestcity and similar soils: About 80 percent
Lundlake and similar soils: About 15 percent
Inclusions: About 5 percent

Setting

Landform: Moraines

Position on the landform: Forestcity—drainageways;
Lundlake—depressions

Slope range: Forestcity—0 to 3 percent; Lundlake—0
to 1 percent

Component Description

Forestcity

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Local alluvium over glacial
till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

*Available water capacity to 60 inches or root-limiting
layer:* About 8.8 inches (moderate)

Content of organic matter in the surface layer: About 6
percent (high)

Lundlake

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot
below the surface

Kind of water table: Apparent

Ponding duration: Very long

*Available water capacity to 60 inches or root-limiting
layer:* About 10.3 inches (high)

Content of organic matter in the surface layer: About
8.5 percent (very high)

A typical soil series description with range in
characteristics is included, in alphabetical order, in this
section. Additional information specific to this map unit,
such as horizon depth and textures, is available in the
“Soil Properties” section in Part II of this publication.

Inclusions

- Koronis and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning
these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Gardencity Series

Depth class: Very deep

Drainage class: Well drained and moderately well
drained

Permeability: Moderately rapid

Landform: Lake plains and outwash plains

Parent material: Glaciolacustrine deposits or glacial
outwash

Slope range: 0 to 12 percent

Taxonomic classification: Coarse-loamy, mixed, mesic
Typic Hapludolls

Typical Pedon

Gardencity very fine sandy loam, 2 to 6 percent
slopes, 1,000 feet east and 2,100 feet north of the
southwest corner of sec. 29, T. 120 N., R. 30 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) very
fine sandy loam, dark gray (10YR 4/1) dry; weak
fine subangular blocky structure; very friable;
neutral; clear smooth boundary.

A—9 to 13 inches; very dark grayish brown (10YR 3/2)
very fine sandy loam, grayish brown (10YR 5/2)
dry; weak fine subangular blocky structure parting
to weak very fine subangular blocky; very friable;
very many very dark brown (10YR 2/2) organic
coatings on faces of peds; neutral; clear smooth
boundary.

AB—13 to 18 inches; dark brown (10YR 3/3) very fine
sandy loam, grayish brown (10YR 5/2) dry; weak
fine subangular blocky structure parting to weak
very fine subangular blocky; very friable; very

many very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; clear smooth boundary.

Bw1—18 to 28 inches; dark brown (10YR 4/3) loamy fine sand with strata of very fine sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; neutral; clear smooth boundary.

Bw2—28 to 34 inches; dark brown (10YR 4/3) very fine sandy loam with strata of loamy fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; neutral; abrupt smooth boundary.

C1—34 to 42 inches; brown (10YR 5/3) very fine sandy loam with strata of loamy very fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.

C2—42 to 60 inches; brown (10YR 5/3) loamy very fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches

Thickness of the mollic epipedon: 10 to 24 inches

Other features: In some pedons the lower part of the Bw horizon and an underlying Bk horizon are dominantly silt loam or very fine sandy loam.

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—very fine sandy loam or fine sandy loam

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—dominantly stratified fine sand, very fine sand, loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam, and silt loam; thin strata of sand or loamy sand in some pedons

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 to 6

Texture—commonly stratified with silt loam, very fine sandy loam, or loamy very fine sand; fine sandy loam or fine sandy loam in some pedons

1177C—Gardencity-Bold complex, 6 to 12 percent slopes, eroded

Composition

Gardencity and similar soils: About 70 percent

Bold and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Gardencity—outwash plains and lake plains; Bold—outwash plains and terraces

Position on the landform: Gardencity—summits and backslopes; Bold—shoulders and summits

Slope range: 6 to 12 percent

Component Description

Gardencity

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 80 inches

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)

Content of organic matter in the surface layer: About 3 percent (moderate)

Bold

Surface layer texture: Silt loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)

Content of organic matter in the surface layer: About 1.25 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1185—Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes

Composition

Gardencity and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and rises on lake plains and outwash plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1801B—Gardencity very fine sandy loam, 2 to 6 percent slopes

Composition

Gardencity and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains and outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Very fine sandy loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Truman and similar soils
- Sparta and similar soils
- Madelia and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Glencoe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Glencoe clay loam, depressional, 0 to 1 percent slopes, 2,300 feet east and 500 feet south of the northwest corner of sec. 30, T. 115 N., R. 30 W., in McLeod County:

Ap—0 to 10 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; abrupt smooth boundary.

A1—10 to 24 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; slightly alkaline; 2 percent gravel; clear smooth boundary.

A2—24 to 34 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; 1 percent gravel; neutral; gradual wavy boundary.

Bg1—34 to 48 inches; olive gray (5Y 4/2) clay loam; weak fine subangular blocky structure; friable; few fine distinct dark gray (10YR 4/1) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; 1 percent gravel; neutral; gradual wavy boundary.

Bg2—48 to 80 inches; light olive gray (5Y 6/2) clay loam; weak medium prismatic structure; friable; common medium distinct yellowish brown (10YR 5/6) iron concentrations; 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 60 inches

Ap horizon:

Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, clay loam, or loam
Content of rock fragments—0 to 2 percent gravel

A horizon:

Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or clay loam
Content of rock fragments—0 to 2 percent gravel

Bg horizon:

Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, or silty clay loam
Content of rock fragments—1 to 2 percent gravel;
0 to 2 percent cobbles and stones

Bkg horizon:

Hue—5Y or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam
Content of rock fragments—2 to 4 percent gravel;
2 to 4 percent cobbles and stones

114—Glencoe clay loam, depressional, 0 to 1 percent slopes

Composition

Glencoe and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Granby Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Rapid
Landform: Outwash plains and beach ridges
Parent material: Glacial outwash
Slope range: 0 to 1 percent

Taxonomic classification: Sandy, mixed, mesic Typic Endoaquolls

Typical Pedon

Granby fine sandy loam, 0 to 1 percent slopes, 2,500 feet south and 2,500 feet west of the northeast corner of sec. 24, T. 121 N., R. 31 W.

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

A1—10 to 13 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A2—13 to 20 inches; very dark gray (5Y 3/1) loamy fine sand; weak fine subangular blocky structure; very friable; few fine faint yellowish brown (10YR 5/6) and dark gray (10YR 4/1) iron depletions; neutral; clear smooth boundary.

Bg1—20 to 23 inches; light olive gray (5Y 6/2) fine sand; weak fine subangular blocky structure; loose; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; abrupt smooth boundary.

Bg2—23 to 26 inches; light olive gray (5Y 6/2) fine sandy loam; moderate fine subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; abrupt smooth boundary.

Cg—26 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; weak fine subangular blocky structure; loose; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Depth to sand or loamy fine sand: Less than 15 inches

Thickness of the mollic epipedon: 10 to 15 inches

Ap horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—fine sandy loam or loamy fine sand

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sandy loam, loamy fine sand, or fine sand

Bg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—fine sand, loamy fine sand, or sand; thin layers of fine sandy loam, loamy very fine sand, or very fine sandy loam in some pedons

Cg horizon:

Hue—2.5Y, 5Y, or 5GY

Value—5 or 6

Chroma—1 to 3

Texture—fine sand or loamy fine sand

178—Granby fine sandy loam, 0 to 1 percent slopes

Composition

Granby and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 5.7 inches (low)

Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1099—Granby loamy fine sand, very wet, 0 to 1 percent slopes

Composition

Granby and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Beach ridges
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loamy fine sand
Depth to bedrock: Greater than 60 inches
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 4.9 inches (low)
Content of organic matter in the surface layer: About 7 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Klossner and similar soils
- Fieldon and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Grovecity Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent

Taxonomic classification: Coarse-loamy, mixed, mesic
Aquic Hapludolls

Typical Pedon

Grovecity loam, 1 to 3 percent slopes, 260 feet north and 40 feet west of the southeast corner of sec. 11, T. 120 N., R. 32 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; slightly acid; abrupt smooth boundary.

A—10 to 15 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; clear wavy boundary.

Bw1—15 to 20 inches; olive brown (2.5Y 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; common dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; 4 percent gravel; 3 percent cobbles and stones; neutral; clear wavy boundary.

Bw2—20 to 30 inches; olive brown (2.5Y 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions and few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; 4 percent gravel; 4 percent cobbles and stones; slightly alkaline; clear wavy boundary.

Bk—30 to 42 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 6 percent gravel; 4 percent cobbles and stones; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—42 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; common medium distinct light brownish gray (2.5Y 5/2) iron depletions; few fine masses and threads of calcium carbonate; 6 percent gravel; 4 percent cobbles and stones; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 8 to 18 inches

A horizon:
Hue—10YR

Value—2 or 3
 Chroma—1 or 2
 Texture—loam
 Content of rock fragments—2 to 3 percent gravel;
 0 to 2 percent cobbles and stones

Bw horizon:

Hue—2.5Y or 10YR
 Value—4 or 5
 Chroma—2 to 4
 Texture—fine sandy loam, sandy loam, or loam
 Content of rock fragments—4 to 8 percent gravel;
 3 to 5 percent cobbles and stones

Bk horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—2 to 6
 Texture—fine sandy loam, sandy loam, or loam
 Content of rock fragments—4 to 6 percent gravel;
 3 to 5 percent cobbles and stones

613—Grovecity loam, 1 to 3 percent slopes

Composition

Grovecity and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils

- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hamel Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Colluvium over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed, mesic
 Typic Argiaquolls

Typical Pedon

Hamel loam, in an area of Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes, 1,700 feet north and 2,100 feet east of the southwest corner of sec. 22, T. 118 N., R. 29 W.

- A1—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
- A2—10 to 19 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; neutral; clear smooth boundary.
- A3—19 to 28 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine angular blocky structure parting to moderate very fine angular blocky; friable; few black (N 2/0) clay films on faces of peds and in pores; about 1 percent gravel; neutral; clear smooth boundary.
- AB—28 to 40 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; many black (N 2/0) clay films on faces of peds and in pores; about 1 percent gravel; neutral; clear smooth boundary.
- Btg1—40 to 47 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate coarse angular blocky; firm; many black (N 2/0) clay films on faces of peds and in pores; about 2 percent gravel; neutral; clear smooth boundary.
- Btg2—47 to 56 inches; olive gray (5Y 5/2) clay loam; weak medium prismatic structure parting to

moderate coarse angular blocky; firm; few black (N 2/0) clay films in channels; about 2 percent gravel; neutral; clear smooth boundary.

Bkg1—56 to 65 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; about 4 percent gravel; about 1 percent cobbles; slightly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—65 to 80 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 4 percent gravel; about 1 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 44 inches

Ap horizon:

Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam
Content of rock fragments—0 to 2 percent gravel

A horizon:

Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or loam
Content of rock fragments—0 to 2 percent gravel

Btg horizon:

Hue—5Y or 2.5Y
Value—2 to 4
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam
Content of rock fragments—1 to 4 percent gravel;
1 to 4 percent cobbles and stones

Bkg horizon:

Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam
Content of rock fragments—2 to 4 percent gravel;
2 to 4 percent cobbles and stones

740—Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes

Composition

Hamel and similar soils: About 70 percent
Glencoe and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Hamel—drainageways;
Glencoe—depressions

Slope range: Hamel—0 to 3 percent; Glencoe—0 to 1 percent

Component Description

Hamel

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

Glencoe

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Le Sueur and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Harps Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, mesic Typic Calciaquolls

Typical Pedon

Harps clay loam, 0 to 2 percent slopes, 2,200 feet north and 2,000 feet west of the southeast corner of sec. 28, T. 117 N., R. 31 W.

Apk—0 to 9 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; moderate very fine subangular blocky structure; friable; 1 percent gravel; violently effervescent; slightly alkaline; clear smooth boundary.

Ak—9 to 19 inches; very dark gray (10YR 3/1) clay loam, gray (N 5/0) dry; weak medium subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg1—19 to 25 inches; dark gray (5Y 4/1) clay loam; weak medium subangular blocky structure parting to weak coarse subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; 2 percent gravel; 2 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—25 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure; friable; many fine prominent dark yellowish brown (10YR 4/6) and common light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 12 to 21 inches

Apk horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or clay loam

Content of rock fragments—1 to 3 percent gravel;
0 to 2 percent cobbles and stones

Bkg1 horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—clay loam or loam

Content of rock fragments—1 to 3 percent gravel;
1 to 2 percent cobbles and stones

Bkg2 horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2

Texture—loam

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

112—Harps clay loam, 0 to 2 percent slopes

Composition

Harps and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rims of depressions on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)

Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Glencoe and similar soils
- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

899—Harps-Okoboji, depressional, complex, 0 to 2 percent slopes

Composition

Harps and similar soils: About 60 percent

Okoboji and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Harps—moraines; Okoboji—lake plains and moraines

Position on the landform: Harps—rims of depressions; Okoboji—depressions

Slope range: Harps—0 to 2 percent; Okoboji—0 to 1 percent

Component Description

Harps

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Content of organic matter in the surface layer: About 4 percent (high)

Okoboji

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Depth to the water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)

Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Havelock Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Havelock loam, 0 to 2 percent slopes, frequently flooded, 100 feet south and 1,500 feet east of the northwest corner of sec. 9, T. 116 N., R. 30 W., in McLeod County:

A1—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky

structure; friable; slightly effervescent; slightly alkaline; gradual wavy boundary.

A2—9 to 15 inches; black (10YR 2/1) loam with few sand seams, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common fine distinct dark yellowish brown (10YR 4/4) iron concentrations; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bg—15 to 38 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common medium distinct dark yellowish brown (10YR 4/4) iron concentrations; strongly effervescent with disseminated calcium carbonate; slightly alkaline; gradual irregular boundary.

Cg—38 to 60 inches; dark gray (10YR 4/1) loam; massive; friable; few fine distinct dark brown (10YR 3/3) iron depletions; very few very dark gray (10YR 3/1) organic coatings; strongly effervescent with disseminated calcium carbonate; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 24 to 40 inches

A1 horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

A2 horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam, silt loam, silty clay loam, or clay loam

B horizon:

Hue—10YR or 2.5Y

Value—2 to 4

Chroma—1 or 2

Texture—loam, clay loam, or silt loam

Cg horizon:

Hue—10YR

Value—4 or 5

Chroma—1 or 2

Texture—loam, clay loam, sandy loam, or silty clay loam

1385—Havelock loam, 0 to 2 percent slopes, frequently flooded

Composition

Havelock and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hawick Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Very rapid

Landform: Outwash plains, terraces, and moraines

Parent material: Glacial outwash

Taxonomic classification: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Hawick sandy loam, in an area of Estherville-Hawick complex, 2 to 6 percent slopes, 160 feet north and 100 feet east of the southwest corner of sec. 4, T. 119 N., R. 29 W.

- Ap—0 to 7 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; 12 percent gravel; neutral; clear smooth boundary.
- Bw—7 to 11 inches; dark brown (10YR 3/3) gravelly loamy coarse sand, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; very friable; 20 percent gravel; slightly alkaline; abrupt smooth boundary.
- 2Bk—11 to 60 inches; light yellowish brown (2.5Y 6/4) gravelly coarse sand; single grain; loose; 30 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 30 inches
Thickness of the loamy mantle: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 to 3
 Texture—sandy loam, gravelly sand, gravelly loamy sand, or gravelly sandy loam
 Content of rock fragments—5 to 25 percent gravel

Bw horizon:

Hue—10YR or 7.5YR
 Value—3 or 4
 Chroma—3 or 4
 Texture—gravelly loamy coarse sand, coarse sand, loamy coarse sand, or loamy sand
 Content of rock fragments—5 to 25 percent gravel

2Bk horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 6
 Texture—coarse sand, gravelly coarse sand, or gravelly sand
 Content of rock fragments—10 to 35 percent gravel

611D—Hawick gravelly sandy loam, 12 to 25 percent slopes**Composition**

Hawick and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Backslopes and shoulders
Slope range: 12 to 25 percent

Component Description

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 2.8 inches (very low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Minneopa and similar soils
- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

875C—Hawick-Estherville complex, 6 to 12 percent slopes**Composition**

Hawick and similar soils: About 60 percent
 Estherville and similar soils: About 25 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Hawick—summits and backslopes; Estherville—shoulders and summits

Slope range: 6 to 12 percent

Component Description

Hawick

Surface layer texture: Gravelly sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 2.8 inches (very low)

Content of organic matter in the surface layer: About 2 percent (moderate)

Estherville

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.4 inches (low)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Houghton Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landform: Moraines, outwash plains, and lake plains

Parent material: Organic materials

Slope range: 0 to 1 percent

Taxonomic classification: Euic, mesic Typic Medisaprist

Typical Pedon

Houghton muck, depressional, 0 to 1 percent slopes, 1,100 feet north and 1,050 feet west of the southeast corner of sec. 8, T. 119 N., R. 29 W.

Oa1—0 to 7 inches; muck (sapric material), black (N 2/0) broken face and unrubbed; weak very fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

Oa2—7 to 56 inches; muck (sapric material), black (10YR 2/1) and dark brown (7.5YR 3/3) broken face; about 50 percent fiber, 5 percent rubbed; weak thin platy structure; very friable; many fine roots; neutral; gradual smooth boundary.

Oa3—56 to 60 inches; muck (sapric material), black (10YR 2/1) and dark brown (7.5YR 3/4) broken face; about 60 percent fiber, 15 percent rubbed; weak thin platy structure; very friable; many fine roots; neutral.

Range in Characteristics

Depth to mineral soil: Greater than 51 inches

O horizon:

Hue—5YR to 10YR or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

523—Houghton muck, depressional, 0 to 1 percent slopes

Composition

Houghton and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains, outwash plains, and moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)

Content of organic matter in the surface layer: About 84.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Kanaranzi Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate in the loamy mantle and very rapid in the underlying sand and gravel

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Kanaranzi loam, 0 to 3 percent slopes (fig. 12), 100 feet west and 2,000 feet south of the northeast corner of sec. 25, T. 119 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common roots; neutral; clear smooth boundary.

Bw1—9 to 14 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common roots; 3 percent gravel; neutral; clear wavy boundary.

Bw2—14 to 18 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; weak fine subangular blocky structure; very friable; common roots; very many brown (10YR 4/3) organic coatings on faces of peds; 3 percent gravel; neutral; clear wavy boundary.

2Bw3—18 to 26 inches; dark brown (10YR 4/3) loamy coarse sand; single grain; loose; 10 percent gravel; neutral; clear wavy boundary.

2Bk—26 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; 17 percent gravel; few soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 28 inches

Thickness of the loamy mantle: 14 to 20 inches

Thickness of the mollic epipedon: 8 to 14 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—3 or 4

Chroma—3 or 4

Texture—loam in the upper part; sandy loam, coarse sandy loam, or gravelly coarse sandy loam in the lower part

Content of rock fragments—2 to 5 percent gravel in the upper part; as much as 35 percent gravel in the lower part

2Bk horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—coarse sand or gravelly coarse sand
Content of rock fragments—10 to 50 percent gravel

415—Kanaranzi loam, 0 to 3 percent slopes

Composition

Kanaranzi and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)

Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Cylinder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kandiyohi Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 5 percent

Taxonomic classification: Fine, montmorillonitic, mesic Aquertic Hapludolls

Typical Pedon

Kandiyohi clay, 2 to 5 percent slopes (fig. 13), 1,950 feet east and 875 feet north of the southwest corner of sec. 5, T. 118 N., R. 32 W.

Ap—0 to 10 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; strong fine angular blocky

structure; firm; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bw1—10 to 17 inches; olive brown (2.5Y 4/3) clay; strong fine prismatic structure parting to strong very fine angular blocky; firm; very dark brown (10YR 2/2) organic coatings on faces of peds; about 1 percent gravel; slightly acid; gradual wavy boundary.

Bw2—17 to 23 inches; olive brown (2.5Y 4/3) clay; strong medium prismatic structure parting to strong very fine angular blocky; firm; few fine distinct light olive brown (2.5Y 5/6) iron concentrations and few fine prominent light olive gray (5Y 6/2) iron depletions; very many very dark grayish brown (2.5Y 3/2) organic coatings on pressure faces; about 1 percent gravel; neutral; gradual wavy boundary.

Bkg1—23 to 29 inches; grayish brown (2.5Y 5/2) clay; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common fine distinct light olive brown (2.5Y 5/4) iron concentrations and common fine distinct light olive gray (5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate distributed uniformly throughout the horizon; common dark grayish brown (2.5Y 4/2) organic coatings on pressure faces; about 2 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2Bkg2—29 to 60 inches; grayish brown (2.5Y 5/2) clay loam; moderate coarse prismatic structure parting to moderate fine angular blocky; firm; many medium prominent yellowish brown (10YR 5/6) iron concentrations and common fine distinct light olive gray (5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches

Thickness of the mollic epipedon: 10 to 24 inches

Ap horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—clay, silty clay, or silty clay loam

Content of rock fragments—0 to 1 percent gravel; 0 to 1 percent cobbles and stones

Bw horizon:

Hue—2.5Y

Value—4 or 5
 Chroma—2 to 4
 Texture—clay, silty clay, or silty clay loam (average clay content is 35 to 60 percent)
 Content of rock fragments—0 to 1 percent gravel;
 0 to 1 percent cobbles and stones

Bkg or 2Bkg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—2 to 4
 Texture—commonly clay loam or clay; silty clay loam in some pedons
 Content of rock fragments—2 to 4 percent gravel;
 1 to 2 percent cobbles and stones

1162A—Kandiyohi clay, 0 to 2 percent slopes

Composition

Kandiyohi and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1162B—Kandiyohi clay, 2 to 5 percent slopes

Composition

Kandiyohi and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kingston Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate

Landform: Lake plains

Parent material: Lacustrine deposits

Slope range: 1 to 3 percent

Taxonomic classification: Fine-silty, mixed, mesic
Aquic Hapludolls

Typical Pedon

Kingston silty clay loam, 1 to 3 percent slopes, 1,620 feet north and 100 feet west of the southeast corner of sec. 26, T. 120 N., R. 30 W.

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; abrupt smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; 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, dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—16 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; friable; many very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; slightly acid; clear smooth boundary.

Bw2—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) iron concentrations; slightly acid; abrupt smooth boundary.

Bk—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) and distinct olive (5Y 5/3) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 32 inches

Thickness of the mollic epipedon: 12 to 24 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silty clay loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—silty clay loam or silt loam

Bk horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—silt loam

197—Kingston silty clay loam, 1 to 3 percent slopes

Composition

Kingston and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Klossner Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate in the organic material; moderately slow to very rapid in the underlying mineral material

Landform: Moraines, lake plains, and flood plains

Parent material: Organic materials over glaciolacustrine deposits or till

Slope range: 0 to 1 percent

Taxonomic classification: Loamy, mixed, euic Terric Medisapristis

Typical Pedon

Klossner muck, depressional, 0 to 1 percent slopes, 600 feet east and 100 feet south of the northwest corner of sec. 27, T. 120 N., R. 31 W.

Oa1—0 to 7 inches; muck (sapric material), black (N 2/0) broken face and rubbed; about 20 percent fiber, trace rubbed; weak fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

Oa2—7 to 28 inches; muck (sapric material), very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 60 percent fiber, 10 percent rubbed; weak medium platy structure; friable; few fine roots; neutral; abrupt smooth boundary.

2A—28 to 34 inches; black (N 2/0) silt loam; massive; sticky; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg1—34 to 45 inches; olive gray (5Y 4/2) silt loam; massive; friable; common fine prominent yellowish brown (10YR 5/8) iron concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—45 to 60 inches; dark gray (5Y 4/1) loam; massive; friable; common fine prominent (10YR 5/8) iron concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to mineral soil: 16 to 50 inches

O horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—muck

2A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—sandy loam, fine sandy loam, loam, silt loam, or silty clay loam

2Cg horizon:

Hue—5Y or 5GY

Value—4 to 6

Chroma—1 or 2

Texture—loam, clay loam, silt loam, silty clay loam, or fine sandy loam

Content of rock fragments—0 to 10 percent gravel

539—Klossner muck, depressional, 0 to 1 percent slopes

Composition

Klossner and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains and moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 18.3 inches (high)

Content of organic matter in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1080—Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes

Composition

Klossner: Variable
 Okoboji: Variable
 Glencoe: Variable
 Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Klossner

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 16.3 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

Okoboji

Surface layer texture: Mucky silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Seasonal high water table: 3 feet above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)
Content of organic matter in the surface layer: About 14 percent (very high)

Glencoe

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)

Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1199—Klossner and Lundlake soils, ponded

Composition

Klossner and similar soils: About 50 percent
 Lundlake and similar soils: About 45 percent
 Inclusions: About 5 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Klossner

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 19.2 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

Lundlake

Surface layer texture: Mucky loam

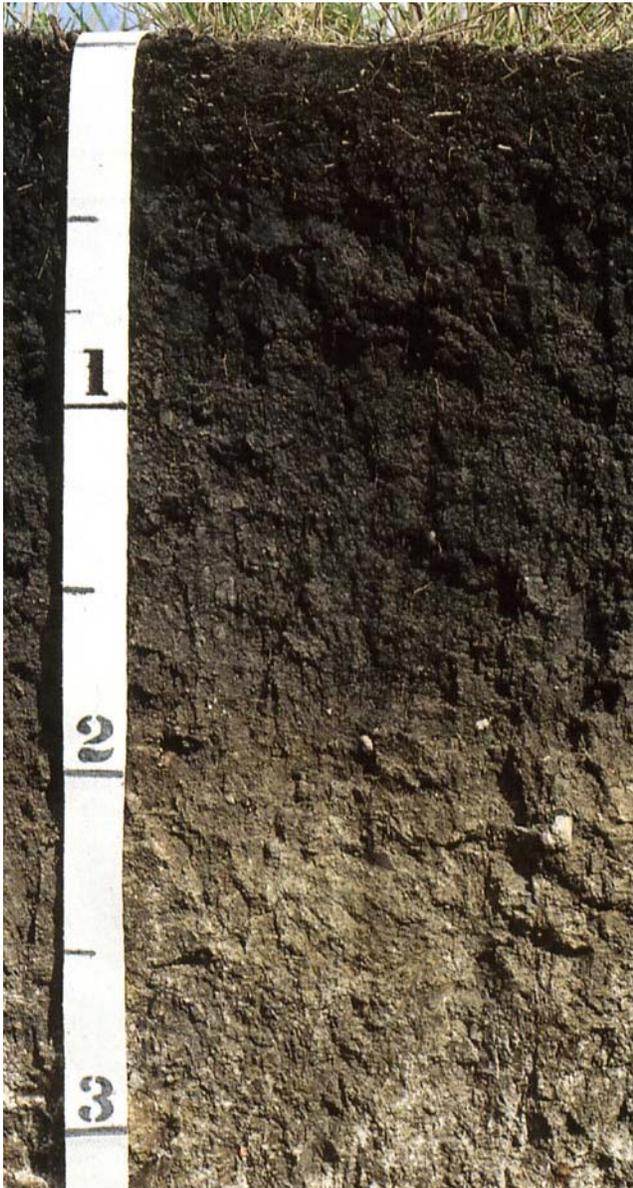


Figure 11.—A profile of Cosmos silty clay in a cultivated field. Light-colored calcium carbonates are below a depth of about 24 inches. Depth is marked in feet.

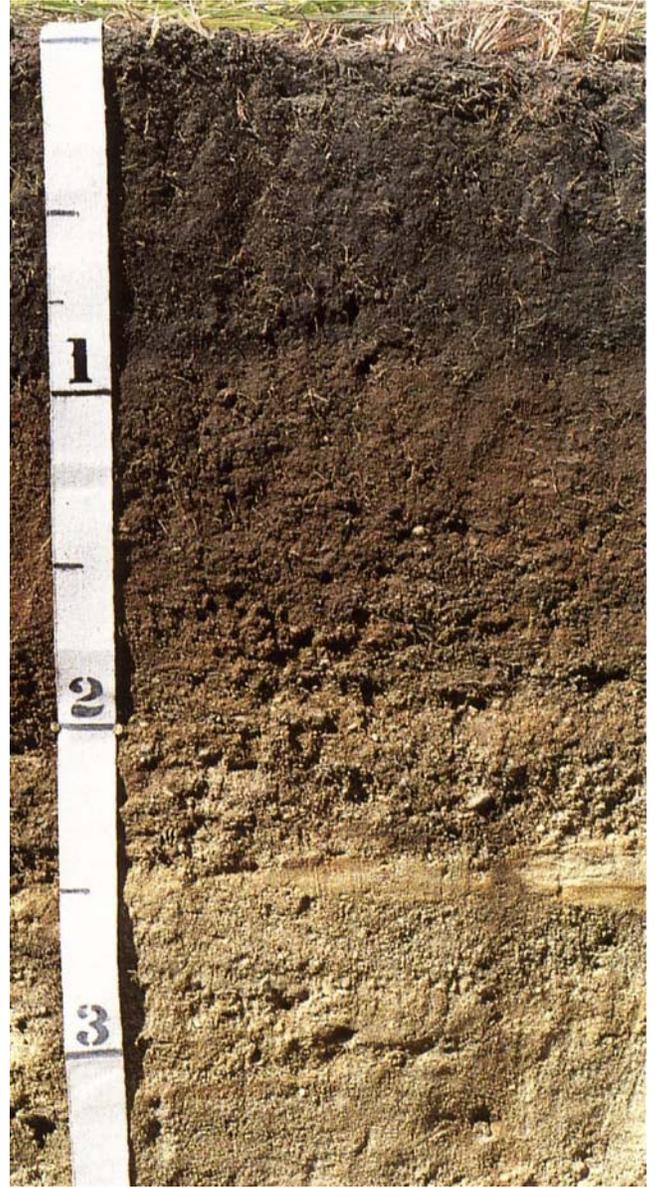


Figure 12.—A profile of Kanaranzi loam in a cultivated field. The loamy mantle is about 18 inches thick over outwash sands and gravel. Depth is marked in feet.

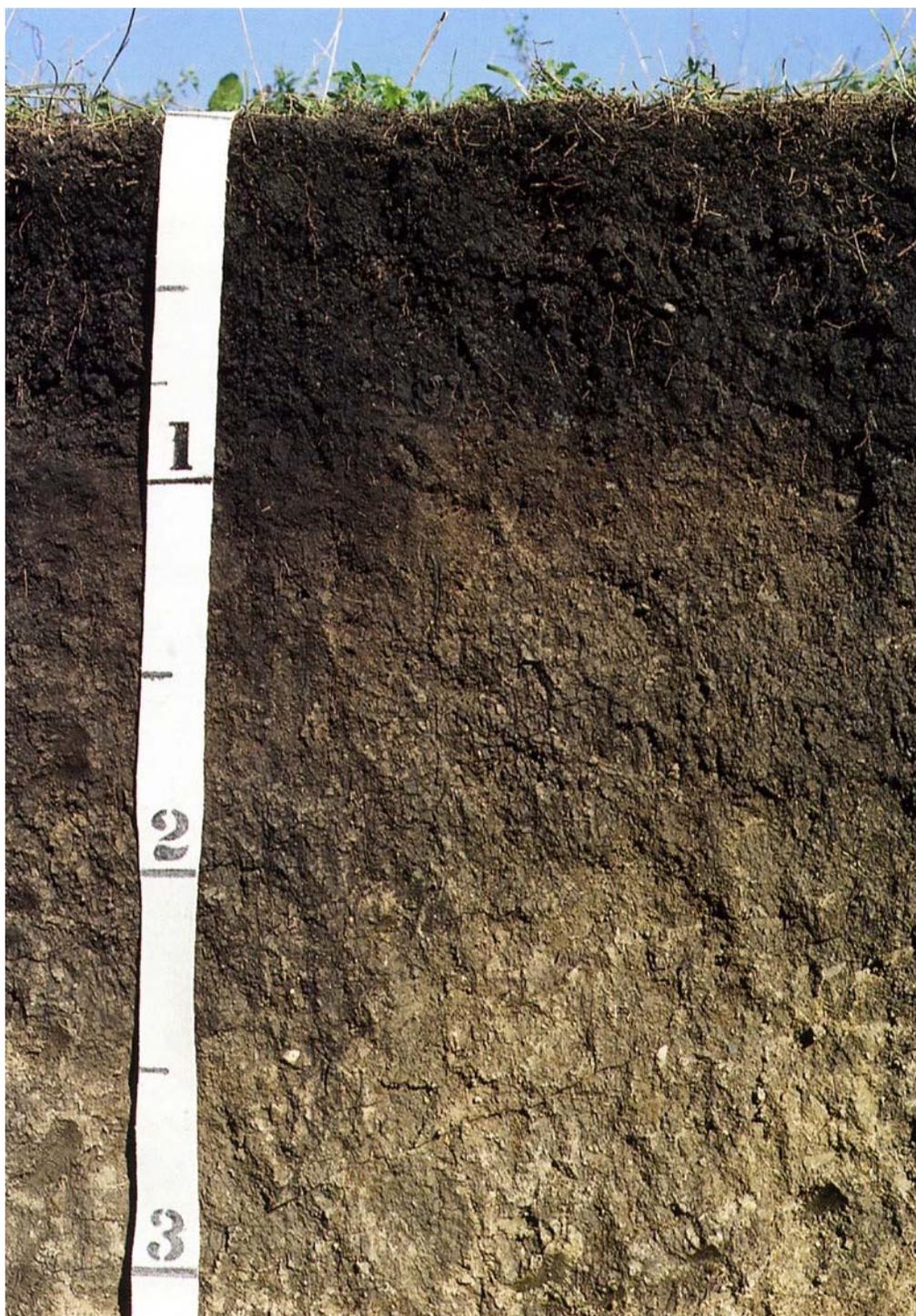


Figure 13.—A profile of Kandiyohi clay in a cultivated field. The horizon boundaries are wavy because of shrinking and swelling. Depth is marked in feet.

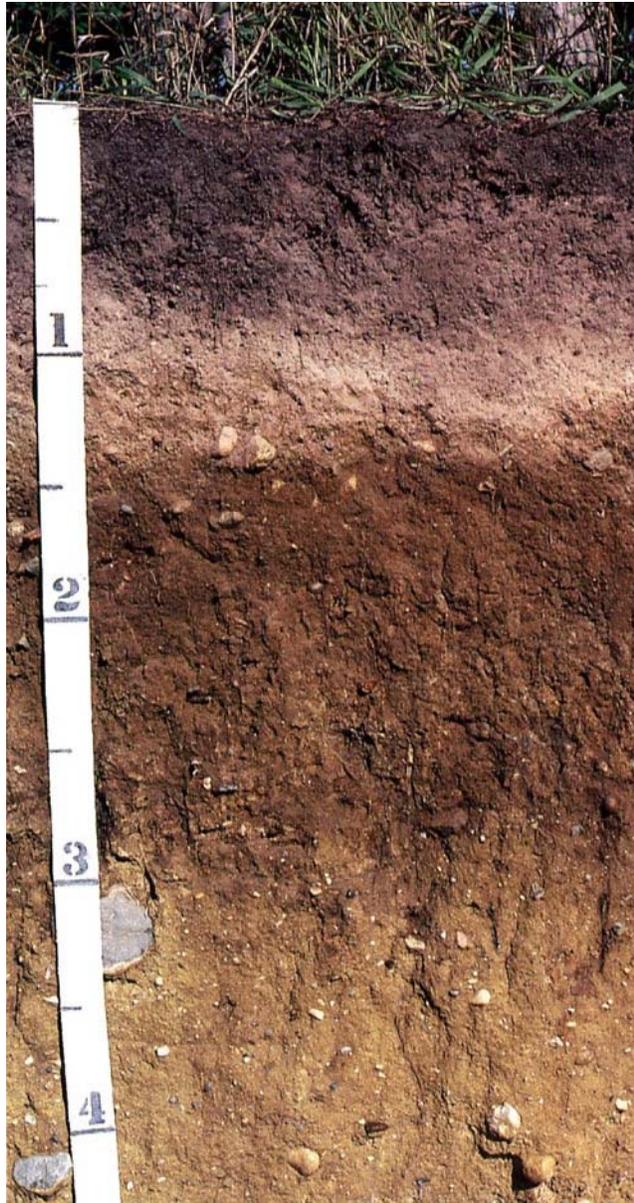


Figure 14.—A profile of Koronis loam in an area that has not been cultivated. The light-colored E horizon, at a depth of 9 to 13 inches, is a result of the washing of soil materials from this horizon to lower horizons. In cultivated areas the E horizon is commonly mixed with the A horizon. Depth is marked in feet.

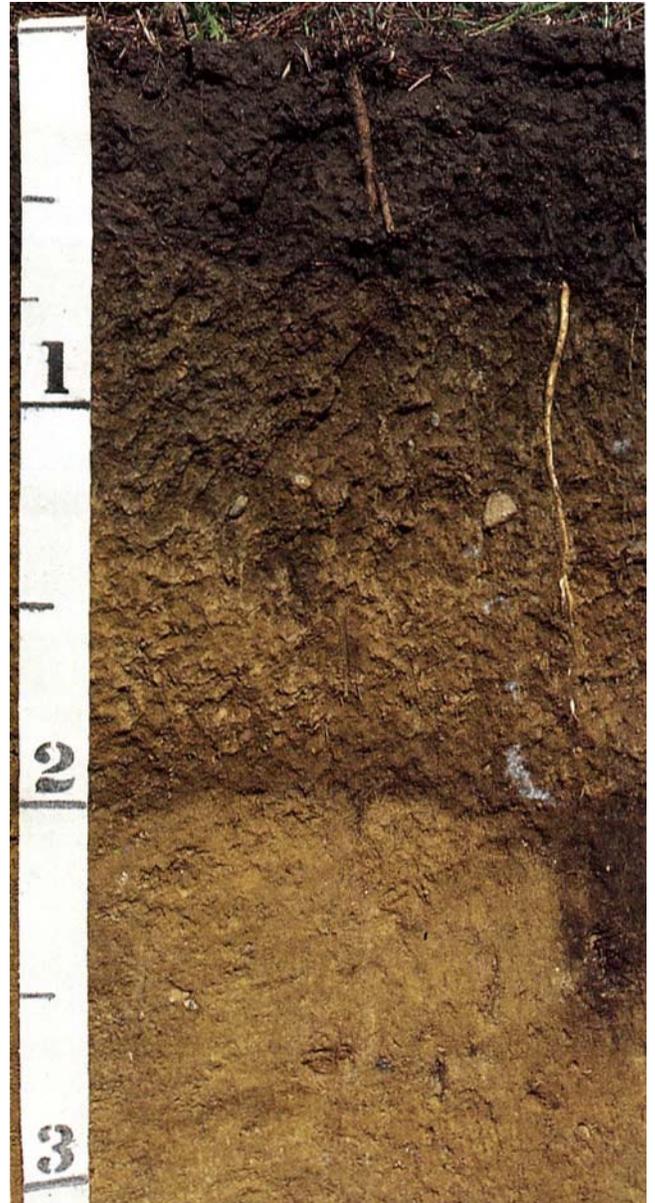


Figure 15.—A profile of Lester loam in a cultivated field. The Bt horizon, at a depth of 7 to 24 inches, has an accumulation of clay. Depth is marked in feet.



Figure 16.—A profile of Muskego muck in a cultivated field. The black sapric material extends to a depth of about 18 inches over gray coprogenous earth. Note the snail-shell fragments in the coprogenous earth. Depth is marked in feet.

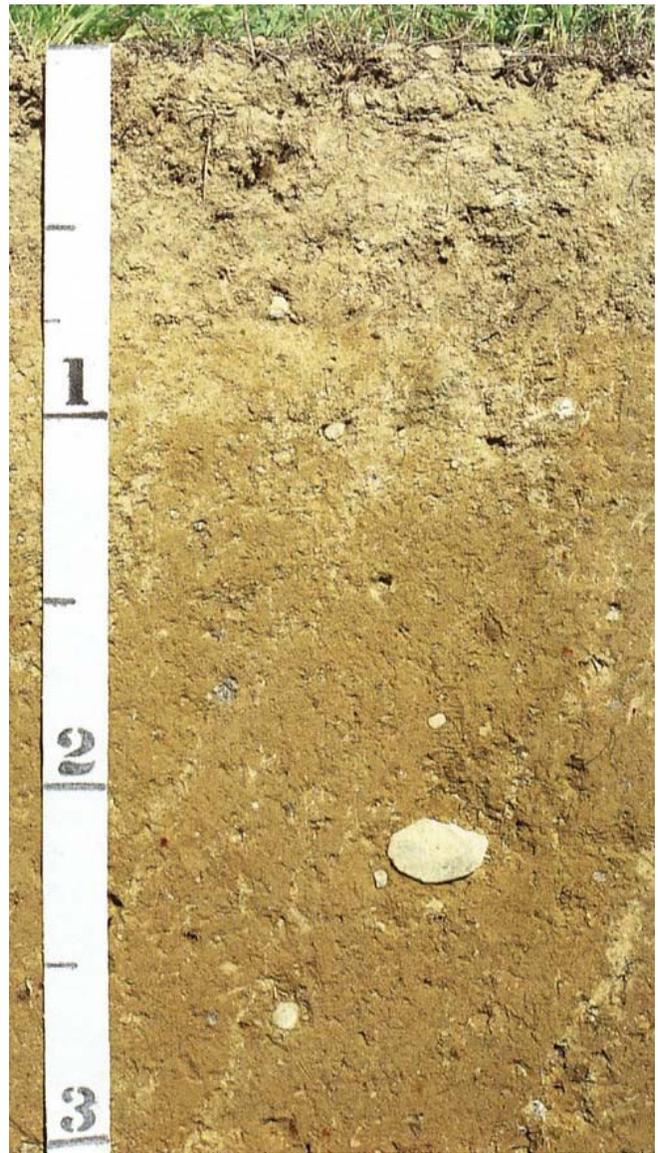


Figure 17.—A profile of Storden loam in a cultivated field. Storden soils have calcium carbonates at the surface. Depth is marked in feet.

Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.4 inches (high)
Content of organic matter in the surface layer: About 15 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Houghton and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Koronis Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Ground moraines
Parent material: Calcareous, loamy glacial till
Slope range: 2 to 40 percent
Taxonomic classification: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Koronis loam, 2 to 6 percent slopes, 1,055 feet west and 2,400 feet north of the southeast corner of sec. 34, T. 121 N., R. 31 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; 3 percent gravel; 2 percent cobbles and stones; slightly acid; abrupt smooth boundary.
- Bt1—8 to 17 inches; dark brown (10YR 4/3) loam; moderate fine and medium subangular blocky structure; friable; many thin dark brown (10YR 3/3) clay films on faces of peds; 4 percent gravel; 3

percent cobbles and stones; slightly acid; clear smooth boundary.

Bt2—17 to 26 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; many thin dark brown (10YR 3/3) clay films on faces of peds; 5 percent gravel; 4 percent cobbles and stones; moderately acid; clear smooth boundary.

Bt3—26 to 31 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate coarse prismatic structure parting to moderate medium subangular blocky; friable; many moderately thick dark brown (10YR 3/3) clay films on vertical faces of peds and common thin brown (10YR 4/3) clay films on faces of peds; 5 percent gravel; 4 percent cobbles and stones; neutral; clear wavy boundary.

Bk1—31 to 35 inches; light olive brown (2.5Y 5/4) fine sandy loam; few fine prominent strong brown (7.5YR 5/6) remnant iron concentrations; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; few moderately thick dark brown (10YR 4/3) clay films on vertical prism faces and common moderately thick dark brown (10YR 3/3) clay films in tubular pores; 8 percent gravel; 5 percent cobbles and stones; strongly effervescent; slightly alkaline; clear wavy boundary.

Bk2—35 to 43 inches; light olive brown (2.5Y 5/4) fine sandy loam; few fine prominent yellowish red (5YR 4/8) remnant iron concentrations; weak medium subangular blocky structure; very friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; moderately alkaline; clear smooth boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine distinct strong brown (7.5YR 5/6) remnant iron concentrations; weak thick platy structure; very friable; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 5 to 9 inches

A horizon:

Hue—10YR

Value—3 moist; 5 or 6 dry

Chroma—1 or 2

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bt horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—sandy clay loam, loam, fine sandy loam,
or sandy loamContent of rock fragments—4 to 8 percent gravel;
3 to 5 percent cobbles and stones**Bk or C horizon:**

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—6 to 10 percent gravel;
4 to 6 percent cobbles and stones**461B—Koronis loam, 2 to 6 percent slopes****Composition**

Koronis and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Summits and backslopes*Slope range:* 2 to 6 percent**Component Description***Surface layer texture:* Loam*Depth to bedrock:* Greater than 60 inches*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 9.4 inches (high)*Content of organic matter in the surface layer:* About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

461C2—Koronis loam, 6 to 12 percent slopes, eroded**Composition**

Koronis and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Summits and backslopes*Slope range:* 6 to 12 percent**Component Description***Surface layer texture:* Loam*Depth to bedrock:* Greater than 60 inches*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 9.3 inches (high)*Content of organic matter in the surface layer:* About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804B—Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes

Composition

Koronis and similar soils: About 50 percent
Sunburg and similar soils: About 20 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Koronis—summits and
backslopes; Sunburg and Hawick—shoulders and
summits

Slope range: Koronis—2 to 6 percent; Sunburg—4 to 6
percent; Hawick—2 to 6 percent

Component Description

Koronis

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 9.6 inches (high)

Content of organic matter in the surface layer: About
2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 9.2 inches (high)

Content of organic matter in the surface layer: About
2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly loamy sand

Depth to bedrock: Greater than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 3.8 inches (low)

Content of organic matter in the surface layer: About 2
percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804C2—Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Koronis and similar soils: About 45 percent
Sunburg and similar soils: About 25 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Koronis—summits and
backslopes; Sunburg and Hawick—shoulders and
summits

Slope range: 6 to 12 percent

Component Description

Koronis

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 8.9 inches (moderate)

Content of organic matter in the surface layer: About
2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804D2—Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded

Composition

Koronis and similar soils: About 40 percent
 Sunburg and similar soils: About 35 percent
 Hawick and similar soils: About 15 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Koronis—backslopes;
 Sunburg and Hawick—backslopes and shoulders
Slope range: 12 to 18 percent

Component Description

Koronis

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804E—Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes

Composition

Koronis and similar soils: About 50 percent
Sunburg and similar soils: About 25 percent
Hawick and similar soils: About 15 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Koronis—backslopes;

Sunburg and Hawick—backslopes and shoulders

Slope range: 18 to 40 percent

Component Description

Koronis

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly loamy sand

Depth to bedrock: Greater than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.1 inches (low)

Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

807D2—Koronis-Sunburg complex, 12 to 18 percent slopes, eroded

Composition

Koronis and similar soils: About 80 percent
Sunburg and similar soils: About 15 percent
Inclusions: About 5 percent

Setting

Landform: Moraines

Position on the landform: Koronis—backslopes;

Sunburg—backslopes and shoulders

Slope range: 12 to 18 percent

Component Description

Koronis

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Lester Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 6 to 40 percent

Taxonomic classification: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Lester loam, 6 to 12 percent slopes, eroded (fig. 15), 200 feet east and 700 feet north of the southwest corner of sec. 2, T. 118 N., R. 30 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 19 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common dark brown (10YR 3/3) clay films on faces of peds

and in pores; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt2—19 to 27 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; few dark brown (10YR 3/3) clay films on faces of peds and in pores; about 2 percent gravel; about 1 percent cobbles and stones; moderately acid; clear wavy boundary.

Bk—27 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 3 percent gravel; about 1 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches

Thickness of the mollic epipedon: 7 to 10 inches

A horizon:

Hue—10YR

Value—3 moist; 5 or 6 dry

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—2 to 4 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Content of rock fragments—1 to 4 percent gravel; 1 to 2 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—4

Texture—loam

Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

106C2—Lester loam, 6 to 12 percent slopes, eroded

Composition

Lester and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

945D2—Lester-Storden complex, 12 to 18 percent slopes, eroded**Composition**

Lester and similar soils: About 70 percent

Storden and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Lester—backslopes;

Storden—backslopes and shoulders

Slope range: 12 to 18 percent

Component Description**Lester**

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

945E—Lester-Storden complex, 18 to 40 percent slopes**Composition**

Lester and similar soils: About 70 percent

Storden and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Lester—backslopes;

Storden—backslopes and shoulders

Slope range: 18 to 40 percent

Component Description

Lester

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Le Sueur Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic classification: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Le Sueur clay loam, 1 to 3 percent slopes, 1,100 feet west and 175 feet south of the northeast corner of sec. 24, T. 118 N., R. 29 W.

Ap—0 to 11 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; cloddy; friable; 1 percent gravel; slightly acid; clear smooth boundary.

AE—11 to 14 inches; very dark brown (10YR 2/2) clay loam, dark gray (10YR 4/1) dry; weak fine angular blocky structure; friable; 1 percent gravel; slightly acid; clear smooth boundary.

BE—14 to 18 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine angular blocky structure; friable; very many very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds and in pores; 2 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.

Bt1—18 to 28 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium prismatic structure parting to moderate coarse angular blocky; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions; few very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 2 percent gravel; 2 percent cobbles and stones; slightly acid; clear smooth boundary.

Bt2—28 to 33 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic structure parting to weak very coarse angular blocky; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; few very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 2 percent gravel; 3 percent cobbles and stones; slightly acid; clear smooth boundary.

Bk1—33 to 40 inches; light brownish gray (2.5Y 6/2) loam; weak coarse prismatic structure parting to weak very coarse angular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—40 to 60 inches; light brownish gray (2.5Y 6/2) loam; weak coarse subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the

horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 45 inches

Thickness of the mollic epipedon: 10 to 18 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam

Content of rock fragments—1 to 3 percent gravel;
0 to 2 percent cobbles and stones

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—clay loam or loam

Content of rock fragments—1 to 2 percent gravel;
2 to 4 percent cobbles and stones

Bk horizon:

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

239—Le Sueur clay loam, 1 to 3 percent slopes

Composition

Le Sueur and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Litchfield Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Sandy, mixed, mesic Aquic Hapludolls

Typical Pedon

Litchfield loamy fine sand, 0 to 2 percent slopes, 1,080 feet west and 1,280 feet south of the northeast corner of sec. 9, T. 119 N., R. 30 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A—9 to 14 inches; very dark gray (10YR 3/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

AB—14 to 20 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw—20 to 33 inches; dark grayish brown (10YR 4/2) fine sand; weak medium subangular blocky structure; very friable; few fine faint grayish brown (10YR 5/2) iron depletions; slightly acid; clear smooth boundary.

BC—33 to 40 inches; light olive brown (2.5Y 5/4) and

grayish brown (2.5Y 5/2) very fine sandy loam; weak medium subangular blocky structure; very friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; few thin seams of loamy fine sand; slightly acid; clear wavy boundary.

Cg—40 to 60 inches; olive gray (5Y 5/2) and olive (5Y 5/3) loamy fine sand; many fine prominent dark reddish brown (5YR 3/3) iron oxide stains; massive; very friable; few thin seams of fine sand; slightly acid.

Range in Characteristics

Depth to carbonates: Greater than 50 inches

Thickness of the mollic epipedon: 10 to 24 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand or sandy loam

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—fine sand or loamy fine sand with strata of very fine sand, loamy very fine sand, fine sandy loam, and very fine sandy loam; loamy sand or sand included when the content of coarse sand is less than 10 percent and the content of very coarse sand is less than 5 percent; strata of sandy clay loam or fine sandy loam in some pedons

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—sand, fine sand, loamy sand, or loamy fine sand

181—Litchfield loamy fine sand, 0 to 2 percent slopes

Composition

Litchfield and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loamy fine sand

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 6.3 inches (moderate)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1176—Litchfield sandy loam, 0 to 2 percent slopes

Composition

Litchfield and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches (low)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lundlake Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Cumulic Endoaquolls

Typical Pedon

Lundlake silty clay loam, in an area of Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes, 800 feet north and 525 feet west of the southeast corner of sec. 20, T. 121 N., R. 31 W.

Ap—0 to 12 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—12 to 22 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

A2—22 to 28 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

AB—28 to 36 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

2Bg1—36 to 45 inches; olive gray (5Y 5/2) sandy loam; weak coarse subangular blocky structure; friable; few fine distinct light olive (5Y 5/4) iron concentrations; about 2 percent gravel; about 5 percent cobbles; neutral; clear smooth boundary.

2Bg2—45 to 60 inches; light olive gray (5Y 6/2) sandy loam; weak coarse subangular blocky structure; very friable; few fine distinct olive (5Y 5/4) iron concentrations; about 2 percent gravel; about 7 percent cobbles; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Thickness of the mollic epipedon: 24 to 48 inches

Other features: A 2Bkg or 2Cg horizon in some pedons

Ap horizon:

Hue—neutral, 5Y, or 10YR

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam, loam, or mucky loam

Content of rock fragments—1 to 3 percent gravel;
0 to 3 percent cobbles and stones

A horizon:

Hue—neutral, 5Y, or 10YR

Value—2 or 3

Chroma—0 to 3

Texture—loam, mucky loam, silty clay loam, or clay loam

Content of rock fragments—1 to 3 percent gravel;
0 to 3 percent cobbles and stones

Bg horizon:

Hue—5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam or sandy clay loam

Content of rock fragments—3 to 6 percent gravel;
3 to 6 percent cobbles and stones

2Bg horizon:

Hue—5Y

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—4 to 8 percent gravel;
4 to 8 percent cobbles and stones

1165—Lundlake silty clay loam, depressional, 0 to 1 percent slopes

Composition

Lundlake and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Swedegrove and similar soils
- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lura Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Lake plains and moraines
Parent material: Lacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Epiaquolls
Taxadjunct features: The Lura soils in this survey area are taxadjuncts because they have carbonates at a depth of less than 40 inches.

Typical Pedon

Lura silty clay, depressional, 0 to 1 percent slopes, 250 feet south and 1,500 feet east of the northwest corner of sec. 25, T. 117 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; cloddy; firm; neutral; clear smooth boundary.

A1—9 to 13 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

A2—13 to 24 inches; black (5Y 2.5/1) silty clay, very dark gray (5Y 3/1) dry; moderate medium angular blocky structure parting to strong very fine angular blocky; friable; very many stress surfaces on faces of peds; neutral; clear wavy boundary.

Bg—24 to 31 inches; olive gray (5Y 4/2) silty clay; weak medium prismatic structure parting to strong very fine angular blocky; friable; very many stress surfaces on faces of peds; common very dark gray (5Y 3/1) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

Bkg1—31 to 36 inches; gray (5Y 5/1) silty clay; weak fine prismatic structure parting to moderate very fine angular blocky; friable; few stress surfaces on faces of peds; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—36 to 60 inches; gray (5Y 5/1) silty clay; moderate very fine angular blocky structure; friable; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 24 to 60 inches

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 in the upper part, 3 in the lower part
Chroma—0 or 1
Texture—silty clay

Bg horizon:

Hue—5Y
Value—4
Chroma—1 or 2

Texture—silty clay, clay, or silty clay loam

Bkg horizon:

Hue—5Y or 5GY

Value—4 to 6

Chroma—1 or 2

Texture—clay, silty clay, or silty clay loam

Content of rock fragments—0 to 2 percent gravel;
0 to 1 percent cobbles and stones

211—Lura silty clay, depressional, 0 to 1 percent slopes

Composition

Lura and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains and moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)

Content of organic matter in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corvuso and similar soils
- Cosmos and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Madelia Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains

Parent material: Lacustrine deposits

Slope range: 0 to 2 percent

Taxonomic classification: Fine-silty, mixed, mesic Typic Endoaquolls

Typical Pedon

Madelia silty clay loam, 0 to 2 percent slopes, 1,000 feet south and 100 feet west of the northeast corner of sec. 29, T. 120 N., R. 29 W.

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

A—10 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate very fine angular blocky; friable; neutral; clear smooth boundary.

Bg1—16 to 21 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure; friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; very many olive gray (5Y 4/2) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

Bg2—21 to 30 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure parting to weak thin platy; friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; neutral; abrupt smooth boundary.

Bkg—30 to 60 inches; light olive gray (5Y 6/2) silt loam; moderate thin platy structure; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

A horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bg horizon:

Hue—5Y or 2.5Y

Value—4 or 5
 Chroma—1 or 2
 Texture—silty clay loam or silt loam

Bkg horizon:

Hue—5Y
 Value—5 or 6
 Chroma—1 or 2
 Texture—silt loam, silty clay loam, or loam that has a high content of very fine sand

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

Composition

Madelia and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on lake plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Spicer and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Marcellon Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Marcellon loam, 0 to 3 percent slopes, 650 feet west and 1,400 feet south of the northeast corner of sec. 8, T. 121 N., R. 30 W.

- Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.
- A—10 to 13 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 1 percent cobbles and stones; slightly acid; clear smooth boundary.
- Bt1—13 to 19 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; 5 percent gravel; 3 percent cobbles and stones; moderately acid; clear smooth boundary.
- Bt2—19 to 27 inches; grayish brown (2.5Y 5/2) loam; weak medium prismatic structure parting to moderate fine subangular blocky; friable; very many dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; common very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 7 percent gravel; 4 percent cobbles and stones; moderately acid; clear smooth boundary.
- Bt3—27 to 32 inches; light olive brown (2.5Y 5/6) loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common fine prominent olive gray (5Y 4/2) iron depletions; common black (10YR 2/1) clay films on faces of peds and in pores; 8 percent gravel; 5 percent cobbles and stones; neutral; clear smooth boundary.
- Bk1—32 to 38 inches; light brownish gray (2.5Y 6/2) loam; weak medium subangular blocky structure; friable; common medium distinct light yellowish

brown (2.5Y 6/4) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—38 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium subangular blocky structure; friable; common medium distinct light yellowish brown (2.5Y 6/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches

Thickness of the mollic epipedon: 10 to 18 inches

Other features: A thin E or BA horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loam

Content of rock fragments—1 to 3 percent gravel;
1 to 3 percent cobbles and stones

Bt horizon:

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—2 to 4

Texture—loam or sandy clay loam

Content of rock fragments—3 to 7 percent gravel;
3 to 5 percent cobbles and stones

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 or 3

Texture—sandy loam or loam

Content of rock fragments—4 to 8 percent gravel;
4 to 8 percent cobbles and stones

511—Marcellon loam, 0 to 3 percent slopes

Composition

Marcellon and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.0 to 2.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)

Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Mayer Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate in the loamy mantle and rapid in the underlying sand and gravel

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Mayer loam, in an area of Mayer-Biscay, depressional, complex, 0 to 2 percent slopes, 800 feet east and 100 feet south of the northwest corner of sec. 21, T. 119 N., R. 30 W.

Ap—0 to 8 inches; black (N 2/0) loam; weak fine subangular blocky structure; friable; 1 percent

gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 16 inches; black (N 2/0) loam; weak fine subangular blocky structure; friable; 1 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg1—16 to 21 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 10 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—21 to 25 inches; olive gray (5Y 5/2) loam; weak fine subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2Bkg3—25 to 60 inches; olive gray (5Y 5/2) gravelly sand; single grain; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 25 percent gravel; common fine soft white (10YR 8/2) accumulations of calcium carbonate on the underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the loamy mantle: 20 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Content of rock fragments—0 to 5 percent gravel

Bkg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—0 to 10 percent gravel

2Bkg horizon:

Hue—5Y

Value—3 to 5

Chroma—1 to 3

Texture—coarse sand, gravelly coarse sand, sand, or gravelly sand

Content of rock fragments—10 to 50 percent gravel

1097—Mayer-Biscay, depressional, complex, 0 to 2 percent slopes

Composition

Mayer and similar soils: About 70 percent

Biscay and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces

Position on the landform: Mayer—flats and swales;

Biscay—depressions

Slope range: Mayer—0 to 2 percent; Biscay—0 to 1 percent

Component Description

Mayer

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 6.0 inches (moderate)

Content of organic matter in the surface layer: About 6 percent (high)

Biscay

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Medo Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate in the organic material and moderately rapid or rapid in the underlying material

Landform: Outwash plains and terraces

Parent material: Organic materials over glacial outwash

Slope range: 0 to 1 percent

Taxonomic classification: Loamy, mixed, euic, mesic
Terric Medisaprists

Typical Pedon

Medo muck, depressional, 0 to 1 percent slopes, 1,700 feet south and 650 feet west of the northeast corner of sec. 15, T. 119 N., R. 30 W.

Oa—0 to 24 inches; muck (sapric material), black (N 2/0) broken face and rubbed; about 20 percent fiber, trace rubbed; weak fine subangular blocky structure; very friable; common fine roots; neutral; abrupt smooth boundary.

2A1—24 to 29 inches; black (N 2/0) silt loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

2A2—29 to 42 inches; black (N 2/0) silty clay loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

2Bw—42 to 56 inches; very dark gray (5Y 3/1) sandy loam; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

2Cg—56 to 60 inches; dark gray (5Y 4/1) sand; single grain; loose; neutral.

Range in Characteristics

Depth to mineral soil: 16 to 40 inches

O horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—muck

2A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—sandy loam, fine sandy loam, loam, silt loam, or silty clay loam

2Cg horizon:

Hue—5Y or 5GY

Value—4 to 6

Chroma—1 or 2

Texture—sand, fine sand, very fine sand, coarse sand, or the loamy or gravelly analogs of these textures

548—Medo muck, depressional, 0 to 1 percent slopes**Composition**

Medo and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 15.1 inches (high)

Content of organic matter in the surface layer: About 35 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1406—Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes

Composition

Medo and similar soils: About 30 percent
 Dassel and similar soils: About 30 percent
 Biscay and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains and terraces

Slope range: 0 to 1 percent

Component Description

Medo

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.0 inches (high)

Content of organic matter in the surface layer: About 35 percent (very high)

Dassel

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 7.6 inches (moderate)

Content of organic matter in the surface layer: About 9 percent (very high)

Biscay

Surface layer texture: Mucky loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Houghton and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Minneopa Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate or moderately rapid in the loamy mantle and rapid or very rapid in the underlying sand and gravel

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Sandy, mixed, mesic Aquic Hapludolls

Typical Pedon

Minneopa loam, 0 to 2 percent slopes, 500 feet east and 150 feet north of the southwest corner of sec. 12, T. 120 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular

blocky structure; friable; slightly acid; clear smooth boundary.

A—7 to 11 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many black (10YR 2/1) organic coatings on faces of peds; slightly acid; clear smooth boundary.

BA—11 to 15 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark brown (10YR 2/2) organic coatings on faces of peds; slightly acid; clear smooth boundary.

2Bw—15 to 18 inches; olive brown (2.5Y 4/3) loamy sand; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many dark grayish brown (10YR 4/2) organic coatings on faces of peds; 12 percent gravel; neutral; clear smooth boundary.

2BC—18 to 25 inches; olive brown (2.5Y 4/3) gravelly loamy sand; common fine faint grayish brown (2.5Y 5/2) iron depletions and light olive brown (2.5Y 5/4) iron concentrations; weak very fine subangular blocky structure; very friable; 20 percent gravel; neutral; clear smooth boundary.

2Bk1—25 to 34 inches; grayish brown (2.5Y 5/2) gravelly loamy sand; common fine distinct light olive brown (2.5Y 5/4) iron concentrations; weak very fine subangular blocky structure; very friable; soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; 25 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

2Bk2—34 to 60 inches; grayish brown (2.5Y 5/2) gravelly sand; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; single grain; loose; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; 25 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 25 inches

Thickness of the loamy mantle: 12 to 20 inches

Thickness of the mollic epipedon: 12 to 20 inches

Other features: A Bw horizon in some pedons

Ap horizon:

Hue—10YR

Value—2

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 10 percent gravel

A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam or loam

Content of rock fragments—0 to 10 percent gravel

2Bw and 2BC horizons:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent gravel

2Bk horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent gravel

1384—Minneopa loam, 0 to 2 percent slopes

Composition

Minneopa and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 3 to 5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 4.7 inches (low)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Estherville and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Muskego Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately rapid in the peaty muck; moderate or slow in the coprogenous earth

Landform: Moraines, flood plains, lake plains, and outwash plains

Parent material: Organic materials and coprogenous earth

Slope range: 0 to 1 percent

Taxonomic classification: Coprogenous, euic, mesic
Limnic Medisaprists

Typical Pedon

Muskego muck, depressional, 0 to 1 percent slopes (fig. 16), 2,150 feet north and 2,000 feet west of the southeast corner of sec. 2, T. 117 N., R. 31 W.

- Op—0 to 10 inches; muck (sapric material), black (10YR 2/1) broken faced and rubbed; about 10 percent fiber, trace rubbed; weak fine granular structure; very friable; neutral; clear smooth boundary.
- Oa1—10 to 30 inches; muck (sapric material), very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 10 percent fiber, trace rubbed; weak thick platy structure parting to weak medium subangular blocky; very friable; neutral; clear smooth boundary.
- Oa2—30 to 40 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 10 percent fiber, trace rubbed; weak thick platy structure parting to weak medium subangular blocky; very friable; neutral; abrupt smooth boundary.
- C—40 to 60 inches; black (10YR 2/1) mucky silt loam (coprogenous earth); massive; very friable; 5

percent snail shells and shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to coprogenous earth: 16 to 50 inches

O horizon:

Hue—neutral, 10YR, or 7.5YR

Value—2 or 3

Chroma—0 to 3

Texture—muck

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 4

Chroma—1 or 2

Texture—mucky silt loam (coprogenous earth)

Content of rock fragments—5 percent snail shells

525—Muskego muck, depressional, 0 to 1 percent slopes

Composition

Muskego and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains, outwash plains, and moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 20.2 inches (high)

Content of organic matter in the surface layer: About 75 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Blue Earth and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1173—Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded

Composition

Muskego and similar soils: About 45 percent

Klossner and similar soils: About 40 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on flood plains

Slope range: 0 to 1 percent

Component Description

Muskego

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: Frequent

Seasonal high water table: 3.0 feet above to 1.5 feet below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 21.4 inches (high)

Content of organic matter in the surface layer: About 75 percent (very high)

Klossner

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: Frequent

Seasonal high water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 17.7 inches (high)

Content of organic matter in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1203—Muskego, Blue Earth, and Houghton soils, ponded

Composition

Muskego and similar soils: About 30 percent

Blue Earth and similar soils: About 30 percent

Houghton and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Muskego

Surface layer texture: Muck

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: 3 feet above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 13.3 inches (high)

Content of organic matter in the surface layer: About 42.5 percent (very high)

Blue Earth

Surface layer texture: Mucky silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Coprogenous earth
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)
Content of organic matter in the surface layer: About 17.5 percent (very high)

Houghton

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None
Seasonal high water table: 2.0 feet above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 84.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okobojo and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Newlondon Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 6 to 18 percent

Taxonomic classification: Fine-loamy, mixed, mesic Aquic Eutrochrepts

Typical Pedon

Newlondon clay loam, in an area of Newlondon-Strout complex, 6 to 12 percent slopes, eroded, 700 feet south and 150 feet west of the northeast corner of sec. 23, T. 118 N., R. 32 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam; cloddy; friable; 1 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 14 inches; light yellowish brown (2.5Y 6/4) clay loam; strong medium angular blocky structure parting to strong very fine angular blocky; firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 1 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—14 to 38 inches; grayish brown (2.5Y 5/2) clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—38 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse angular blocky structure; very firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Ap horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 or 3

Texture—clay loam

Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—4 to 6
 Chroma—3 or 4
 Texture—clay, silty clay, or clay loam
 Content of rock fragments—2 to 4 percent gravel;
 1 to 3 percent cobbles and stones

1171C—Newlondon-Strout complex, 6 to 12 percent slopes, eroded

Composition

Newlondon and similar soils: About 65 percent
 Strout and similar soils: About 30 percent
 Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Newlondon—shoulders and summits; Strout—summits and backslopes
Slope range: 6 to 12 percent

Component Description

Newlondon

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Strout

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.2 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Danielson and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1171D—Newlondon-Strout complex, 12 to 18 percent slopes, eroded

Composition

Newlondon and similar soils: About 80 percent
 Strout and similar soils: About 15 percent
 Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Newlondon—backslopes and shoulders; Strout—backslopes
Slope range: 12 to 18 percent

Component Description

Newlondon

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Strout

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Danielson and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Nicollet Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 1 to 3 percent slopes, 100 feet east and 1,950 feet north of the southwest corner of sec. 29, T. 119 N., R. 31 W.

A_p—0 to 10 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles; neutral; abrupt smooth boundary.

A₁—10 to 13 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

A₂—13 to 16 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

B_{w1}—16 to 25 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine subangular blocky structure parting to weak very fine subangular blocky;

friable; 2 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

B_{w2}—25 to 30 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions; 2 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

B_{k1}—30 to 37 inches; grayish brown (2.5Y 5/2) loam; massive; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions and few prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

B_{k2}—37 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions and common distinct yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 30 inches

Thickness of the mollic epipedon: 10 to 24 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam or silty clay loam

Content of rock fragments—1 to 4 percent gravel;
0 to 1 percent cobbles and stones

B_w horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—loam, clay loam, or silty clay loam in the upper part

Content of rock fragments—1 to 4 percent gravel;
1 to 4 percent cobbles and stones

B_k horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

130—Nicollet clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.0 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1100—Nicollet silty clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 2.0 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Webster and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Okoboji Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Moraines and lake plains
Parent material: Lacustrine deposits over till
Slope range: 0 to 1 percent
Taxonomic classification: Fine, montmorillonitic, mesic
Cumulic Vertic Endoaquolls

Typical Pedon

Okoboji silty clay loam, in an area of Harps-Okoboji, depressional, complex, 0 to 2 percent slopes, 1,900 feet east and 900 feet south of the northwest corner of sec. 28, T. 117 N., R. 32 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very

dark gray (N 3/0) dry; cloddy; friable; neutral; clear smooth boundary.

A—10 to 17 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine angular blocky structure parting to moderate very fine angular blocky; friable; neutral; clear smooth boundary.

AB—17 to 27 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; weak fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear wavy boundary.

Bg1—27 to 36 inches; olive gray (5Y 4/2) silty clay loam; weak fine prismatic structure parting to strong medium angular blocky; firm; neutral; clear wavy boundary.

Bg2—36 to 47 inches; olive gray (5Y 5/2) silty clay loam; moderate fine prismatic structure parting to strong medium angular blocky; firm; neutral; clear wavy boundary.

Bkg—47 to 60 inches; olive gray (5Y 5/2) silty clay loam; moderate fine prismatic structure parting to strong medium angular blocky; firm; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 25 to 56 inches

Thickness of the mollic epipedon: 24 to 48 inches

Ap horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—silty clay loam

Bg horizon:

Hue—5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay loam or silty clay

Bkg horizon:

Hue—5Y

Value—5 or 6

Chroma—1 or 2

Texture—silty clay loam or silt loam

134—Okoboji silty clay loam, depressional, 0 to 1 percent slopes

Composition

Okoboji and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on lake plains and moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Depth to the water table: 1 foot above to 1 foot below the surface

Kind of water table: Apparent

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)

Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Harps and similar soils
- Canisteo and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Omsrud Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 6 to 18 percent

Taxonomic classification: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Omsrud loam, in an area of Storden-Omsrud complex, 6 to 12 percent slopes, eroded, 550 feet east and 1,200 feet south of the northwest corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; neutral; abrupt smooth boundary.

Bw1—9 to 15 inches; olive brown (2.5Y 4/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles and stones; neutral; clear smooth boundary.

Bw2—15 to 25 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; few dark brown (10YR 4/3) organic stains on faces of peds; neutral; clear smooth boundary.

Bk—25 to 60 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak thin platy; friable; few fine distinct light olive brown (2.5Y 5/6) relict mottles; common fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Content of rock fragments—1 to 4 percent gravel;
1 to 4 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—4

Texture—loam

Content of rock fragments—3 to 5 percent gravel;
3 to 5 percent cobbles and stones

1030—Pits, gravel-Udipsamments complex

Composition

Pits, gravel: 45 percent

Udipsamments: 45 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces

Slope range: Udipsamments—0 to 30 percent

Component Description

Pits, gravel

Dominant parent material: Glacial outwash

Udipsamments

Surface layer texture: Sand

Depth to bedrock: Greater than 60 inches

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Reedslake Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 5 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Typic Argiudolls

Typical Pedon

Reedslake loam, 2 to 5 percent slopes, 2,200 feet east and 1,500 feet north of the southwest corner of sec. 22, T. 118 N., R. 29 W.

A—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; neutral; abrupt smooth boundary.

Bt—12 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores, few very dark brown (10YR 2/2) clay films in channels; about 2 percent gravel; neutral; clear smooth boundary.

Bk1—26 to 32 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate; about 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—32 to 48 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine prominent strong brown (7.5YR 5/8) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate; about 3 percent gravel; about 1 percent cobbles; strongly effervescent; moderately alkaline; clear smooth boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) loam; massive; friable; common fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine prominent strong brown (7.5YR 5/8) iron concentrations; few masses and threads of calcium carbonate; about 3 percent gravel; about 1 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches

Thickness of the mollic epipedon: 9 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

Content of rock fragments—1 to 3 percent gravel;
1 to 4 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—loam

Content of rock fragments—3 to 5 percent gravel;
1 to 3 percent cobbles and stones

1204B—Reedslake loam, 2 to 5 percent slopes

Composition

Reedslake and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)

Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

- Forest Land section

Rohrbeck Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid in the upper part, moderately rapid in the lower part

Landform: Moraines

Parent material: Glacial outwash over till

Slope range: 1 to 5 percent

Taxonomic classification: Loamy, mixed, mesic Arenic Hapludalfs

Typical Pedon

Rohrbeck loamy sand, in an area of Rohrbeck-Koronis complex, 1 to 6 percent slopes, 1,800 feet south and 2,000 feet east of the northwest corner of sec. 31, T. 121 N., R. 30 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; 1 percent gravel; moderately acid; abrupt smooth boundary.

E1—6 to 12 inches; dark brown (10YR 4/3) loamy sand; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; many dark brown (10YR 3/3) organic coatings; about 5 percent gravel; slightly acid; clear smooth boundary.

E2—12 to 25 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; many dark brown (10YR 4/3) organic coatings; about 5 percent gravel; neutral; abrupt smooth boundary.

2Bt1—25 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; many dark brown (10YR 4/3) organic coatings; few dark brown (10YR 3/3) clay films on faces of peds and in pores; about 8 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

2Bt2—33 to 41 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions; many olive brown (2.5Y 4/4) organic coatings on faces of peds and in pores; few dark brown (10YR 4/3) clay films on faces of peds and in pores; about 5 percent gravel; about 5 percent cobbles; neutral; clear smooth boundary.

2Bk—41 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/6) iron concentrations and common distinct light brownish gray (2.5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 7 percent gravel; about 5 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Depth to carbonates: 30 to 50 inches

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—2 or 3

Texture—loamy sand

Content of rock fragments—0 to 2 percent gravel

E horizon:

Hue—10YR

Value—3 or 4

Chroma—2 to 4

Texture—sand, fine sand, loamy sand, or loamy fine sand

Content of rock fragments—0 to 5 percent gravel

2Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam or fine sandy loam in the upper part; sandy loam, fine sandy loam, loam, or sandy clay loam in the lower part

Content of rock fragments—4 to 8 percent gravel; 4 to 5 percent cobbles and stones

2Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—6 to 9 percent gravel; 4 to 6 percent cobbles and stones

1198B—Rohrbeck-Koronis complex, 1 to 6 percent slopes

Composition

Rohrbeck and similar soils: About 55 percent

Koronis and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: Rohrbeck—1 to 5 percent; Koronis—3 to 6 percent

Component Description

Rohrbeck

Surface layer texture: Loamy sand

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)

Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Koronis

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Barry and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rolfe Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

Taxonomic classification: Fine, montmorillonitic, mesic Typic Argialbolls

Typical Pedon

Rolfe silt loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 1,800 feet north and 500 feet east of the southwest corner of sec. 1, T. 118 N., R. 29 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; cloddy; friable; slightly acid; abrupt smooth boundary.

AE—9 to 16 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; friable; slightly acid; clear smooth boundary.

E—16 to 23 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 6/1) dry; weak very thin platy structure; very friable; moderately acid; clear smooth boundary.

EB—23 to 28 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 6/1) dry; weak thin platy structure parting to weak fine angular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; very many black (10YR 2/1) organic coatings on faces of peds and in pores; 1 percent gravel; moderately acid; clear smooth boundary.

Btg1—28 to 40 inches; olive gray (5Y 4/2) silty clay; moderate coarse prismatic structure parting to moderate very coarse angular blocky; firm; common black (N 2/0) clay films on faces of peds; very many black (10YR 2/1) organic coatings on faces of peds and in pores; 1 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

2Btg2—40 to 52 inches; olive gray (5Y 4/2) clay loam; moderate coarse prismatic structure parting to moderate very coarse angular blocky; firm; common very dark gray (N 3/0) clay films on faces of peds; very many very dark gray (N 3/0) organic coatings on faces of peds and in pores; 2 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

2Btg3—52 to 60 inches; light olive gray (5Y 6/2) clay loam; weak medium angular blocky structure;

friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common very dark gray (5Y 3/1) clay films on faces of peds; 2 percent gravel; 3 percent cobbles and stones; neutral.

Range in Characteristics

Depth to carbonates: 42 to 60 inches

Thickness of the mollic epipedon: 10 to 24 inches

Other features: A C horizon in some pedons

Ap horizon:

Hue—10YR

Value—2

Chroma—1

Texture—silt loam

Content of rock fragments—0 to 5 percent gravel

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam or loam

Content of rock fragments—0 to 5 percent gravel

E horizon:

Hue—10YR

Value—3 or 4

Chroma—1

Texture—loam or silt loam

Content of rock fragments—0 to 5 percent gravel

Btg horizon:

Hue—5Y

Value—4 to 6

Chroma—2

Texture—silty clay or clay loam

Content of rock fragments—2 to 4 percent gravel;
2 to 4 percent cobbles and stones

Seaforth Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic classification: Fine-loamy, mixed, mesic
Aquic Calciudolls

Typical Pedon

Seaforth loam, 1 to 3 percent slopes, 580 feet north

and 1,550 feet west of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; cloddy; friable; 1 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—12 to 28 inches; grayish brown (2.5Y 5/2) loam; weak very fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—28 to 36 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; friable; few medium distinct grayish brown (2.5Y 5/2) iron depletions; many fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few strong brown (7.5YR 5/8) iron concentrations in ped interiors; 3 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bk3—36 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; friable; many medium distinct grayish brown (2.5Y 5/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few strong brown (7.5YR 5/8) iron oxide concentrations in ped interiors; 3 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 7 inches

Thickness of the mollic epipedon: 10 to 20 inches

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

Content of rock fragments—0 to 5 percent gravel;
0 to 1 percent cobbles and stones

Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

423—Seaforth loam, 1 to 3 percent slopes**Composition**

Seaforth and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Shorewood Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 12 percent
Taxonomic classification: Fine, montmorillonitic, mesic Aquertic Argiudolls

Typical Pedon

Shorewood silty clay loam, 3 to 6 percent slopes, 2,110 feet south and 1,000 feet east of the northwest corner of sec. 10, T. 120 N., R. 30 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; strong very fine angular blocky structure; firm; common light gray or gray (10YR 6/1) silt coatings on faces of peds; neutral; abrupt smooth boundary.

A—8 to 12 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

Bt1—12 to 19 inches; olive brown (2.5Y 4/3) silty clay; weak fine prismatic structure parting to strong very fine angular blocky; firm; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; slightly acid; clear smooth boundary.

Bt2—19 to 27 inches; light olive brown (2.5Y 5/3) silty clay; weak medium prismatic structure parting to strong very fine angular blocky; firm; few fine prominent yellowish brown (10YR 5/6) iron concentrations; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few black (10YR 2/1) clay films in channels; moderately acid; clear smooth boundary.

Bt3—27 to 38 inches; light olive brown (2.5Y 5/3) silty clay; weak medium prismatic structure parting to moderate very fine angular blocky; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few black (10YR 2/1) clay films in channels; moderately acid; clear smooth boundary.

Bk1—38 to 45 inches; light yellowish brown (2.5Y 6/4) silty clay loam; strong thin platy structure; friable; common fine faint light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) threads and masses of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—45 to 60 inches; stratified light yellowish brown (2.5Y 6/4), friable silty clay loam and grayish brown (2.5Y 5.2), firm silty clay; common fine faint light olive brown (2.5Y 5/4) iron concentrations; strong thin platy structure; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 50 inches

Thickness of the mollic epipedon: 10 to 18 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silty clay or silty clay loam

Bt horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2

Texture—silty clay

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—stratified silty clay loam and silty clay
(silty strata 2 to 4 inches thick; clayey strata 1/2
inch to 2 inches thick)

286B—Shorewood silty clay loam, 3 to 6 percent slopes**Composition**

Shorewood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rises on lake plains

Slope range: 3 to 6 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

311C2—Shorewood silty clay, 6 to 12 percent slopes, eroded**Composition**

Shorewood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Lake plains

Position on the landform: Summits and backslopes

Slope range: 6 to 12 percent

Component Description

Surface layer texture: Silty clay

Depth to bedrock: Greater than 60 inches

Drainage class: Moderately well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Bold and similar soils
- Waldorf and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1383A—Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes

Composition

Shorewood and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Rolfe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Sparta Series

Depth class: Very deep
Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 1 to 25 percent

Taxonomic classification: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Sparta loamy sand, 1 to 6 percent slopes, 700 feet west and 2,050 feet north of the southeast corner of sec. 26, T. 121 N., R. 31 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) loamy sand, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; slightly acid; clear smooth boundary.

A—11 to 16 inches; very dark brown (10YR 2/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; moderately acid; clear smooth boundary.

Bw1—16 to 21 inches; dark brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; very friable; moderately acid; clear smooth boundary.

Bw2—21 to 29 inches; brown (10YR 5/3) loamy sand; weak fine subangular blocky structure; very friable; moderately acid; gradual smooth boundary.

C1—29 to 44 inches; brown (10YR 5/3) fine sand; single grain; loose; slightly acid; gradual smooth boundary.

C2—44 to 60 inches; brown (10YR 5/3) sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Thickness of the mollic epipedon: 10 to 24 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand or loamy sand

Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy fine sand, loamy sand, sand, or fine sand

Content of rock fragments—0 to 5 percent gravel

C horizon:

Hue—10YR

Value—4 to 6

Chroma—3 to 6

Texture—sand or fine sand
Content of rock fragments—0 to 10 percent gravel

8B—Sparta loamy sand, 1 to 6 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 1 to 6 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

8C—Sparta loamy sand, 6 to 12 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

8D—Sparta loamy sand, 12 to 25 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Backslopes
Slope range: 12 to 25 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1172C—Sparta-Gardencity complex, 6 to 12 percent slopes

Composition

Sparta and similar soils: About 70 percent

Gardencity and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains

Position on the landform: Summits and backslopes

Slope range: 6 to 12 percent

Component Description

Sparta

Surface layer texture: Loamy sand

Depth to bedrock: Greater than 60 inches

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.1 inches (low)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Gardencity

Surface layer texture: Fine sandy loam

Depth to bedrock: Greater than 80 inches

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Spicer Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains

Parent material: Lacustrine deposits

Slope range: 0 to 2 percent

Taxonomic classification: Fine-silty, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Spicer silty clay loam, 0 to 2 percent slopes, 2,100 feet south and 1,000 feet west of the northeast corner of sec. 36, T. 120 N., R. 30 W.

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

A—7 to 14 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; very friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bkg1—14 to 20 inches; dark gray (5Y 4/1) silty clay loam; weak fine subangular blocky structure

parting to moderate very fine subangular blocky; very friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—20 to 27 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent olive (5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—27 to 60 inches; light olive gray (5Y 6/2) silt loam; moderate very thin platy structure; very friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 12 to 24 inches

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg horizon (upper part):

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay loam or silt loam

Bkg horizon (lower part):

Hue—5Y

Value—5 or 6

Chroma—1 or 2

Texture—silt loam or silty clay loam

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

Composition

Spicer and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on lake plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting

layer: About 11.7 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Storden Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 4 to 40 percent

Taxonomic classification: Fine-loamy, mixed, mesic Typic Eutrochrepts

Typical Pedon

Storden loam (fig. 17), in an area of Storden-Omsrud complex, 6 to 12 percent slopes, eroded, 2,400 feet north and 2,300 feet west of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 21 inches; light olive brown (2.5Y 5/4) loam; weak medium platy structure; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few red (2.5YR 4/6) streaks; 2 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—21 to 60 inches; light olive brown (2.5Y 5/4) loam; weak medium platy structure; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few red (2.5YR 4/6) iron oxide concentrations; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Content of rock fragments: 2 to 5 percent gravel; 2 to 5 percent cobbles and stones

A horizon:

Hue—10YR

Value—4 or 5

Chroma—2 or 3

Texture—loam

Bk horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 6

Texture—loam

960C2—Storden-Omsrud complex, 6 to 12 percent slopes, eroded

Composition

Storden and similar soils: About 65 percent

Omsrud and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Storden—shoulders and summits; Omsrud—summits and backslopes

Slope range: 6 to 12 percent

Component Description

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)

Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

960D2—Storden-Omsrud complex, 12 to 18 percent slopes, eroded

Composition

Storden and similar soils: About 65 percent

Omsrud and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Storden—backslopes and shoulders; Omsrud—backslopes

Slope range: 12 to 18 percent

Component Description

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Strout Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 18 percent
Taxonomic classification: Fine, montmorillonitic, mesic Vertic Hapludolls

Typical Pedon

Strout clay, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 300 feet west and 300 feet north of the southeast corner of sec. 14, T. 118 N., R. 32 W.

Ap—0 to 7 inches; clay, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.
 AB—7 to 10 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; about 20 percent masses of dark olive brown (2.5Y 4/4) clay, light yellowish brown (2.5Y 6/4) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; 2 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.
 Bt1—10 to 16 inches; clay, olive brown (2.5Y 4/4) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; firm; dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.
 Bt2—16 to 24 inches; olive brown (2.5Y 4/4) clay; moderate fine prismatic structure parting to moderate very fine angular blocky; firm; dark grayish brown (2.5Y 4/2) clay films on faces of peds; 3 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.
 Bk1—24 to 36 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse angular blocky structure parting to weak fine angular blocky; firm; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.
 Bk2—36 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse angular blocky structure parting to weak fine angular blocky; firm; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 7 to 24 inches

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—clay or clay loam
 Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:

Hue—2.5Y
 Value—4 or 5

Chroma—3 or 4
 Texture—clay loam, clay, silty clay, or silty clay loam
 Content of rock fragments—1 to 3 percent gravel; 0 to 2 percent cobbles and stones

Bk horizon:

Hue—2.5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—clay loam, clay, silty clay, or silty clay loam
 Content of rock fragments—1 to 4 percent gravel; 0 to 1 percent cobbles and stones

1159B—Strout-Arkton complex, 2 to 6 percent slopes

Composition

Strout and similar soils: About 70 percent
 Arkton and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Strout—summits and backslopes; Arkton—shoulders and summits
Slope range: Strout—2 to 6 percent; Arkton—4 to 6 percent

Component Description

Strout

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

Arkton

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sunburg Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 4 to 40 percent
Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Sunburg sandy loam, in an area of Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded, 1,400 feet west and 500 feet north of the southeast corner of sec. 9, T. 121 N., R. 32 W.

- Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine subangular blocky structure; very friable; 6 percent gravel; 4 percent cobbles and stones; strongly effervescent; slightly alkaline; abrupt smooth boundary.
- Bk1—8 to 14 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak coarse subangular blocky structure parting to weak medium platy; very friable; common fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 7 percent gravel; 5 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—14 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak coarse subangular blocky structure parting to weak thick platy; very friable; few distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Content of rock fragments: 6 to 10 percent gravel; 3 to 5 percent cobbles and stones

A horizon:

Hue—10YR

Value—3 or 4

Chroma—2 or 3

Texture—sandy loam or fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 or 4

Texture—loam, sandy loam, or fine sandy loam (average clay content of less than 18 percent)

805C2—Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded

Composition

Sunburg and similar soils: About 50 percent

Wadenill and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Sunburg—shoulders and summits; Wadenill—summits and backslopes

Slope range: 6 to 12 percent

Component Description

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Wadenill

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

805D2—Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded

Composition

Sunburg and similar soils: About 65 percent

Wadenill and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Sunburg—backslopes and shoulders; Wadenill—backslopes

Slope range: 12 to 18 percent

Component Description

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)

Content of organic matter in the surface layer: About 2.5 percent (moderate)

Wadenill

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)

Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Swanlake Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 4 to 6 percent

Taxonomic classification: Fine-loamy, mixed, mesic Typic Calcudolls

Typical Pedon

Swanlake loam, in an area of Clarion-Swanlake complex, 2 to 6 percent slopes, 2,000 feet west and 1,600 feet north of the southeast corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam; weak fine subangular blocky structure; friable; few

dark yellowish brown (10YR 4/4) streaks in ped interiors; 1 percent gravel; 1 percent cobbles and stones; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 12 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles and stones; slightly effervescent; slightly alkaline; clear smooth boundary.

Bk2—12 to 21 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine distinct light brownish gray (2.5Y 6/2) relict iron depletions and few fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk3—21 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; common fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few soft strong brown (7.5YR 5/8) accumulations; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 11 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bk horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam

Content of rock fragments—3 to 5 percent gravel; 3 to 5 percent cobbles and stones

Swedegrove Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Swedegrove loam, 0 to 2 percent slopes, 2,300 feet east and 500 feet south of the northwest corner of sec. 17, T. 120 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; 2 percent gravel; 1 percent cobbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—9 to 14 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few fine irregular soft light brownish gray (2.5Y 6/2) threads and masses of calcium carbonate distributed uniformly throughout the horizon; about 2 percent gravel; about 1 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg1—14 to 20 inches; olive gray (5Y 5/2) fine sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 2 percent gravel; about 2 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—20 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam; weak coarse subangular blocky structure; very friable; many medium distinct light olive gray (5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 6 percent gravel; 6 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or sandy clay loam

Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bkg horizon (upper part):

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam, sandy clay loam, fine sandy loam, or sandy loam

Content of rock fragments—2 to 6 percent gravel; 2 to 4 percent cobbles and stones

Bkg horizon (lower part):

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—fine sandy loam or sandy loam

Content of rock fragments—4 to 8 percent gravel; 4 to 7 percent cobbles and stones

1168—Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes

Composition

Swedegrove and similar soils: About 70 percent

Lundlake and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Swedegrove—rims of depressions and flats; Lundlake—depressions

Slope range: Swedegrove—0 to 2 percent; Lundlake—0 to 1 percent

Component Description

Swedegrove

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Lundlake

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1175—Swedegrove loam, 0 to 2 percent slopes

Composition

Swedegrove and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Rims of depressions and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Truman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 2 to 18 percent
Taxonomic classification: Fine-silty, mixed, mesic Typic Hapludolls

Typical Pedon

Truman silt loam, 2 to 6 percent slopes, 500 feet south and 200 feet east of the northwest corner of sec. 28, T. 120 N., R. 30 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

AB—9 to 14 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

- Bw1**—14 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
- Bw2**—20 to 31 inches; yellowish brown (10YR 5/4) silt loam; weak coarse subangular blocky structure parting to weak very fine subangular blocky; friable; neutral; clear smooth boundary.
- Bk1**—31 to 40 inches; light olive brown (2.5Y 5/4) silt loam; weak thin platy structure; friable; very few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.
- Bk2**—40 to 60 inches; light olive brown (2.5Y 5/4) silt loam; moderate thin platy structure; friable; common fine distinct light olive brown (2.5Y 5/6) and common prominent yellowish brown (10YR 5/8) relict iron concentrations; few white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—silt loam

Bw horizon:

Hue—10YR
 Value—3 to 5
 Chroma—3 to 5
 Texture—silt loam or silty clay loam

Bk horizon:

Hue—2.5Y or 10YR
 Value—5 or 6
 Chroma—4 to 6
 Texture—silt loam

101B—Truman silt loam, 2 to 6 percent slopes

Composition

Truman and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okobojo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1015—Udipsamments (cut and fill land)

Composition

Udipsamments and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Slope range: 0 to 6 percent

Component Description

Surface layer texture: Sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

Inclusions

- Biscay and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1016—Udorthents, loamy (cut and fill land)

Composition

Udorthents: Variable

Inclusions: About 15 percent

Setting

Landform: Moraines

Slope range: 0 to 20 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.6 inches (moderate)

Content of organic matter in the surface layer: About 0.75 percent (low)

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Uniongrove Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Uniongrove loam, 0 to 2 percent slopes, 1,500 feet east and 1,525 feet south of the northwest corner of sec. 27, T. 121 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; 1 percent cobbles; slightly acid; abrupt smooth boundary.

A—9 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; about 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bg1—16 to 24 inches; olive gray (5Y 4/2) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; very dark gray (10YR 3/1) organic coatings on faces of peds; 3 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bg2—24 to 30 inches; olive gray (5Y 5/2) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; 3 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

Bkg1—30 to 38 inches; olive gray (5Y 5/2) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations and few distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 5 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—38 to 60 inches; light olive gray (5Y 6/2) fine sandy loam; weak coarse subangular blocky structure; very friable; common fine prominent light olive brown (2.5Y 5/6) and few light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 7 percent gravel; 4 percent cobbles; violently effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 42 inches

Thickness of the mollic epipedon: 11 to 24 inches

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2
 Texture—loam
 Content of rock fragments—1 to 3 percent gravel;
 1 to 3 percent cobbles and stones

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—1 or 2
 Texture—loam, sandy clay loam, fine sandy loam,
 or sandy loam
 Content of rock fragments—2 to 5 percent gravel;
 1 to 4 percent cobbles and stones

Bkg horizon:

Hue—5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—fine sandy loam, sandy loam, or loam
 that has a high content of sand
 Content of rock fragments—4 to 8 percent gravel;
 4 to 7 percent cobbles and stones

1178—Uniongrove loam, 0 to 2 percent slopes

Composition

Uniongrove and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils

- Swedegrove and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wadena Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate in the loamy mantle and very rapid in the underlying sand and gravel

Landform: Outwash plains and terraces

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Wadena loam, 0 to 2 percent slopes, 600 feet west and 400 feet north of the southeast corner of sec. 20, T. 119 N., R. 30 W.

Ap—0 to 9 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A—9 to 13 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—13 to 16 inches; dark brown (10YR 3/3) loam; weak very fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; slightly acid; clear smooth boundary.

Bw2—16 to 29 inches; dark brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; brown (10YR 4/3) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

2Bw3—29 to 35 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak fine subangular blocky structure; very friable; 20 percent gravel; neutral; clear smooth boundary.

2Bk—35 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; common soft white (10YR 8/1) and light gray (10YR 7/2) lime concentrations on the underside of gravel and very coarse sand; 20 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 50 inches

Thickness of the loamy mantle: 24 to 40 inches

Thickness of the mollic epipedon: 12 to 24 inches

A horizon:

Hue—10YR

Value—2

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 2 percent gravel

Bw horizon:

Hue—10YR

Value—4 or 5

Chroma—3 or 4

Texture—loam; sandy loam or coarse sandy loam
in the lower part in some pedons

Content of rock fragments—0 to 5 percent gravel

2Bk horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—stratified sand, coarse sand, or the
gravelly or very gravelly analogs of these
textures

Content of rock fragments—0 to 50 percent gravel

39A—Wadena loam, 0 to 2 percent slopes

Composition

Wadena and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.3 inches (moderate)

Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wadenill Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Till

Slope range: 2 to 18 percent

Taxonomic classification: Coarse-loamy, mixed, mesic
Typic Hapludolls

Typical Pedon

Wadenill loam, in an area of Wadenill-Sunburg complex, 2 to 6 percent slopes, 1,200 feet south and 1,500 feet east of the northwest corner of sec. 26, T. 120 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; neutral; abrupt smooth boundary.

Bw1—9 to 16 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark brown (10YR 4/3) organic coatings on faces of peds and in pores; 4 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

Bw2—16 to 25 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; very many dark yellowish brown (10YR 4/4) organic coatings on faces of peds and in pores; 7 percent gravel; 4 percent cobbles and stones; neutral; clear smooth boundary.

Bk1—25 to 38 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; common fine distinct light

brownish gray (2.5Y 6/2) relict iron depletions and few distinct yellowish brown (10YR 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—38 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; many medium distinct light brownish gray (2.5Y 6/2) relict iron depletions and common distinct yellowish brown (10YR 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or sandy loam

Content of rock fragments—2 to 4 percent gravel;
1 to 3 percent cobbles and stones

Bw horizon:

Hue—10YR

Value—4 or 5

Chroma—3 or 4

Texture—loam, fine sandy loam, or sandy loam

Content of rock fragments—4 to 8 percent gravel;
3 to 5 percent cobbles and stones

Bk horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—6 to 10 percent gravel;
4 to 6 percent cobbles and stones

612B—Wadenill loam, 2 to 6 percent slopes

Composition

Wadenill and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.9 inches (high)

Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1391B—Wadenill-Sunburg complex, 2 to 6 percent slopes

Composition

Wadenill and similar soils: About 70 percent

Sunburg and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Wadenill—summits and backslopes; Sunburg—shoulders and summits

Slope range: Wadenill—2 to 6 percent; Sunburg—4 to 6 percent

Component Description

Wadenill

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

Sunburg

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Waldorf Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Waldorf silty clay loam, 0 to 2 percent slopes, 1,200

feet north and 1,500 feet west of the southeast corner of sec. 24, T. 120 N., R. 30 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; cloddy; friable; neutral; clear smooth boundary.

A—8 to 13 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

AB—13 to 23 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; many black (N 2/0) stress surfaces on faces of peds; neutral; clear smooth boundary.

Bg1—23 to 30 inches; olive gray (5Y 4/2) silty clay; strong fine prismatic structure parting to strong very fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; many very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear smooth boundary.

Bg2—30 to 35 inches; olive gray (5Y 5/2) silty clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; many olive gray (5Y 4/2) clay films on faces of peds; neutral; clear smooth boundary.

Bkg—35 to 60 inches; light olive gray (5Y 6/2) silty clay loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; firm; common fine prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 26 to 40 inches

Thickness of the mollic epipedon: 16 to 24 inches

Other features: Some pedons have a C horizon, which consists of alternating strata of silty clay and silty clay loam and silt loam.

Ap horizon:

Hue—neutral or 10YR

Value—2

Chroma—0 or 1

Texture—silty clay loam

A horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam or silty clay

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay loam or silty clay

Bkg horizon:

Hue—5Y

Value—5 or 6

Chroma—2

Texture—silty clay loam or silty clay

229—Waldorf silty clay loam, 0 to 2 percent slopes**Composition**

Waldorf and similar soils: About 90 percent

Inclusions: About 10 percent

Setting*Landform:* Drainageways and flats on lake plains*Slope range:* 0 to 2 percent**Component Description***Surface layer texture:* Silty clay loam*Depth to bedrock:* Greater than 60 inches*Drainage class:* Poorly drained*Dominant parent material:* Lacustrine deposits*Flooding:* None*Depth to the water table:* 0.5 foot to 1.5 feet*Kind of water table:* Apparent*Available water capacity to 60 inches or root-limiting layer:* About 10.9 inches (high)*Content of organic matter in the surface layer:* About 7 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Collinwood and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

W—Water**Composition**

Water: 100 percent

Description of the Unit

- Naturally occurring basins of surface water

1356—Water, miscellaneous**Composition**

Water: 100 percent

Description of the Unit

- Small manmade areas that are used for industrial, sanitary, or mining applications and that contain water most of the year

Webster Series*Depth class:* Very deep*Drainage class:* Poorly drained*Permeability:* Moderate*Landform:* Moraines*Parent material:* Till or lacustrine deposits over till*Slope range:* 0 to 2 percent*Taxonomic classification:* Fine-loamy, mixed, mesic Typic Endoaquolls**Typical Pedon**

Webster clay loam, 0 to 2 percent slopes, 2,100 feet south and 1,100 feet west of the northeast corner of sec. 26, T. 117 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; cloddy; friable; 1 percent gravel; neutral; clear smooth boundary.

A—9 to 17 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; about 1 percent gravel; neutral; gradual smooth boundary.

Bg—17 to 24 inches; olive gray (5Y 4/2) clay loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; very many dark olive gray (5Y 3/2) organic coatings on faces of peds and in pores; 2 percent gravel; about 2 percent cobbles and stones; neutral; clear smooth boundary.

Bkg—24 to 60 inches; olive gray (5Y 5/2) loam; weak coarse subangular blocky structure parting to weak thin platy; friable; common fine prominent

light olive brown (2.5Y 5/6) iron concentrations; 1 percent gravel; 3 percent cobbles and stones; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 14 to 24 inches

A horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—clay loam or silty clay loam

Content of rock fragments—1 to 2 percent gravel;
0 to 1 percent cobbles and stones

Bg horizon:

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or silty clay loam in the upper part; clay loam in the lower part

Content of rock fragments—2 to 4 percent gravel;
1 to 2 percent cobbles and stones

Bkg horizon:

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—1 to 3

Texture—dominantly loam or sandy loam; clay loam in some pedons

Content of rock fragments—2 to 4 percent gravel;
1 to 4 percent cobbles and stones

113—Webster clay loam, 0 to 2 percent slopes

Composition

Webster and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1101—Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes

Composition

Webster and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Lacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)

Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit

such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Zook Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic classification: Fine, montmorillonitic, mesic
Cumulic Vertic Endoaquolls

Typical Pedon

Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded, 2,300 feet east and 1,700 feet north of the southwest corner of sec. 18, T. 120 N., R. 29 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate medium angular blocky structure; friable; neutral; abrupt smooth boundary.

A1—10 to 28 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

A2—28 to 41 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

Bg1—41 to 48 inches; gray (5Y 5/1) silty clay loam; weak medium angular blocky structure parting to moderate very fine angular blocky; friable; many medium prominent light yellowish brown (10YR 5/6) iron concentrations; few very dark gray (N 3/0) root channels; neutral; clear smooth boundary.

Bg2—48 to 60 inches; gray (5Y 5/1) silty clay loam; weak medium angular blocky structure; friable; neutral.

Range in Characteristics

Depth to carbonates: Greater than 50 inches

Thickness of the mollic epipedon: 36 to 48 inches

Ap horizon:

Hue—neutral or 10YR

Value—2

Chroma—0 or 1

Texture—silty clay loam

A horizon:

Hue—neutral or 10YR

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam or silty clay

Bg horizon:

Hue—5Y or 10YR

Value—3 to 5

Chroma—1

Texture—silty clay loam or silty clay

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

Composition

Zook and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1 foot below the surface

Kind of water table: Apparent

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)

Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Calco and similar soils

Major Uses of the Unit

- Cropland

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

References

American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.

Lamson, Frank B. (no date). Condensed history of Meeker County.

Lindholm, G.F., and others. 1974. Water resources of the Crow River watershed, South Central Minnesota. Atlas HA-528.

Marschner, Francis J. 1974. The original vegetation of Minnesota. Map. United States Department of Agriculture, Forest Service, North Central Forest Experiment Station.

Ojakangas, Richard W., and Matsch, Charles L. 1982. Minnesota geology. University of Minnesota.

Sims, Paul K. 1970. Geologic map of Minnesota, bedrock geology. Minnesota Geological Survey, Minnesota Department of Conservation, and Minnesota Department of Iron Range Resources and Rehabilitation.

United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conservation Service, U.S. Department of Agriculture Handbook 436.

United States Department of Agriculture. 1993. Soil survey manual. U.S. Department of Agriculture Handbook 430.

This page intentionally left blank.

Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

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. Material, such as sand, silt, or clay, deposited on land by streams.

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

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Aspect. The direction in which a slope faces.

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 geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a

footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.

Basal till. Compact glacial 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.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

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 shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

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 but 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. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil material. Soil material that is, 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. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese

and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

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.

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.

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

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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 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. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where soil blowing is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming).

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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

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.

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

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.

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.

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

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; 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. 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.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

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

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the

profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

- Drainage, surface.** Runoff, or surface flow of water, from an area.
- Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.
- 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.
- 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 soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.
- 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 layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill 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. The term is more often applied to cliffs resulting from differential erosion.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

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 oven-dry 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.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, 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. A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

Footslope. The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. The surface is dominantly concave. In terms of gradational processes, a footslope is a transition zone between an upslope site of erosion (backslope) and a downslope site of deposition (toeslope).

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

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

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.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded 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 is 15 to 50 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 underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. 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.

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-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

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 natural elevation 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; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

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. The major horizons of mineral soil are as follows:

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

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-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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 formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are 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

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

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. An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

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

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.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

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. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. 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.

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. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

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.

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

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

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. Nearly all such rocks are crystalline.

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. An area that has little or no natural soil and supports little or no 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. An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are 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. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

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.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

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 plain. An extensive area of glaciofluvial material that was deposited by meltwater streams

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

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 thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Extremely slow	less than 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

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

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

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

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

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

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

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.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

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 in 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:

Extremely acid	less than 4.5
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. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from

which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

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

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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.

Salty water (in tables). Water that is too salty for consumption by livestock.

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.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

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. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

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 hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

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.

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.

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 depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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 over periods 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 substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing 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 and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.
- 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 or loosen a layer that restricts roots.
- 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 profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform, such as a hill, mountain, or tableland. It usually refers to a high interfluvial area of gentler slope that is flanked by steeper hillslopes, for example, mountain fronts or tableland escarpments.
- 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 due to 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.
- Terminal moraine.** A belt of thick glacial drift that generally marks the termination of important glacial advances.
- Terrace.** 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 is generally 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 (geologic).** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.
- 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."
- Thin layer (in tables).** Otherwise suitable soil material too thin for the specified use.
- Till.** Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
- Till plain.** An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.
- Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.
- Toeslope.** The outermost inclined surface at the base of a hill. Toeslopes are commonly gentle and linear in profile.
- 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.
- Toxicity (in tables).** Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.
- Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.
- Unstable fill (in tables).** Risk of caving or sloughing on banks of fill material.
- Upland (geology).** Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.
- Valley fill.** In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.
- Variation.** 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 and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the 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 oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at <http://offices.sc.egov.usda.gov/locator/app>.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.