United States Department of Agriculture

Soil Conservation Service

In cooperation with the Minnesota Agricultural Experiment Station

Soil Survey of Nicollet County, Minnesota

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How To Use This Soil Survey

General Soil Map

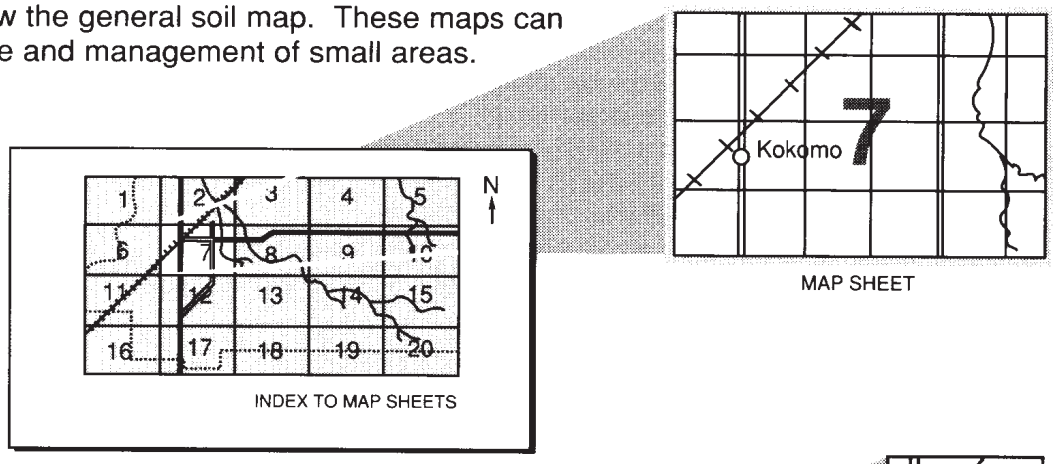
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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** for a general description of the soils in your area.

Detailed Soil Maps

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

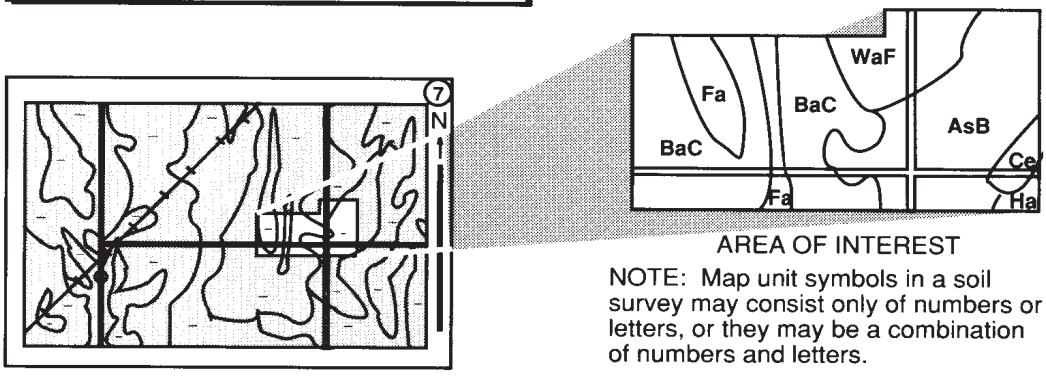
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP 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** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for 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 Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1989. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station. Partial funding was provided by the Legislative Commission for Minnesota Resources and by Nicollet County. The survey is part of the technical assistance furnished to the Nicollet County Soil and Water Conservation District.

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.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: The Minnesota River flowing through an area of Chaska and Minneiska soils.

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Issued June 1994

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Nicollet County. 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 Soil Conservation Service or the Cooperative Extension Service.

Gary R. Nordstrom
State Conservationist
Soil Conservation Service

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Soil Survey of Nicollet County, Minnesota

By Thomas C. Jackson, Soil Conservation Service

Fieldwork by Thomas C. Jackson and James U. Schulzetenberg, Soil Conservation Service, and Terry L. Bovee, Gary S. Elsner, and Grant K. Johnson, Minnesota Agricultural Experiment Station

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

NICOLLET COUNTY is located in the south-central part of Minnesota (fig. 1). It is bordered on the south and east by the Minnesota River and on the north by Renville and Sibley Counties. The total area of the county is 298,800 acres, or about 467 square miles, of which 17,000 acres is water.

In 1987, the estimated population of Nicollet County was 28,494 *(11)*. St. Peter, the county seat, had a population of 9,144. Other urban areas in the county are Courtland, Lafayette, Nicollet, and North Mankato. Approximately 73 percent of the population lives in these cities and towns.

The county was named in honor of a French explorer, Joseph N. Nicollet, who mapped this area around 1840. At that time the survey area was mostly a prairie characterized by tall grasses and a large number of sloughs and shallow lakes. Buffalo herds moving through the region shared the land with Dakota Indians and, occasionally, trappers and explorers. By the mid 1850's, settlers began arriving at outposts scattered along the Minnesota River Valley. These pioneer farmers steadily migrated westward from the river communities, displacing the Indians. By the early 1870's, more than 40,000 acres had been cultivated. Wheat and oats were the principal crops, but most farms were diversified. Hogs and dairy cattle were the primary livestock raised *(8)*.

Because the water table is high in about 62 percent of the soils in the county, artificial drainage systems were installed in the 1880's to enhance crop production. The systems incorporated open ditches and tile drains. Today, more than 325 miles of open ditches and approximately 4,500 miles of tile help drain the county. The use of most of the drained areas has changed from pasture and hay to cash crops, such as corn and

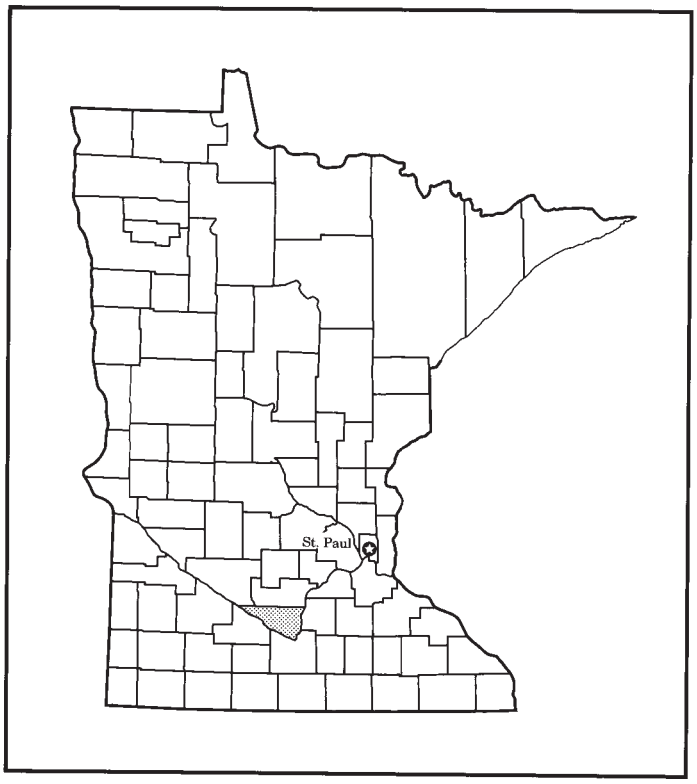

Figure 1.—Location of Nicollet County in Minnesota.

soybeans. This change in land use has resulted in a shift from the dairy and hog enterprises of the past to operations in which beef cattle and hogs are raised, mostly in confined systems. In 1987, more than 80 percent of the 185,600 acres of cropland was used for the production of corn and soybeans *(14)*.

Markets for agricultural crops grown by the early farmers were limited to areas within about 30 miles. Today, however, commodities are marketed throughout the world. An extensive network of roads provides transportation routes from farms to processing and distribution centers.

Most of the county is a nearly level and gently undulating upland till plain that is characterized by dark, loamy soils that formed in glacial deposits. Some soils bordering the Minnesota River formed in weathered bedrock and alluvium. The original vegetation was predominantly tall prairie grasses, but small areas of mixed deciduous hardwood forests were scattered in the eastern part of the county.

This soil survey updates the survey of Nicollet County published in 1958 *(4)*. It provides additional information and larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about the survey area. It describes physiography, relief, and drainage; water supply; geology; and climate.

Physiography, Relief, and Drainage

Nicollet County lies in the Olivia Till Plain section of the Minnesota Lowlands province. The county is covered with a mantle of glacial drift varying in thickness from less than 100 feet near Courtland and St. Peter to more than 400 feet in Bernadotte and New Sweden Townships. This gently sloping terrain, which has many small depressions, marshes, swales, and low, nearly level areas, is characteristic of the immature drainage network of a young glacial till plain *(9)*.

Because more than 75 miles of the Minnesota River Valley is in Nicollet County, the valley itself is the most striking and scenic feature of the area. Outcrops of crystalline and sedimentary rock occur throughout the valley. Terraces that formed as a result of postglacial melting of glacial ice are at various elevations above the flood plain *(16, 17)*. Very steep wooded bluffs separate the flood plain area from the uplands. Elevation gently decreases from about 1,045 feet above sea level in the northwestern part of the county to less than 1,000 feet in the southern and eastern parts. The lowest elevation, in the Minnesota River Valley at the eastern county line, is about 730 feet.

About 80 percent of the county is drained by the Minnesota River and its few small tributaries. The South Branch Rush River provides drainage for the remaining 20 percent, mostly in Bernadotte and New Sweden Townships *(7)*. Some of the small creeks have meandering, shallow courses near their headwaters but fall into rather deep ravines within 2 or 3 miles of the Minnesota River *(4)*. Drainage in the interior of the county is a result of extensive artificial development.

Water Supply

The water supply of Nicollet County comes mainly from sand and gravel deposits within glacial drift and from various sedimentary rock aquifers. The sand and gravel aquifers are in most areas of the county. They generally produce sufficient amounts of water to supply households, farms, and small industries. In a few areas where drift deposits are thin, water supplies must come from the underlying sedimentary rock. The western half of the county has Cretaceous sandstone beneath the glacial drift, which yields adequate amounts of water for most local uses *(15)*. In the eastern part of the county, a series of Precambrian and Paleozoic sandstones, which are deep beneath the glacial sediments, form a sequence of high-yielding aquifers *(3)*. Few wells penetrate these aquifers because suitable water supplies are usually available from the shallow drift aquifers, but larger cities, such as North Mankato and St. Peter, and large industries rely on water supplies from these ancient water-bearing sedimentary rocks.

The quality of ground water is related to the presence or absence of minerals and the length of time water is in contact with minerals, among other factors. Most water supplies within the county require treatment to reduce hardness and naturally high concentrations of iron, sulfate, and dissolved solids.

Most of the county is in an area of ground-water recharge. Regional flow converges on the Minnesota River, where ground water discharges as base flow. To maintain the present quality of ground water, care must be taken to ensure that land use activities do not degrade the aquifers and associated surface water resources *(10)*.

Geology

Nicollet County is underlain by rocks of three different ages. The oldest, about 1,500 to 3,000 million years old, are Precambrian metamorphic and igneous rocks consisting primarily of granite, gneiss, and quartzite. These rocks underlie the entire county and

crop out in the Minnesota River Valley near Fort Ridgely and near Courtland. Most of this crystalline rock is covered by younger sedimentary rock, except in the north-central part of the county, where only glacial drift covers the Precambrian rock *(3)*. In the eastern part of the county, the crystalline rock is draped with Paleozoic sandstone and dolomite deposited about 570 to 480 million years ago in a shallow sea environment *(3, 6)*. Outcrops of these stratified rocks can be observed along the Minnesota River Valley between Mankato and St. Peter. Approximately 135 to 65 million years ago, the western part of the county was flooded by another shallow sea spreading from the west *(5)*. During this period, thin bands of sandstones and shales were deposited over the Precambrian rock *(15)*. Outcrops of these Cretaceous sediments occur only on a few low terraces along the Minnesota River in Courtland Township.

The various rock formations are covered by Pleistocene glacial deposits. Periods of glaciation began nearly 2 million years ago, but most of the surficial materials in Nicollet County were deposited during the late Wisconsin period, about 12,000 years ago *(9, 17)*. The loamy, calcareous till deposited by glacial ice forms a gently sloping to nearly level ground moraine in most of the county.

The Minnesota River Valley and associated meltwater channels and terraces were formed by meltwaters released during the retreat of the Des Moines lobe ice sheet *(9)*. The terrace and meltwater channel deposits are sandy and gravelly sediments that were sorted by flowing meltwater. The loamy and sandy sediments on the Minnesota River flood plain are the youngest depositional materials in the county. They are postglacial erosional sediments and are derived primarily from the surrounding upland till plain.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at North Mankato, Minnesota, in the period 1954 to 1984. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 17 degrees F and the average daily minimum temperature is 8 degrees. The lowest temperature on record, which occurred at North Mankato on January 9, 1977, is -34 degrees. In summer, the average temperature is 71 degrees and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 9, 1976, is 102 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 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 28.6 inches. Of this, 20.7 inches, or about 72 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 7.09 inches at North Mankato on August 7, 1968. Thunderstorms occur on about 38 days each year. Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration. They may result in minor damage in scattered areas. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

The average seasonal snowfall is 40 inches. The greatest snow depth at any one time during the period of record was 24 inches. On the average, 88 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in spring.

How This Survey Was Made

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

The soils in the survey area occur in an orderly

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

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

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, 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. 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 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 assure 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.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. 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 soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns 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 similar inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been

observed and consequently 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 of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils 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 onsite investigation is needed to plan for intensive uses in small areas.

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General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

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

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

Soil Descriptions

1. Canisteo-Webster-Nicollet Association

Nearly level, very poorly drained to moderately well drained, loamy soils formed in glacial till on ground moraines

Setting

Landform and position on the landform: Nearly level areas, depressions, rims of depressions, and slightly convex slopes on ground moraines (fig. 2)
Slope range: 0 to 3 percent

Composition

Percent of survey area: 19
Extent of components in the association:
Canisteo soils and similar soils—35 percent
Webster soils and similar soils—23 percent
Nicollet soils and similar soils—15 percent
Minor soils—27 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained and very poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Webster

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Nicollet

Drainage class: Moderately well drained and somewhat poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Minor Soils

- The very poorly drained Glencoe, Okoboji, and Klossner soils in depressions
- The well drained Clarion soils on convex slopes

Use and Management

Major use: Cropland
Major management factors: Canisteo—pH, drainage; Webster—drainage, clay content

2. Canisteo-Marna-Nicollet Association

Nearly level, very poorly drained to moderately well drained, loamy and clayey soils formed in glacial till and lacustrine sediments on ground moraines and lacustrine plains

Setting

Landform and position on the landform: Nearly level areas, depressions, rims of depressions, and slightly convex slopes on ground moraines
Slope range: 0 to 3 percent

Composition

Percent of survey area: 2
Extent of components in the association:
Canisteo soils and similar soils—25 percent
Marna soils and similar soils—25 percent
Nicollet soils and similar soils—19 percent
Minor soils—31 percent

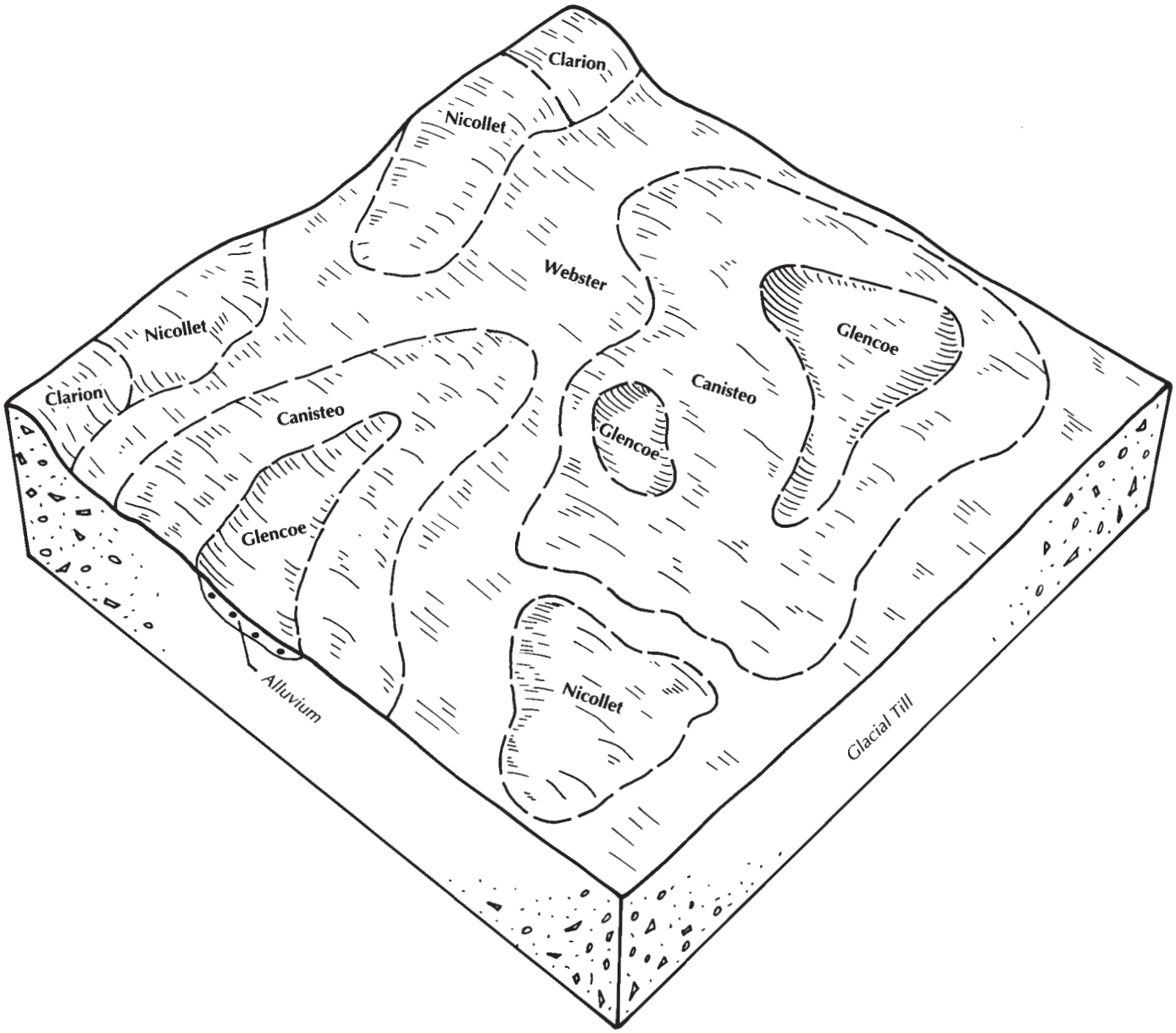

Figure 2.—Pattern of soils and parent material in the Canisteo-Webster-Nicollet association.

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Marna

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Silty clay loam

Nicollet

Drainage class: Moderately well drained and somewhat poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Minor Soils

- The very poorly drained Glencoe, Okoboji, and Rolfe soils in depressions

• The poorly drained Brownton soils on rims of depressions and in nearly level areas

Use and Management

Major use: Cropland
Major management factors: Canisteo—pH, drainage; Marna—drainage, clay content

3. Harps-Clarion-Delft Association

Nearly level to hilly, poorly drained and well drained, loamy soils formed in glacial till and alluvium on ground moraines

Setting

Landform and position on the landform: Nearly level areas, rims of depressions, drainageways or swales, and convex slopes on ground moraines
Slope range: 0 to 18 percent

Composition

Percent of survey area: 9
Extent of components in the association:
Harps soils and similar soils—26 percent
Clarion soils—23 percent
Delft soils and similar soils—18 percent
Minor soils—33 percent

Soil Properties and Qualities

Harps

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Clarion

Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Delft

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Minor Soils

• The very poorly drained Glencoe and Okoboji soils in depressions
• The moderately well drained and somewhat poorly drained Nicollet soils in nearly level areas and on slightly convex slopes
• The well drained Storden soils on convex slopes

Use and Management

Major use: Cropland
Major management factors: Harps—pH, drainage; Clarion—slope, erosion; Delft—drainage

4. Clarion-Canisteo-Webster Association

Nearly level to hilly, well drained and poorly drained, loamy soils formed in glacial till on ground moraines

Setting

Landform and position on the landform: Nearly level areas, depressions, rims of depressions, and convex slopes on ground moraines (fig. 3)
Slope range: 0 to 18 percent

Composition

Percent of survey area: 27
Extent of components in the association:
Clarion soils and similar soils—26 percent
Canisteo soils and similar soils—25 percent
Webster soils and similar soils—19 percent
Minor soils—30 percent

Soil Properties and Qualities

Clarion

Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Canisteo

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Webster

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Minor Soils

• The very poorly drained Glencoe, Okoboji, and Klossner soils in depressions
• The moderately well drained and somewhat poorly drained Nicollet soils in nearly level areas and on slightly convex slopes
• The well drained Storden soils on convex slopes

Use and Management

Major use: Cropland
Major management factors: Clarion—slope, erosion; Canisteo—pH, drainage; Webster—drainage, clay content

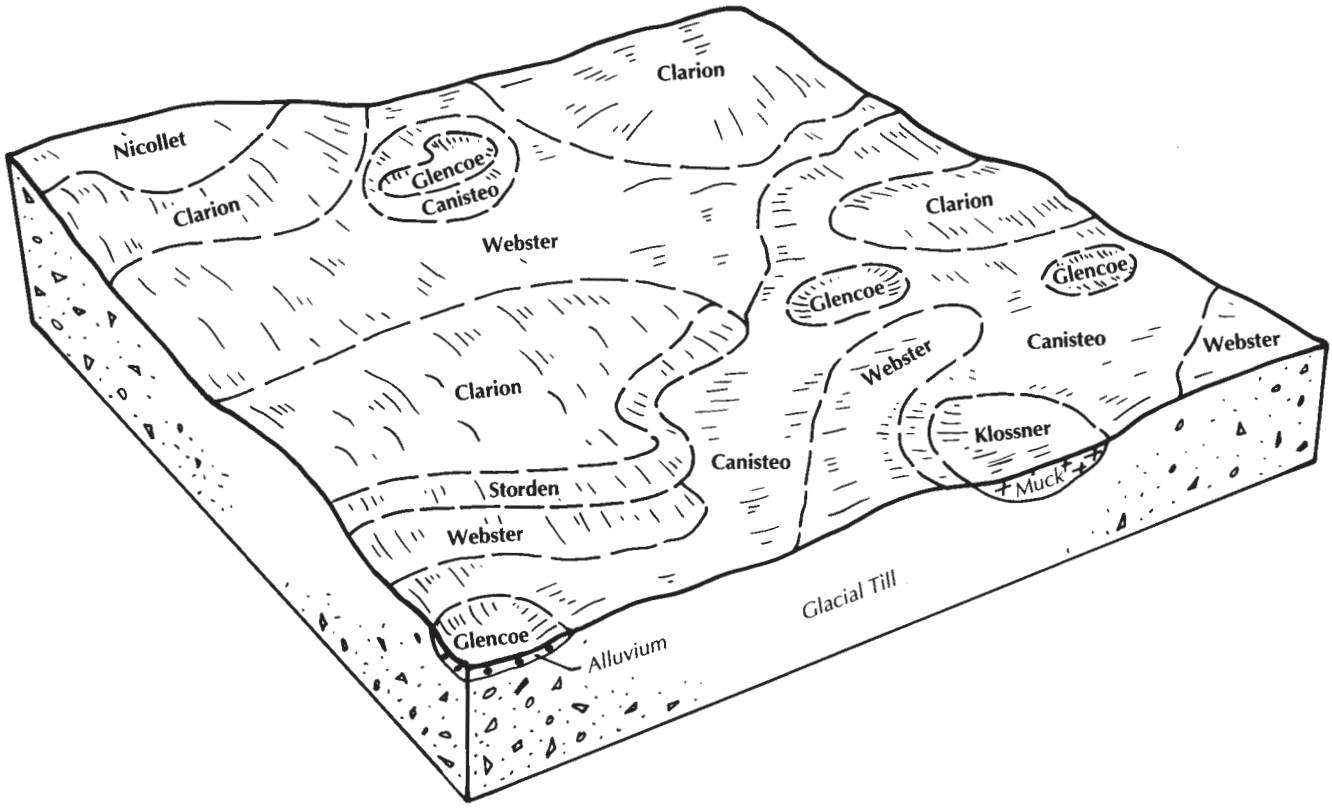

Figure 3.—Pattern of soils and parent material in the Clarion-Canisteo-Webster association.

5. Cordova-Lester-Le Sueur Association

Nearly level to hilly, poorly drained, well drained, moderately well drained, and somewhat poorly drained, loamy soils formed in glacial till on ground moraines

Setting

Landform and position on the landform: Nearly level areas, slightly convex slopes, and convex slopes on ground moraines (fig. 4)
Slope range: 0 to 18 percent; typically 0 to 6 percent

Composition

Percent of survey area: 25
Extent of components in the association:
Cordova soils and similar soils—25 percent
Lester soils and similar soils—23 percent
Le Sueur soils and similar soils—21 percent
Minor soils—31 percent

Soil Properties and Qualities

Cordova

Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Lester

Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Le Sueur

Drainage class: Moderately well drained and somewhat poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Minor Soils

- The very poorly drained Klossner and Rolfe soils in depressions
- The poorly drained Canisteo soils in nearly level areas and on rims of depressions
- The well drained Storden soils on convex slopes

Use and Management

Major use: Cropland
Major management factors: Cordova—drainage, clay content; Lester—slope, erosion

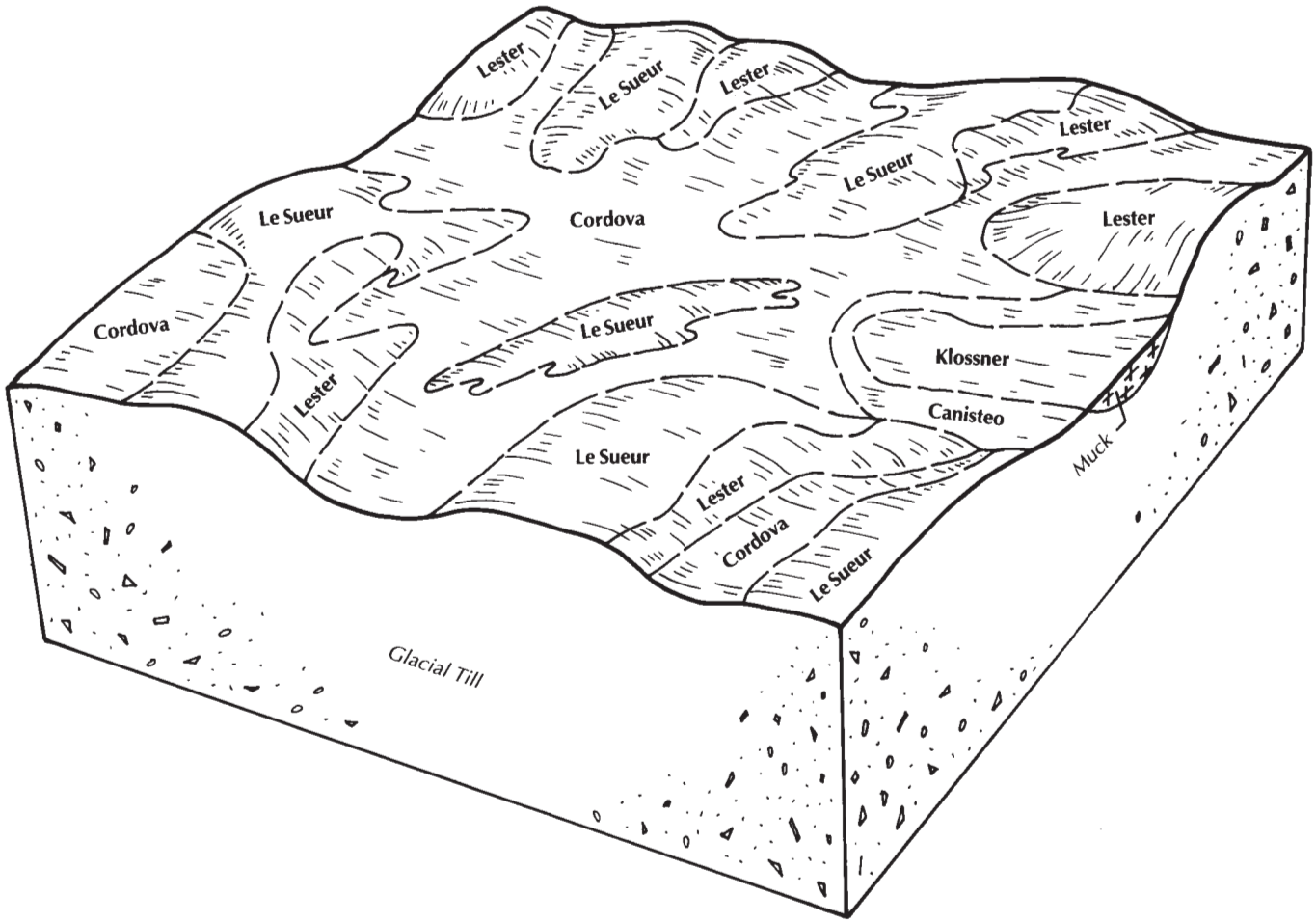

Figure 4.—Pattern of soils and parent material in the Cordova-Lester-Le Sueur association.

6. Lester-Storden-Terril Association

Nearly level to very steep, well drained and moderately well drained, loamy soils formed in glacial till and alluvium on ground moraines

Setting

Landform and position on the landform: Very steep side slopes and foot slopes on ground moraines
Slope range: 2 to 70 percent

Composition

Percent of survey area: 10
Extent of components in the association:
Lester soils and similar soils—41 percent
Storden soils—22 percent
Terril soils—15 percent
Minor soils—22 percent

Soil Properties and Qualities

Lester

Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Storden

Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Terril

Drainage class: Moderately well drained
Parent material: Alluvium
Surface texture: Loam

Minor Soils

• The poorly drained Delft soils in drainageways and swales

• The moderately well drained and somewhat poorly drained Le Sueur soils on slightly convex slopes
• The moderately well drained Minneiska soils in nearly level areas
• The shallow, well drained Copaston soils on convex slopes
• The excessively drained Hawick soils on convex slopes

Use and Management

Major use: Woodland
Secondary uses: Hayland, pasture, cropland
Major management factors: Slope, erosion

7. Plainfield-Dickinson-Wadena Association

Nearly level to hilly, excessively drained and well drained, sandy and loamy soils formed in glacial outwash on stream terraces

Setting

Landform and position on the landform: Nearly level areas, slightly convex slopes, and convex slopes on terraces
Slope range: 0 to 15 percent

Composition

Percent of survey area: 2
Extent of components in the association:
Plainfield soils and similar soils—48 percent
Dickinson soils—26 percent
Wadena soils and similar soils—22 percent
Minor soils—4 percent

Soil Properties and Qualities

Plainfield

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Dickinson

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Loam

Wadena

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Loam

Minor Soils

• The well drained Estherville soils in nearly level areas and on convex slopes
• The well drained Copaston soils in nearly level areas and on convex slopes

Use and Management

Major use: Cropland
Major management factors: Ground-water contamination; Plainfield—soil blowing, available water capacity or droughtiness; Dickinson—available water capacity or droughtiness in some years; Wadena—droughtiness in some years, slope

8. Millington-Nishna-Minneiska Association

Nearly level and gently undulating, very poorly drained to moderately well drained, loamy and clayey soils formed in alluvium on flood plains

Setting

Landform and position on the landform: Nearly level areas and convex slopes on flood plains
Slope range: 0 to 4 percent; typically 0 to 2 percent

Composition

Percent of survey area: 3
Extent of components in the association:
Millington soils and similar soils—38 percent
Nishna soils—26 percent
Minneiska soils—24 percent
Minor soils—12 percent

Soil Properties and Qualities

Millington

Drainage class: Poorly drained
Parent material: Alluvium
Surface texture: Clay loam

Nishna

Drainage class: Poorly drained and very poorly drained
Parent material: Alluvium
Surface texture: Silty clay loam

Minneiska

Drainage class: Moderately well drained
Parent material: Alluvium
Surface texture: Sandy loam

Minor Soils

• The poorly drained and very poorly drained Kalmarville soils in drainageways and swales
• The very poorly drained Oshawa soils in abandoned river channels or oxbows
• The moderately well drained Du Page soils in nearly level areas and on slightly convex slopes

Figure 5.—An area of the Millington-Nishna-Minneiska association flooded by spring runoff.

Use and Management

Major use: Cropland
Secondary use: Wildlife habitat
Major management factors: Millington—flooding, pH, drainage; Nishna—flooding, drainage, pH, clay content, ponding; Minneiska—flooding, pH (fig. 5)

9. Copaston-Tilfer Association

Nearly level to very steep, well drained and poorly drained, loamy soils formed in alluvium or glacial drift over bedrock on stream terraces

Setting

Landform and position on the landform: Nearly level to very steep areas and escarpments on stream terraces and flood plains

Slope range: 0 to 60 percent

Composition

Percent of survey area: 1
Extent of components in the association:
Copaston soils—45 percent
Tilfer soils—21 percent
Minor soils—34 percent

Soil Properties and Qualities

Copaston

Drainage class: Well drained
Parent material: Alluvium or glacial drift over bedrock
Surface texture: Loam

Tilfer

Drainage class: Poorly drained
Parent material: Alluvium or glacial drift over bedrock
Surface texture: Silty clay loam

Minor Soils

- The poorly drained Joliet soils in nearly level areas
- The moderately well drained Terril soils on foot slopes
- The well drained Dickinson and Dickman soils in nearly level areas and on convex slopes
- The excessively drained Plainfield soils on convex slopes

Use and Management

Major use: Pasture
Secondary use: Cropland
Major management factors: Copaston—available water capacity, shallow root zone, slope; Tilfer—drainage, pH, available water capacity

10. Minneiska-Chaska-Oshawa Association

Nearly level and gently undulating, moderately well drained, somewhat poorly drained, and very poorly drained, loamy and silty soils formed in alluvium on flood plains

Setting

Landform and position on the landform: Depressions, nearly level areas, and convex slopes on flood plains
Slope range: 0 to 3 percent

Composition

Percent of survey area: 2
Extent of components in the association:
Minneiska soils and similar soils—40 percent
Chaska soils and similar soils—20 percent
Oshawa soils and similar soils—15 percent
Minor soils—25 percent

Soil Properties and Qualities

Minneiska

Drainage class: Moderately well drained
Parent material: Calcareous, loamy alluvium
Surface texture: Fine sandy loam

Chaska

Drainage class: Somewhat poorly drained
Parent material: Calcareous, loamy alluvium
Surface texture: Loam

Oshawa

Drainage class: Very poorly drained
Parent material: Calcareous, silty alluvium
Surface texture: Silty clay loam

Minor Soils

- The very poorly drained Kalmarville soils in channels
- The moderately well drained Terril and poorly drained Delft soils on foot slopes

Use and Management

Major use: Cropland
Secondary uses: Woodland, recreational areas
Major management factors: Seasonal flooding

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, 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 material. 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, 2 to 6 percent slopes, is a phase of the Clarion series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Canisteo-Glencoe complex is an example.

An *undifferentiated group* is made up of two or more soils 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 in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Klossner and Muskego soils, ponded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits component of the Udorthents-Pits, gravel, complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") 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.

Soil Descriptions

27A—Dickinson loam, 0 to 2 percent slopes

Composition

Dickinson soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 75 acres

Typical Profile

0 to 11 inches—black, very friable loam
11 to 19 inches—very dark gray, very friable loam
19 to 29 inches—brown, friable sandy loam
29 to 36 inches—dark yellowish brown, loose loamy sand
36 to 60 inches—yellowish brown, loose fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickman soils, which are in landscape positions similar to those of the Dickinson soil and have more sand
• Moderately well drained soils in the lower landscape positions

Similar soils:
• Soils that have gravel or cobbles in the lower part
• Soils that have glacial till within a depth of 60 inches
• Soils that have a mantle of loamy material less than 20 inches thick
• Soils that have silt loam and free lime in the lower part
• Soils in areas adjacent to streams that are subject to rare flooding
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, organic matter content
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Planting field windbreaks, returning crop residue to the soil, using minimum tillage, and chiseling stubble fields on the contour or across the slope conserve moisture and reduce the hazard of soil blowing.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIs
Windbreak suitability group: 6G

27B—Dickinson loam, 2 to 6 percent slopes

Composition

Dickinson soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 50 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 9 inches—black, friable loam
9 to 16 inches—dark brown, friable loam
16 to 25 inches—dark yellowish brown, friable fine sandy loam
25 to 33 inches—dark yellowish brown, very friable loamy fine sand
33 to 60 inches—brown, loose fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickman soils, which are in landscape positions similar to those of the Dickinson soil and have more sand
• Moderately well drained soils in the lower landscape positions

Similar soils:
• Soils that have gravel or cobbles in the lower part
• Soils that have glacial till within a depth of 60 inches
• Soils that have a mantle of loamy material less than 20 inches thick
• Soils that have silt loam and free lime in the lower part
• Soils that have a surface layer of sandy loam or silt loam
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, organic matter content

Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of erosion and conserve moisture.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 6G

35—Blue Earth mucky silt loam

Composition

Blue Earth soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 10 to 200 acres

Typical Profile

0 to 8 inches—black, very friable, calcareous mucky silt loam
8 to 60 inches—very dark gray, very friable, calcareous mucky silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Depth to water table: 2 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils, which formed in glacial till and are in the higher landscape positions
• The poorly drained Essexville soils, which are on the borders of depressions or in sandbars that extend into the depressions

Similar soils:
• Soils that have more clay throughout
• Soils that have thin bands of loamy sand
• Soils that have a layer of muck as much as 10 inches thick
• Soils that have loam, silt loam, clay loam, or silty clay loam in the lower part

Use and Management

Cropland

Major management factors: Ponding, drainage, high pH
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

39A—Wadena loam, 0 to 2 percent slopes

Composition

Wadena soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 5 to 50 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 11 inches—black, friable loam
11 to 19 inches—dark brown, friable loam
19 to 36 inches—dark yellowish brown, friable clay loam
36 to 60 inches—dark yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate in the upper part, very rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Wadena soil and have more sand in the upper part
• The well drained Estherville soils, which are in landscape positions similar to those of the Wadena soil and have a thinner mantle of loamy material

• The well drained Kasota soils, which are in landscape positions similar to those of the Wadena soil and have more clay in the subsoil

Similar soils:
• Soils that have more silt in the solum
• Soils that have loamy very fine sand in the lower part

Use and Management

Cropland

Major management factors: Available water capacity, ground-water contamination
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Planting field windbreaks, returning crop residue to the soil, using minimum tillage, and chiseling stubble fields on the contour or across the slope in the fall conserve moisture.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIs
Windbreak suitability group: 6G

39B—Wadena loam, 2 to 6 percent slopes

Composition

Wadena soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 5 to 50 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 9 inches—black, friable loam
9 to 13 inches—very dark grayish brown, friable loam
13 to 21 inches—dark brown, friable clay loam
21 to 37 inches—brown, friable clay loam
37 to 60 inches—yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate in the upper part, very rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are nearly level and have more sand in the upper part than the Wadena soil
• The well drained Estherville soils, which are in landscape positions similar to those of the Wadena soil and have a thinner mantle of loamy material
• The well drained Kasota soils, which are nearly level and have more clay in the subsoil than the Wadena soil

Similar soils:
• Soils that have more silt in the solum
• Soils that have loamy very fine sand in the lower part

Use and Management

Cropland

Major management factors: Available water capacity, ground-water contamination, slope
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• The hazard of water erosion can be reduced by chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 6G

41B—Estherville sandy loam, 1 to 6 percent slopes

Composition

Estherville soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 80 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 9 inches—very dark brown, friable sandy loam
9 to 16 inches—dark yellowish brown, friable loam
16 to 23 inches—dark yellowish brown, loose gravelly loamy coarse sand

23 to 60 inches—dark brown, loose, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Wadena soils, which are in landscape positions similar to those of the Estherville soil, have a thicker mantle of loamy material, and contain more clay in the upper part
• Moderately well drained soils in the lower landscape positions
• The poorly drained Essexville soils, which are in the lower landscape positions in the Swan Lake area of central Nicollet County

Similar soils:
• Soils that have more clay in the solum
• Soils that do not have gravelly material
• Soils that have a surface layer of gravelly sandy loam
• Soils that have glacial till within a depth of 40 inches

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIs
Windbreak suitability group: 7

84—Brownton silty clay

Composition

Brownton soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and the rims of depressions on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

0 to 14 inches—black, firm, calcareous silty clay
14 to 20 inches—very dark gray, firm, calcareous silty clay
20 to 41 inches—olive gray, firm, mottled, calcareous silty clay loam
41 to 60 inches—olive gray, firm, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow in the upper part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions
• The very poorly drained Rolfe, Okoboji, and Glencoe soils, which are in depressions and are subject to ponding

Similar soils:
• Soils having a surface layer that is leached of free lime or is more than 24 inches thick
• Soils that have a higher content of lime
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have a high content of silt and very fine sand in the lower part
• Soils that have a surface layer of silt loam

Use and Management

Cropland

Major management factors: Drainage, high pH, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

86—Canisteo clay loam

Composition

Canisteo soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and the rims of depressions on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 4 to 600 acres

Typical Profile

0 to 9 inches—black, friable, calcareous clay loam
9 to 20 inches—very dark gray, friable, calcareous clay loam
20 to 26 inches—grayish brown, friable, mottled, calcareous clay loam
26 to 40 inches—grayish brown, friable, mottled, calcareous clay loam
40 to 60 inches—light brownish gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils, which are in depressions and are subject to ponding
• The somewhat poorly drained Crippin soils, which are in the slightly higher landscape positions
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions
• The very poorly drained Okoboji soils, which are in depressions and are subject to ponding
• Poorly drained soils that are in landscape positions similar to those of the Canisteo soil but have sandy and gravelly material in the lower part

Similar soils:
• Soils that have a surface layer of loam and silty clay loam
• Soils having a surface layer that is leached of free lime
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have a higher content of lime
• Soils that have silty sediments in the lower part
• Soils that are on stream terraces

Use and Management

Cropland

Major management factors: Drainage, high pH
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

94B—Terril loam, 1 to 6 percent slopes

Composition

Terril soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Foot slopes on ground moraines and stream terraces
Shape of areas: Elongated
Size of areas: 4 to 70 acres
Slope length: 100 to 300 feet

Typical Profile

0 to 10 inches—very dark brown, friable loam
10 to 26 inches—black, friable loam
26 to 34 inches—very dark grayish brown, friable loam
34 to 60 inches—brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion and Lester soils, which are in

landscape positions similar to those of the Terril soil and have a dark surface layer less than 24 inches thick
• The poorly drained Delft soils, which are in the lower landscape positions
• The moderately well drained Minneiska soils, which are in the lower landscape positions, have a dark surface layer less than 24 inches thick, and are subject to rare flooding
• Soils that have strata of sand and gravel in the lower part

Similar soils:
• Soils that have a dark surface layer more than 36 inches thick or less than 24 inches thick
• Soils that have a surface layer of sandy loam
• Soils that are shallow to free lime
• Soils that have bedrock at a depth of more than 40 inches

Use and Management

Cropland

Major management factors: Slope, water erosion
Management measures:
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of water erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

94C—Terril loam, 6 to 12 percent slopes

Composition

Terril soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Foot slopes on ground moraines and stream terraces
Shape of areas: Elongated
Size of areas: 4 to 50 acres
Slope length: 100 to 250 feet

Typical Profile

0 to 23 inches—black, friable loam
23 to 29 inches—very dark gray, friable clay loam
29 to 38 inches—very dark grayish brown, friable loam
38 to 50 inches—dark brown, friable loam
50 to 60 inches—dark yellowish brown, friable, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Clarion soils, which are in landscape positions similar to those of the Terril soil and have a dark surface layer less than 24 inches thick
• The poorly drained Delft soils, which are in the lower landscape positions
• Soils that have strata of sand and gravel in the lower part

Similar soils:
• Soils that have a dark surface layer less than 24 inches thick or more than 38 inches thick
• Soils that have a surface layer of sandy loam

Use and Management

Cropland

Major management factors: Slope, water erosion
Management measures:
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of water erosion.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 3

100B—Copaston loam, 1 to 6 percent slopes

Composition

Copaston soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and convex slopes on stream terraces
Shape of areas: Irregular
Size of areas: 40 to 200 acres
Slope length: 50 to 125 feet

Typical Profile

0 to 7 inches—black, friable loam
7 to 14 inches—very dark grayish brown, friable loam
14 to 19 inches—brown, friable loam
19 inches—fractured limestone bedrock

Soil Properties and Qualities

Depth to bedrock: Shallow
Drainage class: Well drained

Permeability: Moderate or moderately rapid
Available water capacity: Low
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Joliet and Tilfer soils, which are in the lower landscape positions
• Outcrops of limestone, sandstone, and granite

Similar soils:
• Soils that have bedrock at a depth of less than 8 inches or more than 20 inches

Use and Management

Cropland

Major management factors: Shallow root zone, available water capacity, ground-water contamination, slope, water erosion
Management measures:
• Chiseling the stubble field on the contour and including high-residue crops in the rotation reduce the hazard of water erosion.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Pasture

Major management factors: Available water capacity, ground-water contamination, slope
Management measures:
• Rotation grazing helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 10

102B—Clarion loam, 2 to 6 percent slopes

Composition

Clarion soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex slopes on ground moraines
Shape of areas: Irregular
Size of areas: 4 to 60 acres
Slope length: 100 to 175 feet

Typical Profile

0 to 13 inches—black, friable loam
13 to 21 inches—brown, friable clay loam
21 to 39 inches—dark yellowish brown, friable loam
39 to 60 inches—light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Webster soils, which are in the lower landscape positions
• The well drained Storden soils, which are in the steeper areas and have a dark surface layer less than 7 inches thick
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the lower landscape positions
• Soils that have small pockets of sand and gravel

Similar soils:
• Soils that have free lime at or near the surface
• Soils that have accumulations of lime in the lower part of the subsoil
• Soils that have more clay or silt in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Slope, water erosion
Management measures:
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of water erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

106B—Lester loam, 2 to 6 percent slopes

Composition

Lester soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Convex slopes on ground moraines
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Slope length: 75 to 175 feet

Typical Profile

0 to 9 inches—very dark brown, friable loam
9 to 16 inches—dark brown, firm clay loam
16 to 40 inches—dark yellowish brown, friable clay loam
40 to 60 inches—light olive brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils, which are in the lower landscape positions
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the lower, less sloping areas
• Soils that have small pockets of sand and gravel

Similar soils:
• Soils that are eroded or that have a lighter colored surface layer
• Soils that have less clay in the subsoil
• Soils that have more silt

Use and Management

Cropland

Major management factors: Slope, water erosion, low pH
Management measures:
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of water erosion.
• In areas where the surface layer and subsoil are moderately acid, alfalfa responds well to applications of lime.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 3

106C2—Lester loam, 6 to 12 percent slopes, eroded

Composition

Lester soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Convex slopes on ground moraines
Shape of areas: Irregular
Size of areas: 5 to 80 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 7 inches—very dark grayish brown, friable loam
7 to 20 inches—brown, firm clay loam
20 to 24 inches—dark yellowish brown, friable clay loam
24 to 60 inches—olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in drainageways and swales
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the less sloping areas
• The well drained Storden soils, which are on the steeper slopes and have a dark surface layer less than 7 inches thick

Similar soils:
• Soils that have less clay in the subsoil
• Soils that have a thicker, darker surface layer
• Soils that have an exposed subsoil

Use and Management

Cropland

Major management factors: Eroded surface, slope
Management measures:
• Chiseling the stubble field on the contour or across the slope, including high-residue crops in the rotation, and establishing terraces, diversions, and grassed waterways reduce the hazard of water erosion.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 3

109—Cordova clay loam

Composition

Cordova soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Nearly level areas on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 4 to 200 acres

Typical Profile

0 to 8 inches—black, friable clay loam
8 to 14 inches—very dark gray, friable, mottled clay loam
14 to 30 inches—olive gray, firm, mottled clay loam
30 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow in the upper part, moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils, which are in depressions and are subject to ponding
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions
• The very poorly drained Rolfe soils, which are in depressions, contain more clay in the subsoil than the Cordova soil, and are subject to ponding

Similar soils:
• Soils that have free lime in the surface layer
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Cropland

Major management factors: Drainage, high clay content, low pH
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.
• In areas where the surface layer and the subsoil are moderately acid, alfalfa responds well to applications of lime.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

110—Marna silty clay loam

Composition

Marna soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas on ground moraines and lacustrine plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

0 to 10 inches—black, friable silty clay loam
10 to 16 inches—black, firm silty clay
16 to 25 inches—dark grayish brown, firm, mottled silty clay
25 to 39 inches—dark grayish brown, friable, mottled, calcareous clay loam
39 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow in the upper part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions
• The very poorly drained Okoboji soils, which are in depressions and are subject to ponding

Similar soils:
• Soils that have free lime at or near the surface
• Soils that have a dark surface layer more than 24 inches thick or less than 16 inches thick
• Soils that have less clay in the solum
• Soils that have more clay in the lower part

Use and Management

Cropland

Major management factors: Drainage, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

112—Harps clay loam

Composition

Harps soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and the rims of depressions on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 4 to 30 acres

Typical Profile

0 to 19 inches—black, friable, calcareous clay loam
19 to 23 inches—very dark gray, friable, calcareous clay loam
23 to 31 inches—grayish brown, friable, mottled, calcareous clay loam
31 to 60 inches—light brownish gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Crippin soils, which are on slight rises
• The very poorly drained Glencoe soils, which are in depressions and are subject to ponding
• The very poorly drained Okoboji soils, which are in depressions, have more clay than the Harps soil, and are subject to ponding

Similar soils:
• Soils that have less free lime
• Soils that have more clay in the subsoil
• Soils that have thin, variable layers of sandy or gravelly material
• Soils that have gypsum crystals at or near the surface

Use and Management

Cropland

Major management factors: Drainage, high pH

Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

113—Webster clay loam

Composition

Webster soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 4 to 1,700 acres

Typical Profile

0 to 19 inches—black, friable clay loam
19 to 26 inches—dark grayish brown, friable, mottled clay loam
26 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 2 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils, which are in depressions and are subject to ponding
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions
• The very poorly drained Okoboji and Rolfe soils, which are in depressions, have more clay than the Webster soil, and are subject to ponding
• Poorly drained soils that are in landscape positions similar to those of the Webster soil but have sand and gravel in the lower part

Similar soils:
• Soils that have free lime at or near the surface
• Soils that have a dark surface layer more than 24 inches thick

• Soils that have more clay in the surface layer and subsoil
• Soils that have more silty material throughout
• Soils that have bedrock at a depth of 40 to 60 inches
• Soils that are on terraces
• Soils that are shallow to free lime

Use and Management

Cropland

Major management factors: Drainage, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

114—Glencoe silty clay loam

Composition

Glencoe soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 4 to 80 acres

Typical Profile

0 to 27 inches—black, friable silty clay loam
27 to 38 inches—very dark gray, friable clay loam
38 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow or moderate in the upper part, moderate in the lower part
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils, which are on the rims of depressions
• The very poorly drained Blue Earth soils, which formed in mucky silt loam (coprogenous earth)

Similar soils:
• Soils that have a dark surface layer less than 24 inches thick or more than 46 inches thick
• Soils that have a thin surface layer of muck
• Soils that have free lime in the surface layer
• Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Ponding, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

118—Crippin loam

Composition

Crippin soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on ground moraines
Slope range: 1 to 3 percent
Slope length: 50 to 100 feet
Shape of areas: Irregular
Size of areas: 4 to 8 acres

Typical Profile

0 to 14 inches—black, friable, calcareous loam
14 to 22 inches—dark grayish brown, friable, calcareous clay loam
22 to 31 inches—olive brown, friable, mottled, calcareous clay loam
31 to 60 inches—grayish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils, which are in the lower landscape positions

• The well drained Clarion soils, which are in the higher landscape positions
• The well drained Storden soils, which are in the higher landscape positions and have a dark surface layer less than 7 inches thick

Similar soils:
• Soils that have a surface layer leached of free lime
• Soils that have brighter colors in the subsoil
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have a higher content of lime in the surface layer and subsoil
• Soils that have thin, variable layers of sandy and gravelly material

Use and Management

Cropland

Management measures:
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.
• The Crippin soil is one of the most productive soils in the county and can be intensively cropped.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1K

130—Nicollet clay loam

Composition

Nicollet soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on ground moraines
Slope range: 1 to 3 percent
Slope length: 75 to 150 feet
Shape of areas: Irregular
Size of areas: 4 to 200 acres

Typical Profile

0 to 10 inches—black, friable clay loam
10 to 17 inches—very dark gray, friable loam
17 to 23 inches—very dark grayish brown, friable clay loam
23 to 34 inches—dark grayish brown, friable, mottled clay loam
34 to 60 inches—light olive brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils, which are in the lower landscape positions
• The well drained Clarion soils, which are in the higher landscape positions
• The poorly drained Webster soils, which are in the lower landscape positions

Similar soils:
• Soils that have free lime at or near the surface
• Soils that have more clay in the subsoil
• Soils that have thin, variable layers of sandy and gravelly material
• Soils that have silt loam or silty clay loam in the lower part

Use and Management

Cropland

Management measures:
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.
• The Nicollet soil is one of the most productive soils in the county and can be intensively cropped.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1

134—Okoboji silty clay loam

Composition

Okoboji soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—black, friable, calcareous silty clay loam
10 to 26 inches—black, friable silty clay loam
26 to 50 inches—olive gray, friable, mottled silty clay loam
50 to 60 inches—gray, friable, mottled, calcareous, stratified loam, silt loam, and silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow in the upper part, moderate in the lower part
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils, which are on the rims of depressions
• The very poorly drained Blue Earth soils, which are in landscape positions similar to those of the Okoboji soil and formed in mucky silt loam (coprogenous earth)
• The very poorly drained Klossner soils, which are in landscape positions similar to those of the Okoboji soil and formed in muck near the center of depressions

Similar soils:
• Soils that have a dark surface layer less than 24 inches thick
• Soils that have a thin surface layer of muck
• Soils that have less clay in the subsoil and underlying material
• Soils that have very fine sandy loam in the lower part

Use and Management

Cropland

Major management factors: Ponding, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

196—Joliet silty clay loam

Composition

Joliet soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Nearly level areas on stream terraces
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 4 to 40 acres

Typical Profile

0 to 9 inches—black, friable, calcareous silty clay loam
9 to 17 inches—very dark gray, friable, mottled, calcareous silty clay loam
17 to 20 inches—grayish brown, friable, mottled, calcareous fine sandy loam
20 inches—fractured limestone bedrock

Soil Properties and Qualities

Depth class: Shallow
Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: Low
Organic matter content: High
Surface runoff: Slow
Depth to water table: 0 to 1 foot
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The well drained Copaston soils, which are in the higher landscape positions

Similar soils:
• Soils that have a mantle of loamy material more than 20 inches thick

Use and Management

Cropland

Major management factors: Drainage, high pH, ground-water contamination, shallow root zone
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Pasture

Management measures:
• Rotation grazing, mowing and clipping, and installing a drainage system help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: IVw
Windbreak suitability group: 10

206—Kasota loam

Composition

Kasota soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on stream terraces
Slope range: 0 to 3 percent
Slope length: 75 to 150 feet
Shape of areas: Irregular
Size of areas: 5 to 180 acres

Typical Profile

0 to 10 inches—very dark brown, friable loam
10 to 14 inches—very dark grayish brown, friable silt loam
14 to 20 inches—brown, friable silty clay loam
20 to 26 inches—dark yellowish brown, very firm clay
26 to 33 inches—yellowish brown, firm clay loam
33 to 60 inches—yellowish brown, loose, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow in the upper part, rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson and Estherville soils, which are in landscape positions similar to those of the Kasota soil but have less clay and more sand in the surface layer and subsoil

Similar soils:
• Soils that have strata of silt and fine sand in the subsoil
• Soils that have less clay in the subsoil
• Soils that have a mantle of loamy and clayey material more than 40 inches deep

Use and Management

Cropland

Major management factors: Ground-water contamination
Management measures:
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIs
Windbreak suitability group: 6G

221—Canisteo silty clay loam, depressional

Composition

Canisteo soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 4 to 35 acres

Typical Profile

0 to 12 inches—black, friable, mottled, calcareous silty clay loam
12 to 16 inches—very dark gray, friable, mottled, calcareous silty clay loam
16 to 36 inches—olive gray, friable, mottled, calcareous silty clay loam
36 to 60 inches—olive gray, firm, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Ponded
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Harps soils, which are slightly higher on the landscape than the Canisteo soil and have a higher content of free lime

Similar soils:
• Soils that have thin, variable layers of sandy or gravelly material
• Soils that have a surface layer of muck less than 10 inches thick
• Soils that have a dark surface layer more than 24 inches thick that is leached of free lime

Use and Management

Cropland

Major management factors: Ponding, high pH
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2W

239—Le Sueur clay loam

Composition

Le Sueur soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on ground moraines
Slope range: 1 to 3 percent
Slope length: 75 to 150 feet
Shape of areas: Irregular
Size of areas: 5 to 150 acres

Typical Profile

0 to 15 inches—black, friable clay loam
15 to 32 inches—dark grayish brown, firm, mottled clay loam
32 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium or slow
Depth to water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils, which are in the slightly lower landscape positions
• The well drained Lester soils, which are on the steeper slopes

Similar soils:
• Soils that have more clay throughout
• Soils that have less clay in the subsoil
• Soils having a surface layer that is thinner or lighter in color
• Soils that have thin, variable layers of silty, sandy, and gravelly material throughout

Use and Management

Cropland

Major management factors: Low pH
Management measures:
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.
• In places where the surface layer and subsoil are moderately acid, alfalfa responds well to applications of lime.
• The Le Sueur soil is one of the most productive soils in the county and can be cropped intensively.

Interpretive Groups

Land capability classification: I
Windbreak suitability group: 1

269—Millington clay loam

Composition

Millington soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Nearly level areas on flood plains (fig. 6)
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 10 to 150 acres

Typical Profile

0 to 31 inches—black, friable, calcareous clay loam
31 to 43 inches—very dark gray, friable, calcareous clay loam
43 to 60 inches—olive gray, friable, mottled, calcareous, stratified clay loam, silt loam, and sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 2 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The poorly drained Tilfer soils, which are in landscape positions similar to those of the Millington soil and are underlain by limestone bedrock
• The moderately well drained Du Page soils, which are in the higher landscape positions
• The moderately well drained Minneiska soils, which are in the higher landscape positions and have more sand throughout than the Millington soil

Similar soils:
• Soils that have sand or gravel at a depth of more than 40 inches
• Soils that do not have lime in the surface layer
• Soils that have more clay in the surface layer

Figure 6.—An area of Millington clay loam in the Minnesota River Valley. This highly productive soil is nearly level and occasionally flooded.

• Soils that have less clay in the subsoil and underlying material
• Soils that have limestone bedrock at a depth of more than 30 inches
• Soils that have a dark surface layer more than 48 inches thick

Use and Management

Cropland

Major management factors: Flooding, drainage, high pH
Management measures:
• Most suitable crops can be grown if adequate drainage and protection from flooding are provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis

Pasture

Management measures:
• Rotation grazing, mowing and clipping, and installing a drainage system help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

283A—Plainfield loamy sand, 0 to 2 percent slopes

Composition

Plainfield soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 50 acres

Typical Profile

0 to 10 inches—very dark grayish brown, very friable loamy sand
10 to 21 inches—dark yellowish brown, very friable loamy sand
21 to 39 inches—dark yellowish brown, loose sand
39 to 60 inches—yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Plainfield soil and have more clay in the upper part
• Moderately well drained soils in the lower landscape positions

Similar soils:
• Soils that have gravel in the subsoil and underlying material
• Soils that have thin bands of sandy loam throughout
• Soils that have free lime in the lower part
• Soils that have a dark surface layer more than 10 inches thick

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, organic matter content
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IVs
Windbreak suitability group: 7

283B—Plainfield loamy sand, 2 to 6 percent slopes

Composition

Plainfield soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 50 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 9 inches—very dark grayish brown, very friable loamy sand
9 to 20 inches—dark yellowish brown, loose loamy sand
20 to 33 inches—dark yellowish brown, loose sand
33 to 60 inches—yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Plainfield soil and have more clay in the upper part

Similar soils:
• Soils that have gravel in the subsoil and underlying material
• Soils that have loamy strata or glacial till within a depth of 60 inches
• Soils that have thin bands of sandy loam throughout
• Soils that have free lime in the lower part
• Soils that have a dark surface layer more than 10 inches thick

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, organic matter content
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.

• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IVs
Windbreak suitability group: 7

283C—Plainfield loamy sand, 6 to 15 percent slopes

Composition

Plainfield soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 30 acres

Typical Profile

0 to 8 inches—very dark grayish brown, very friable loamy sand
8 to 20 inches—brown, very friable loamy sand
20 to 60 inches—dark yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Terril soils, which are on foot slopes and have a thicker dark surface layer, more clay, and less sand than the Plainfield soil

Similar soils:
• Soils that have gravel in the subsoil and underlying material
• Soils that have loamy strata or glacial till within a depth of 60 inches
• Soils that have a surface layer of sandy loam
• Soils that have a finer texture
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have free lime in the lower part

Use and Management

Pasture

Major management factors: Slope, available water capacity, organic matter content

Management measures:
• Adjusting the stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: VIs
Windbreak suitability group: 7

317—Oshawa silty clay loam

Composition

Oshawa soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Depressions in abandoned river channels and oxbows on flood plains
Slope range: 0 to 1 percent
Shape of areas: Elongated
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—very dark gray, friable, mottled, calcareous silty clay loam
10 to 36 inches—stratified dark olive gray and dark grayish brown, friable, mottled, calcareous silt loam
36 to 60 inches—black, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Depth to water table: 1 foot above to 1 foot below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• The poorly drained Millington soils, which are in the higher landscape positions
• Very poorly drained soils that are in landscape positions similar to those of the Oshawa soil and have a layer of muck more than 16 inches thick

Similar soils:
• Soils that have a thin layer of sand
• Soils that have a thin surface layer of muck

Use and Management

Habitat for wetland wildlife

Major management factors: Ponding
Potential for habitat elements: Good

Management measures:
• Adapted plant species that provide food and cover for wildlife should be established, and food plots should be maintained nearby.
• Seasonal flooding and ponding provide water for wildlife.

Interpretive Groups

Land capability classification: VIw
Windbreak suitability group: 10

321—Tilfer silty clay loam

Composition

Tilfer soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Nearly level areas on stream terraces
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 4 to 400 acres

Typical Profile

0 to 10 inches—black, friable, calcareous silty clay loam
10 to 13 inches—black, friable, calcareous clay loam
13 to 20 inches—very dark gray, friable, calcareous clay loam
20 to 27 inches—dark grayish brown, friable, mottled, calcareous loam
27 inches—fractured limestone bedrock

Soil Properties and Qualities

Depth class: Moderately deep
Drainage class: Very poorly drained and poorly drained
Permeability: Moderate
Available water capacity: Low
Organic matter content: High
Surface runoff: Slow
Depth to water table: 0 to 2 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• Soils that are underlain by shale, sandstone, or Sioux quartzite and are not flooded or are rarely flooded
• The well drained Copaston soils, which are in the higher landscape positions
• The poorly drained Joliet soils, which are in landscape positions similar to those of the Tilfer soil and have a surface layer that is thinner over bedrock
• The moderately well drained and somewhat poorly drained Le Sueur soils, which are in the slightly higher landscape positions

Similar soils:
• Soils that have a mantle of loamy material more than 40 inches thick
• Soils having a surface layer that is leached of free lime

Use and Management

Cropland

Major management factors: Drainage, high pH, ground-water contamination, moderately deep root zone
Management measures:
• Most suitable crops can be grown if adequate drainage and protection from flooding are provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2K

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

Composition

Dickman soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on stream terraces
Shape of areas: Irregular or elongated
Size of areas: 4 to 200 acres

Typical Profile

0 to 9 inches—black, friable sandy loam
9 to 18 inches—brown, friable sandy loam
18 to 45 inches—dark yellowish brown, loose sand
45 to 60 inches—yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Dickman soil and have more clay in the upper part

• Moderately well drained soils on the lower foot slopes

Similar soils:
• Soils that have gravel in the lower part
• Soils that have glacial till within a depth of 60 inches
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have a surface layer of loamy sand

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIs
Windbreak suitability group: 7

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

Composition

Dickman soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Convex slopes on stream terraces
Shape of areas: Irregular
Size of areas: 4 to 40 acres

Typical Profile

0 to 10 inches—very dark brown, very friable sandy loam
10 to 14 inches—brown, very friable sandy loam
14 to 35 inches—brown, loose sand
35 to 60 inches—pale brown, loose sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Dickman soil and have more clay in the upper part
• Moderately well drained soils on the lower foot slopes

Similar soils:
• Soils that have a surface layer of loamy sand
• Soils that have gravel, cobbles, or glacial till within a depth of 60 inches
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination
Management measures:
• Supplemental irrigation should be provided during periods of limited precipitation.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.
• The use of fertilizers, pesticides, herbicides, and other chemicals should be carefully controlled to prevent ground-water contamination.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: 7

329—Chaska loam

Composition

Chaska soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landscape: Nearly level areas and slightly convex slopes on flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 8 to 100 acres

Typical Profile

0 to 9 inches—very dark brown, friable, calcareous loam
9 to 35 inches—very dark grayish brown and dark grayish brown, very friable, mottled, calcareous, stratified loam, silt loam, fine sandy loam, and silty clay loam
35 to 60 inches—gray and dark gray, friable, mottled, calcareous, stratified silt loam and silty clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderately slow to moderately rapid in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to water table: 1 to 3 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The moderately well drained Minneiska soils, which are in the higher landscape positions
• The very poorly drained Oshawa soils, which are in depressions in abandoned river channels and oxbows

Similar soils:
• Soils that have more sand or clay in the surface layer

Use and Management

Cropland

Major management factors: Flooding, drainage
Management measures:
• Most suitable crops can be grown if adequate drainage and protection from flooding are provided.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 1K

336—Delft clay loam

Composition

Delft soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Drainageways or swales on ground moraines
Slope range: 1 to 3 percent
Shape of areas: Elongated
Size of areas: 4 to 55 acres

Typical Profile

0 to 20 inches—black, friable clay loam
20 to 36 inches—black, firm silty clay loam
36 to 51 inches—black, firm clay loam
51 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils, which are in depressions and are subject to ponding
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the slightly higher landscape positions
• The moderately well drained Terril soils, which are in the slightly higher landscape positions

Similar soils:
• Soils that have glacial outwash within a depth of 60 inches
• Soils that have a dark surface layer less than 24 inches thick
• Soils that have free lime

Use and Management

Cropland

Major management factors: Drainage, high clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• If worked when wet, the soil becomes compacted and cloddy.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2

386—Okoboji mucky silty clay loam

Composition

Okoboji soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 4 to 50 acres

Typical Profile

0 to 12 inches—black, friable mucky silty clay loam
12 to 30 inches—black, friable silty clay loam
30 to 48 inches—black, friable, mottled silty clay loam
48 to 60 inches—gray, friable, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate in the upper part, moderately slow in the lower part
Available water capacity: High or very high
Organic matter content: Very high
Surface runoff: Ponded or very slow
Depth to water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Blue Earth soils, which are in landscape positions similar to those of the Okoboji soil and formed in mucky silt loam (coprogenous earth)
• The poorly drained Canisteo and Harps soils, which are in the higher landscape positions and have free lime throughout

Similar soils:
• Soils that have free lime and snail shells in the surface layer
• Soils that have a layer of muck more than 16 inches thick
• Soils that have thin bands of sand in the lower part

Use and Management

Cropland

Major management factors: Drainage, soil blowing
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2

463A—Minneiska sandy loam, 0 to 2 percent slopes

Composition

Minneiska soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Nearly level areas on flood plains
Shape of areas: Irregular or elongated
Size of areas: 4 to 100 acres

Typical Profile

0 to 9 inches—very dark grayish brown, very friable, calcareous sandy loam
9 to 60 inches—very dark grayish brown, dark grayish brown, and brown, very friable, mottled, calcareous, stratified loam, silt loam, sand, and fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to water table: 3 to 6 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The poorly drained Millington and somewhat poorly drained Chaska soils, which are in the lower positions on the flood plains
• The very poorly drained Oshawa soils, which are in depressions in abandoned river channels and oxbows

Similar soils:
• Soils having a surface layer that is leached of free lime
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have more sand
• Soils that are not stratified

Use and Management

Cropland

Major management factors: Flooding, high pH, soil blowing
Management measures:
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.
• Maintaining crop residue on the surface and using minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 1K

463B—Minneiska loam, 1 to 4 percent slopes

Composition

Minneiska soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and convex slopes on flood plains
Shape of areas: Irregular
Size of areas: 4 to 60 acres

Typical Profile

0 to 8 inches—very dark grayish brown, friable, calcareous loam
8 to 60 inches—dark brown and brown, friable, mottled, calcareous, stratified loam, silt loam, sand, sandy loam, and fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to water table: 3 to 6 feet
Frequency of flooding: Rare

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in the higher landscape positions
• The poorly drained Millington and somewhat poorly drained Chaska soils, which are in the lower landscape positions
• The moderately well drained Terril soils, which are on foot slopes

Similar soils:
• Soils having a surface layer that is leached of free lime
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have more sand
• Soils that have gravelly material in the lower part
• Soils that are not stratified

Use and Management

Cropland

Major management factors: Erosion, high pH
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: 1K

525—Muskego muck

Composition

Muskego soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 5 to 100 acres

Typical Profile

0 to 8 inches—black, very friable muck
8 to 18 inches—very dark brown, very friable muck
18 to 25 inches—black, very friable muck
25 to 60 inches—very dark gray, very friable, calcareous mucky silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part, slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded or very slow
Depth to water table: 1 foot above to 1 foot below the surface
Special characteristics:
• Some areas are covered with 3 to 14 inches of fill material that has a surface texture of loam or clay loam.

Inclusions

Contrasting inclusions:
• The poorly drained Essexville soils, which are on the borders of depressions or on sandbars that extend into the depressions
• The very poorly drained Glencoe soils, which are in landscape positions similar to those of the Muskego soil and formed in mineral soil material
• The poorly drained Canisteo and Harps soils, which are on the rims of depressions

Similar soils:
• Soils that have a layer of muck more than 51 inches thick or less than 16 inches thick
• Soils that have lime in the surface layer
• Soils that have moderately decomposed organic material

• Soils that have loamy glacial till in the lower part

Use and Management

Cropland

Major management factors: Drainage, soil blowing
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IVw
Windbreak suitability group: 2(O)

539—Klossner muck

Composition

Klossner soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 5 to 125 acres

Typical Profile

0 to 26 inches—black, friable muck
26 to 36 inches—black, friable mucky silty clay loam
36 to 48 inches—black, friable silty clay loam
48 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded or very slow
Depth to water table: 1 foot above to 1 foot below the surface
Special characteristics:
• Some areas are covered with 3 to 14 inches of fill material that has a surface texture of loam or clay loam.

Inclusions

Contrasting inclusions:
• The very poorly drained Blue Earth soils, which are in landscape positions similar to those of the Klossner soil and formed in mucky silt loam (coprogenous earth)
• The poorly drained Canisteo and Harps soils, which are on the rims of depressions
• The poorly drained Essexville soils, which are on the borders of depressions or on sandbars that extend into the depressions

Similar soils:
• Soils that have a layer of muck less than 16 inches thick
• Soils that have moderately decomposed organic material
• Soils that have a layer of organic material more than 51 inches thick
• Soils that have free lime at or near the surface

Use and Management

Cropland

Major management factors: Drainage, soil blowing
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2(O)

574—Du Page loam

Composition

Du Page soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Nearly level areas and slightly convex slopes on flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—very dark gray, friable, calcareous loam
10 to 43 inches—very dark gray, friable, calcareous loam
43 to 60 inches—very dark gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow

Depth to water table: 4 to 6 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The poorly drained Millington soils, which are in the lower landscape positions
• The moderately well drained Minneiska soils, which are in landscape positions similar to those of the Du Page soil and have more sand in the lower part
• The poorly drained Nishna soils, which are in the lower landscape positions and have more clay throughout than the Du Page soil

Similar soils:
• Soils that are rarely flooded
• Soils having a surface layer that is leached of free lime

Use and Management

Cropland

Major management factors:
• The seasonal flooding limits the production and harvesting of crops.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 1K

575—Nishna silty clay loam

Composition

Nishna soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Nearly level areas on flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or elongated
Size of areas: 4 to 200 acres

Typical Profile

0 to 20 inches—black, friable, calcareous silty clay loam
20 to 38 inches—black, friable, calcareous silty clay
38 to 60 inches—very dark gray, very firm, calcareous silty clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to water table: 1 to 3 feet
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• The moderately well drained Minneiska soils, which are in the slightly higher landscape positions
• The very poorly drained, ponded Nishna soils, which are in the lower landscape positions

Similar soils:
• Soils that do not have free lime in the surface layer
• Soils that have more sand and less clay
• Soils that have a dark surface layer more than 60 inches thick
• Soils that have snail shells between depths of 21 and 60 inches

Use and Management

Cropland

Major management factors: Flooding, drainage, low pH
Management measures:
• Most suitable crops can be grown if adequate drainage and protection from flooding are provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2K

611F—Hawick sandy loam, 18 to 70 percent slopes

Composition

Hawick soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Steep and very steep side slopes on stream terraces (fig. 7)
Shape of areas: Irregular or elongated
Size of areas: 4 to 15 acres
Slope length: 75 to 150 feet

Typical Profile

0 to 9 inches—black, friable, calcareous sandy loam
9 to 19 inches—brown, loose, calcareous gravelly coarse sand
19 to 60 inches—yellowish brown, loose, calcareous coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low or moderate

Figure 7.—An area of Hawick sandy loam, 18 to 70 percent slopes. This soil is generally not used as cropland.

Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Minneiska soils, which are on alluvial fans and flood plains
- The moderately well drained Terril soils, which are on foot slopes
- The well drained Wadena soils, which are lower on the landscape than the Hawick soil and have a thicker mantle of loamy material that is deeper over sand or gravel
- The well drained Clarion and Storden soils, which are along side slopes
- Excessively drained soils that have boulders on the surface

Similar soils:
- Soils that have a mantle of loamy material more than 20 inches thick
- Soils that have a surface layer of gravelly coarse sandy loam
- Soils that have a dark surface layer less than 8 inches thick

Use and Management

Pasture

- Adjusting the stocking rates, especially on the steeper slopes, helps to maintain the quality and quantity of forage plants.

Interpretive Groups

Land capability classification: VIIs
Windbreak suitability group: 7

851—Chaska-Minneiska-Urban land complex

Composition

Chaska soil and similar soils: 30 to 50 percent
Minneiska soil and similar soils: 25 to 35 percent

Urban land: 20 to 35 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Chaska—nearly level areas on flood plains; Minneiska—nearly level areas and slightly convex slopes on flood plains; Urban land—nearly level areas covered by paved roads, parking lots, and buildings on the flood plain along the Minnesota River in and around the city of North Mankato
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 1 to 900 acres

Typical Profile

Chaska

0 to 7 inches—very dark brown, friable, calcareous loam
7 to 60 inches—very dark gray, dark grayish brown, and very dark gray, friable, mottled, calcareous, stratified loam, fine sandy loam, and sand

Minneiska

0 to 10 inches—very dark grayish brown, very friable, calcareous fine sandy loam
10 to 60 inches—brown, very friable, calcareous, stratified loam, fine sand, sand, and fine sandy loam

Soil Properties and Qualities

Drainage class: Chaska—somewhat poorly drained; Minneiska—moderately well drained
Permeability: Chaska—moderate in the upper part, moderately rapid in the lower part; Minneiska—moderately rapid
Available water capacity: Chaska—moderate; Minneiska—high
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to water table: Chaska—1 to 3 feet; Minneiska—3 to 6 feet
Frequency of flooding: Rare

Inclusions

Contrasting inclusions:
• The very poorly drained Oshawa soils, which are in abandoned river channels and oxbows

Similar soils:
• Soils having a surface layer that is leached of free lime
• Soils that have more sand in the solum
• Soils that are not stratified
• Soils that have coarse sand in the lower part

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Chaska—1K; Minneiska—1K

852—Copaston-Urban land complex

Composition

Copaston soil and similar soils: 40 to 60 percent
Urban land: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Copaston—nearly level areas and slightly convex slopes on stream terraces and flood plains; Urban land—gently undulating areas covered by paved roads, parking lots, and buildings in the city of St. Peter
Slope range: 1 to 4 percent
Shape of areas: Irregular
Size of areas: 1 to 200 acres

Typical Profile

Copaston

0 to 10 inches—very dark brown, friable loam
10 to 20 inches—dark yellowish brown, friable loam
20 inches—fractured limestone bedrock

Soil Properties and Qualities

Depth to bedrock: Copaston—shallow
Drainage class: Copaston—well drained
Permeability: Copaston—moderate in the upper part, moderate or moderately rapid in the lower part
Available water capacity: Copaston—low
Organic matter content: Copaston—moderate or high
Surface runoff: Copaston—slow or medium
Depth to water table: Copaston—more than 6 feet
Special characteristics: Copaston—potential for groundwater contamination caused by sanitary facilities or the misuse of lawn chemicals because of a poor filtering capacity

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in the higher landscape positions and are deep over bedrock
• The excessively drained Plainfield soils, which are in the higher landscape positions and are sandy throughout

Similar soils:
• Soils that have a mantle of loamy material more than 20 inches thick
• Soils in areas where fill material has been deposited at various depths

• Soils from which the mantle of loamy material has been removed

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Copaston—10

854—Cordova-Urban land complex

Composition

Cordova soil and similar soils: 50 to 65 percent
Urban land: 30 to 40 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Cordova—nearly level areas on ground moraines; Urban land—nearly level areas covered by paved roads, parking lots, and buildings in and around the city of North Mankato
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Cordova

0 to 15 inches—black, friable clay loam
15 to 21 inches—very dark gray, friable clay loam
21 to 44 inches—olive gray, firm, mottled clay loam
44 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Cordova—poorly drained
Permeability: Cordova—moderately slow in the upper part, moderate in the lower part
Available water capacity: Cordova—high
Organic matter content: Cordova—high
Surface runoff: Cordova—slow
Depth to water table: Cordova—1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo soils, which are in landscape positions similar to those of the Cordova soil and have free lime throughout
• The very poorly drained Glencoe soils, which are in small depressions and are subject to ponding
• The moderately well drained and somewhat poorly drained Le Sueur soils, which are in the higher landscape positions

Similar soils:
• Soils that have less clay in the subsoil
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have free lime throughout

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Cordova—2

864B—Plainfield-Urban land complex, 0 to 6 percent slopes

Composition

Plainfield soil and similar soils: 35 to 50 percent
Urban land: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plainfield—nearly level areas and convex slopes on stream terraces; Urban land—gently undulating areas covered by paved roads, parking lots, and buildings in the city of St. Peter
Shape of areas: Irregular
Size of areas: 80 to 600 acres

Typical Profile

Plainfield

0 to 10 inches—very dark grayish brown, very friable loamy sand
10 to 15 inches—dark brown, very friable loamy sand
15 to 60 inches—dark yellowish brown, very friable fine sand

Soil Properties and Qualities

Drainage class: Plainfield—excessively drained
Permeability: Plainfield—rapid
Available water capacity: Plainfield—low
Organic matter content: Plainfield—low or moderately low
Surface runoff: Plainfield—slow
Depth to water table: Plainfield—more than 6 feet
Special characteristics: Plainfield—potential for groundwater contamination caused by sanitary facilities or the misuse of lawn chemicals because of a poor filtering capacity

Inclusions

Contrasting inclusions:
• The well drained Copaston soils, which are in

landscape positions similar to those of the Plainfield soil but have a loamy surface layer and are shallow over bedrock
• The well drained Dickinson soils, which are in the lower landscape positions and have more clay in the upper part than the Plainfield soil

Similar soils:
• Soils that have thin bands of sandy loam and fine sandy loam in the subsoil and underlying material
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Plainfield—7

864C—Plainfield-Urban land complex, 6 to 15 percent slopes

Composition

Plainfield soil and similar soils: 40 to 60 percent
Urban land: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plainfield—convex slopes on stream terraces; Urban land—sloping and moderately steep areas covered by paved roads, parking lots, and buildings in the city of St. Peter
Shape of areas: Irregular
Size of areas: 1 to 250 acres

Typical Profile

Plainfield

0 to 8 inches—very dark grayish brown, very friable loamy sand
8 to 20 inches—brown, very friable loamy sand
20 to 60 inches—dark yellowish brown, loose sand

Soil Properties and Qualities

Drainage class: Plainfield—excessively drained
Permeability: Plainfield—rapid
Available water capacity: Plainfield—low
Organic matter content: Plainfield—low or moderately low
Surface runoff: Plainfield—medium or rapid
Depth to water table: Plainfield—more than 6 feet
Special characteristics: Plainfield—potential for ground-water contamination caused by sanitary facilities or the misuse of lawn chemicals because of a poor filtering capacity

Inclusions

Contrasting inclusions:
• The well drained Dickinson soils, which are in landscape positions similar to those of the Plainfield soil but have more clay in the upper part
• The well drained Kasota soils, which are nearly level and have more clay in the upper part than the Plainfield soil

Similar soils:
• Soils that have gravel in the lower part
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Plainfield—7

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

Composition

Clarion soil and similar soils: 35 to 55 percent
Storden soil and similar soils: 20 to 35 percent
Hawick soil and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion and Hawick—the less convex parts of slopes on ground moraines; Storden—the more convex parts of slopes on ground moraines
Shape of areas: Irregular
Size of areas: 4 to 40 acres
Slope length: 75 to 150 feet

Typical Profile

Clarion

0 to 10 inches—very dark grayish brown, friable loam
10 to 29 inches—brown, friable loam
29 to 41 inches—yellowish brown, friable, calcareous loam
41 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Storden

0 to 8 inches—brown, friable, calcareous loam
8 to 37 inches—brown, friable, calcareous loam
37 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Hawick

0 to 10 inches—very dark gray, friable, calcareous sandy loam
10 to 22 inches—brown, very friable, calcareous loamy sand
22 to 46 inches—dark yellowish brown, loose, calcareous coarse sand
46 to 60 inches—brown, loose, calcareous sand

Soil Properties and Qualities

Drainage class: Clarion and Storden—well drained; Hawick—excessively drained
Permeability: Clarion and Storden—moderate; Hawick—moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Clarion and Storden—high; Hawick—low
Organic matter content: Clarion—moderate or high; Storden—moderately low; Hawick—moderately low or moderate
Surface runoff: Clarion and Storden—medium; Hawick—slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in the lower landscape positions, drainageways, and swales
• The moderately well drained and somewhat poorly drained Nicollet soils, which are in the lower landscape positions
• The poorly drained Webster soils, which are in the lower landscape positions

Similar soils:
• Soils that have less gravel and more sand
• Soils that have sandy or gravelly deposits less than 40 inches thick
• Soils that are similar to the Clarion soil but have a thinner dark surface layer
• Soils that are similar to the Hawick soil but have a surface layer of gravelly coarse sandy loam
• Soils that are similar to the Clarion and Storden soils but have silt loam, fine sandy loam, or sandy loam in the lower part

Use and Management

Cropland

Major management factors: Clarion and Storden—slope, eroded surface; Storden—organic matter content; Hawick—soil blowing, available water capacity
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.

Interpretive Groups

Land capability classification: Clarion—IIe; Storden—IIe; Hawick—IVs
Windbreak suitability group: Clarion—3; Storden—8; Hawick—7

920C2—Clarion-Storden-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Clarion soil and similar soils: 35 to 55 percent
Storden soil and similar soils: 20 to 35 percent
Hawick soil and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Clarion and Hawick—the less convex parts of slopes on ground moraines; Storden—the more convex parts of slopes on ground moraines
Shape of areas: Irregular
Size of areas: 4 to 20 acres
Slope length: 75 to 150 feet

Typical Profile

Clarion

0 to 8 inches—very dark grayish brown, friable loam
8 to 29 inches—brown, friable loam
29 to 42 inches—yellowish brown, friable, calcareous loam
42 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Storden

0 to 6 inches—dark brown, friable, calcareous loam
6 to 60 inches—yellowish brown, friable, calcareous loam

Hawick

0 to 9 inches—very dark grayish brown, friable, calcareous sandy loam
9 to 23 inches—brown, very friable, calcareous gravelly coarse sand
23 to 39 inches—dark yellowish brown, loose, calcareous sand
39 to 60 inches—dark yellowish brown, loose, mottled, calcareous sand

Soil Properties and Qualities

Drainage class: Clarion and Storden—well drained; Hawick—excessively drained

Permeability: Clarion and Storden—moderate; Hawick—moderately rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Clarion and Storden—high; Hawick—low
Organic matter content: Clarion—moderate; Storden—moderately low; Hawick—moderately low or moderate
Surface runoff: Clarion and Storden—medium; Hawick—slow
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in the lower landscape positions, drainageways, and swales
• The moderately well drained and somewhat poorly drained Nicollet soils, which are in the lower landscape positions
• The moderately well drained Terril soils, which are on foot slopes
• The poorly drained Webster soils, which are in the lower landscape positions

Similar soils:
• Soils that have less gravel and more sand
• Soils that have sandy or gravelly deposits less than 40 inches thick
• Soils that are similar to the Clarion and Storden soils but have silt loam, sandy loam, or fine sandy loam in the lower part
• Soils that are similar to the Clarion soil but have an eroded surface layer and an exposed subsoil
• Soils that are similar to the Hawick soil but have a surface layer of gravelly coarse sandy loam
• Soils that are similar to the Storden soil but do not have free lime in the surface layer

Use and Management

Cropland

Major management factors: Clarion and Storden—slope, eroded surface; Storden—organic matter content; Hawick—soil blowing, available water capacity
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• If water erosion is not controlled, more fertilizer is needed, productivity is lower, and crop yields are reduced.

Interpretive Groups

Land capability classification: Clarion—IIIe; Storden—IIIe; Hawick—IVs
Windbreak suitability group: Clarion—3; Storden—8; Hawick—7

921B—Clarion-Storden complex, 2 to 6 percent slopes

Composition

Clarion soil and similar soils: 60 to 75 percent
Storden soil and similar soils: 15 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion—the less convex parts of slopes on ground moraines; Storden—the more convex parts of slopes on ground moraines (fig. 8)
Slope range: Clarion—2 to 6 percent; Storden—3 to 6 percent
Slope length: 75 to 150 feet
Shape of areas: Irregular
Size of areas: 4 to 30 acres

Typical Profile

Clarion

0 to 10 inches—very dark brown, friable loam
10 to 21 inches—brown, friable loam
21 to 60 inches—olive brown, friable, calcareous loam

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 60 inches—light yellowish brown, friable, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Clarion—moderate or high; Storden—moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in the lower landscape positions
• The moderately well drained and somewhat poorly drained Nicollet soils, which are in the lower landscape positions and in the less sloping areas
• The poorly drained Webster soils, which are in the lower landscape positions
• Soils that have small pockets of sand and gravel

Figure 8.—An area of Clarion-Storden complex, 2 to 6 percent slopes. The light-colored Storden soil on the knolls is surrounded by the dark-colored Clarion soil.

Similar soils:
• Soils that are similar to the Clarion soil but are shallow to free lime
• Soils that are similar to the Storden soil but have a dark surface layer that is thicker and that does not have free lime
• Soils in eroded areas that have a very dark grayish brown or dark brown surface layer
• Soils that have silt loam, sandy loam, or fine sandy loam in the lower part

Use and Management

Cropland

Major management factors: Clarion and Storden—slope, water erosion; Storden—organic matter content
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of erosion.

Interpretive Groups

Land capability classification: IIe
Windbreak suitability group: Clarion—3; Storden—8

921C2—Clarion-Storden complex, 6 to 12 percent slopes, eroded

Composition

Clarion soil and similar soils: 55 to 75 percent
Storden soil and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion—the less convex parts of slopes on ground moraines; Storden—the more convex parts of slopes on ground moraines
Shape of areas: Irregular
Size of areas: 4 to 30 acres

Slope length: 75 to 150 feet

Typical Profile

Clarion

0 to 7 inches—very dark grayish brown, friable loam
7 to 23 inches—dark yellowish brown, friable loam
23 to 60 inches—brown, friable, mottled loam

Storden

0 to 6 inches—brown, friable, calcareous loam
6 to 60 inches—light olive brown, friable, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Clarion—moderate; Storden—moderately low
Surface runoff: Medium
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in the lower landscape positions
• The moderately well drained and somewhat poorly drained Nicollet soils, which are in the lower landscape positions
• The moderately well drained Terril soils, which are on foot slopes
• The poorly drained Webster soils, which are in the lower landscape positions
• Soils that have small pockets of sand and gravel

Similar soils:
• Soils that are similar to the Clarion soil but are shallow to free lime
• Soils that are similar to the Storden soil but have a dark surface layer that is thicker and that does not have free lime
• Soils that have a surface layer of sandy loam
• Soils that have sandy loam or fine sandy loam in the lower part
• Soils that are similar to the Clarion soil but have an eroded surface layer and an exposed subsoil
• Soils that are similar to the Clarion soil but have a thicker dark surface layer

Use and Management

Cropland

Major management factors: Clarion and Storden—slope, eroded surface; Storden—organic matter content
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• If water erosion is not controlled, more fertilizer is needed, productivity is lower, and crop yields are reduced.

Interpretive Groups

Land capability classification: IIIe
Windbreak suitability group: Clarion—3; Storden—8

923—Copaston-Rock outcrop complex, 2 to 60 percent slopes

Composition

Copaston soil and similar soils: 50 to 75 percent
Rock outcrop: 20 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Copaston—convex slopes on flood plains and stream terraces; Rock outcrop—escarpments on flood plains and stream terraces (fig. 9)
Shape of areas: Irregular
Size of areas: 4 to 20 acres
Slope length: 50 to 125 feet

Typical Profile

Copaston

0 to 6 inches—very dark brown, friable, calcareous loam
6 to 9 inches—brown, friable, calcareous loam
9 inches—fractured limestone bedrock

Soil Properties and Qualities

Depth to bedrock: Copaston—very shallow
Drainage class: Copaston—well drained
Permeability: Copaston—moderate in the upper part, moderate or moderately rapid in the lower part
Available water capacity: Copaston—very low
Organic matter content: Copaston—moderate or high
Surface runoff: Copaston—medium or rapid
Depth to water table: Copaston—more than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Lester soils, which are in landscape positions similar to those of the Copaston soil and are very deep over bedrock

Similar soils:
• Outcrops of Sioux quartzite and gneiss in areas along the Minnesota River Valley in Ridgeley and Courtland Townships

Figure 9.—A typical area of Copaston-Rock outcrop complex, 2 to 60 percent slopes. An adequate sewage treatment system should be installed in areas used for urban development.

• Soils that have a surface layer of fine sandy loam and sandy loam
• Soils that have a mantle of loamy material more than 20 inches thick
• Soils that have flagstones and channers of dolomite and some igneous boulders on the surface

Use and Management

Pasture

Major management factors: Slope, available water capacity, shallow root zone
Management measures:
• Adjusting stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: Copaston—VIIs; Rock outcrop—not assigned
Windbreak suitability group: Copaston—10; Rock outcrop—not assigned

944F—Lester-Storden-Estherville complex, 18 to 70 percent slopes

Composition

Lester soil and similar soils: 40 to 65 percent
Storden soil and similar soils: 15 to 25 percent
Estherville soil and similar soils: 20 to 30 percent
Contrasting inclusions: 0 to 15 percent

Setting

Landform and position on the landform: Steep and very steep side slopes on ground moraines
Shape of areas: Irregular or elongated
Size of areas: 4 to 80 acres
Slope length: 75 to 150 feet

Typical Profile

Lester

0 to 6 inches—very dark gray, friable loam
6 to 20 inches—dark yellowish brown, friable loam
20 to 60 inches—yellowish brown, friable, calcareous loam

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 60 inches—yellowish brown, friable, calcareous loam

Estherville

0 to 7 inches—very dark brown, friable sandy loam
7 to 13 inches—dark brown, friable coarse sandy loam
13 to 60 inches—yellowish brown, loose, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Lester and Storden—moderate; Estherville—moderately rapid in the upper part, rapid in the lower part
Available water capacity: Lester and Storden—high; Estherville—low
Organic matter content: Lester and Estherville—moderate; Storden—moderately low
Surface runoff: Lester and Storden—rapid or very rapid; Estherville—rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Copaston soils, which are in landscape positions similar to those of the Lester, Storden, and Estherville soils and are shallow over bedrock
• The poorly drained Delft soils, which are in drainageways
• The moderately well drained Minneiska soils, which are on alluvial fans on flood plains
• The moderately well drained Terril soils, which are on foot slopes

Similar soils:
• Soils that are similar to the Lester soil but have a thicker dark surface layer
• Soils that are similar to the Lester soil but are shallow to free lime
• Soils that are similar to the Storden soil but have a thicker dark surface layer

Use and Management

Pasture

Major management factors: Estherville—slope, available water capacity; Storden—organic matter content
Management measures:
• Adjusting stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: VIIe
Windbreak suitability group: Lester—3; Storden—8; Estherville—7

945D2—Lester-Storden complex, 12 to 18 percent slopes, eroded

Composition

Lester soil and similar soils: 45 to 65 percent
Storden soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilly side slopes on ground moraines
Shape of areas: Irregular
Size of areas: 5 to 100 acres
Slope length: 75 to 150 feet

Typical Profile

Lester

0 to 7 inches—very dark grayish brown, friable loam
7 to 20 inches—brown, friable loam
20 to 25 inches—yellowish brown, friable loam
25 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Storden

0 to 9 inches—dark grayish brown, friable, calcareous loam
9 to 24 inches—yellowish brown, friable, calcareous loam
24 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Lester—moderate; Storden—moderately low
Surface runoff: Medium or rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in drainageways
• The moderately well drained Terril soils, which are on foot slopes
• Soils that have small pockets of sand and gravel

Similar soils:
• Soils in which the subsoil has been exposed by erosion
• Soils that are similar to the Lester soil but are shallow to free lime
• Soils that are similar to the Lester soil but have a thicker dark surface layer

Use and Management

Cropland

Major management factors: Lester and Storden—slope, eroded surface; Storden—organic matter content
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• If water erosion is not controlled, more fertilizer is needed, productivity is lower, and crop yields are reduced.

Pasture

• Adjusting stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: IVe
Windbreak suitability group: Lester—3; Storden—8

945F—Lester-Storden complex, 18 to 70 percent slopes

Composition

Lester soil and similar soils: 45 to 65 percent
Storden soil and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Very steep side slopes on ground moraines (fig. 10)
Shape of areas: Irregular or elongated
Size of areas: 5 to 250 acres
Slope length: 75 to 150 feet

Typical Profile

Lester

0 to 8 inches—very dark brown, friable loam
8 to 12 inches—brown, friable clay loam
12 to 26 inches—dark yellowish brown, firm clay loam
26 to 60 inches—light olive brown, friable, calcareous loam

Storden

0 to 4 inches—dark grayish brown, friable, calcareous loam
4 to 12 inches—grayish brown, friable, calcareous loam
12 to 60 inches—grayish brown, friable, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Lester—moderate; Storden—moderately low
Surface runoff: Rapid or very rapid
Depth to water table: More than 6 feet

Figure 10.—A typical area of Lester-Storden complex, 18 to 70 percent slopes. Typically, areas of this map unit support deciduous forest vegetation.

Inclusions

Contrasting inclusions:
- The poorly drained Delft soils, which are in drainageways
- The moderately well drained Terril soils, which are on foot slopes
- Soils that have small pockets of sand and gravel

Similar soils:
- Soils that have less clay in the subsoil
- Soils that are similar to the Lester soil but have a thicker dark surface layer
- Soils that are similar to the Lester soil but are shallow to free lime
- Soils that have fine sandy loam or sandy loam in the lower part
- Soils that are subject to hillside seepage

Use and Management

Pasture

Major management factors: Lester and Storden—slope; Storden—organic matter content

Management measures:
- Adjusting stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: VIIe
Windbreak suitability group: Lester—3; Storden—8

956—Canisteo-Glencoe complex

Composition

Canisteo soil and similar soils: 50 to 70 percent
Glencoe soil and similar soils: 30 to 50 percent
Contrasting inclusions: 0 to 15 percent

Setting

Landform and position on the landform: Canisteo—nearly level areas and the rims of depressions on ground moraines; Glencoe—depressions on ground moraines

Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 1,100 acres

Typical Profile

Canisteo

0 to 10 inches—black, friable, calcareous clay loam
10 to 22 inches—very dark gray, friable, calcareous clay loam
22 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Glencoe

0 to 10 inches—black, friable silty clay loam
10 to 20 inches—black, friable, mottled silty clay loam
20 to 28 inches—very dark gray, friable, mottled clay loam
28 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Canisteo—poorly drained; Glencoe—very poorly drained
Permeability: Canisteo—moderate; Glencoe—moderately slow or moderate in the upper part, moderate in the lower part
Available water capacity: Canisteo—high; Glencoe—very high
Organic matter content: Canisteo—high; Glencoe—high or very high
Surface runoff: Canisteo—slow; Glencoe—ponded
Depth to water table: Canisteo—1 to 3 feet; Glencoe—1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Crippin soils, which are in the higher landscape positions
• The moderately well drained and somewhat poorly drained Le Sueur or Nicollet soils, which are in the higher landscape positions

Similar soils:
• Soils that have bands of sandy and silty sediment in the lower part
• Soils that have a few gypsum crystals on or near the surface
• Soils that are similar to the Canisteo soil but have a surface layer and subsoil that are leached of free lime

Use and Management

Cropland

Major management factors: Canisteo—drainage, high pH; Glencoe—drainage, ponding, clay content
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.
• If worked when wet, the soils become compacted and cloddy.

Interpretive Groups

Land capability classification: Canisteo—IIw; Glencoe—IIIw
Windbreak suitability group: Canisteo—2K; Glencoe—2W

960D2—Storden-Clarion complex, 12 to 18 percent slopes, eroded

Composition

Storden soil and similar soils: 35 to 65 percent
Clarion soil and similar soils: 35 to 55 percent
Contrasting inclusions: 0 to 10 percent

Setting

Landform and position on the landform: Hilly side slopes on ground moraines
Shape of areas: Irregular
Size of areas: 4 to 20 acres
Slope length: 75 to 150 feet

Typical Profile

Storden

0 to 9 inches—dark grayish brown, friable, calcareous loam
9 to 24 inches—yellowish brown, friable, calcareous loam
24 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Clarion

0 to 8 inches—very dark grayish brown, friable loam
8 to 17 inches—dark yellowish brown, friable loam
17 to 25 inches—yellowish brown, friable loam
25 to 35 inches—yellowish brown, friable, calcareous loam
35 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Storden—moderately low; Clarion—moderate

Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in drainageways
• The moderately well drained Terril soils, which are on foot slopes
• Soils that have small pockets of sand and gravel

Similar soils:
• Soils that are similar to the Clarion soil but in which erosion has removed most of the original darkened surface layer and exposed the subsoil
• Soils that are similar to the Clarion soil but are shallow to free lime

Use and Management

Cropland

Major management factors: Storden and Clarion—slope, eroded surface; Storden—organic matter content
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• If water erosion is not controlled, more fertilizer is needed, productivity is lower, and crop yields are reduced.

Interpretive Groups

Land capability classification: IVe
Windbreak suitability group: Storden—8; Clarion—3

960F—Storden-Clarion complex, 18 to 50 percent slopes

Composition

Storden soil and similar soils: 45 to 70 percent
Clarion soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Steep and very steep side slopes on ground moraines
Shape of areas: Irregular or elongated
Size of areas: 6 to 200 acres
Slope length: 75 to 150 feet

Typical Profile

Storden

0 to 6 inches—dark grayish brown, friable, calcareous loam
6 to 60 inches—yellowish brown, friable, calcareous loam

Clarion

0 to 9 inches—black, friable loam
9 to 16 inches—brown, friable loam
16 to 24 inches—brown, friable, calcareous loam
24 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Storden—moderately low; Clarion—moderate or high
Surface runoff: Rapid
Depth to water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils, which are in drainageways
• The excessively drained Hawick soils, which are in landscape positions similar to those of the Storden and Clarion soils and are sandy
• The moderately well drained Terril soils, which are on foot slopes

Similar soils:
• Soils that have fine sandy loam or sandy loam in the lower part
• Soils that are similar to the Clarion soil but are shallow to free lime

Use and Management

Pasture

Major management factors: Storden and Clarion—slope; Storden—organic matter content
Management measures:
• Adjusting stocking rates, especially on the steeper slopes, helps to keep the pasture in good condition.

Interpretive Groups

Land capability classification: VIIe
Windbreak suitability group: Storden—8; Clarion—3

978—Cordova-Rolfe complex

Composition

Cordova soil and similar soils: 50 to 75 percent
Rolfe soil and similar soils: 20 to 40 percent
Contrasting inclusions: 2 to 10 percent

Figure 11.—A typical area of Cordova-Rolfe complex. The Cordova soil is adjacent to the lighter colored Rolfe soil.

Setting

Landform and position on the landform: Cordova—nearly level areas on ground moraines; Rolfe—depressions on ground moraines (fig. 11)
Slope range: Cordova—0 to 2 percent; Rolfe—0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Typical Profile

Cordova

0 to 17 inches—black, friable clay loam
17 to 22 inches—very dark grayish brown, firm, mottled clay loam
22 to 33 inches—olive gray, firm, mottled clay loam
33 to 41 inches—grayish brown, firm, mottled clay loam
41 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Rolfe

0 to 10 inches—black, friable silt loam
10 to 17 inches—dark gray, friable silt loam
17 to 26 inches—very dark gray, firm clay
26 to 36 inches—dark gray, firm silty clay
36 to 47 inches—olive gray, friable, mottled clay loam
47 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Cordova—poorly drained; Rolfe—very poorly drained
Permeability: Cordova—moderately slow in the upper part, moderate in the lower part; Rolfe—moderate to slow in the upper part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: Cordova—high; Rolfe—moderate or high
Surface runoff: Cordova—slow; Rolfe—ponded or very slow
Depth to water table: Cordova—1 to 3 feet; Rolfe—1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The moderately well drained and somewhat poorly drained Le Sueur and Nicollet soils, which are in the higher landscape positions

Similar soils:
• Soils that have a dark surface layer more than 24 inches thick and less clay in the subsoil
• Soils that have more clay throughout
• Soils that have free lime throughout

Use and Management

Cropland

Major management factors: Cordova and Rolfe—drainage, low pH, high clay content; Rolfe—ponding
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• In areas where the surface layer and subsoil are moderately acid, alfalfa responds well to applications of lime.
• If worked when wet, the soils become compacted and cloddy.

Interpretive Groups

Land capability classification: Cordova—IIw; Rolfe—IIIw
Windbreak suitability group: 2

1030—Udorthents-Pits, gravel, complex

Description of areas: Active or abandoned areas used as sand and gravel pits, some of which are covered with excavated soil material, stockpiles of sand and gravel, waste material, and ponds (fig. 12)
Shape of areas: Irregular
Size of areas: 3 to 250 acres
Use and management:
• If reclaimed, areas of this unit are suited to many uses. Reclamation, however, generally requires extensive filling and grading.
• Some areas can be reclaimed for agricultural uses if loamy topsoil is stockpiled.

Figure 12.—An area of Udorthents-Pits, gravel, complex. The very steep, unvegetated side slopes are highly susceptible to erosion.

• Some areas are suitable for commercial, industrial, or residential development.
• Wildlife habitat or recreational areas can be developed by revegetating areas near the ponds.
• Onsite investigation is needed to determine the potential and limitations of areas for specific uses.
Interpretive groups: Not assigned

1075—Klossner and Muskego soils, ponded

Composition

Klossner soil and similar soils: 40 to 65 percent
Muskego soil and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions on ground moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular or circular
Size of areas: 5 to 500 acres

Typical Profile

Klossner

0 to 40 inches—black, friable muck
40 to 44 inches—dark gray, friable, calcareous loam
44 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Muskego

0 to 35 inches—black, friable, calcareous muck
35 to 60 inches—very dark gray, friable, mottled, calcareous mucky silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Klossner—moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part; Muskego—moderately slow to moderately rapid in the upper part, moderate in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Depth to water table: 3 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Harps and Canisteo soils, which are on the rims of depressions
• The very poorly drained, depressional Canisteo soils, which are in landscape positions similar to those of the Klossner and Muskego soils and formed in loamy material
• The poorly drained Essexville soils, which are on the borders of depressions or on sandbars that extend into the depressions
• The very poorly drained Glencoe soils, which are in landscape positions similar to those of the Klossner and Muskego soils and formed in loamy material
• The very poorly drained Okoboji soils, which are in landscape positions similar to those of the Klossner and Muskego soils and formed in clayey material
• Very poorly drained soils that are in landscape positions similar to those of the Klossner and Muskego soils and formed in sandy material more than 40 inches thick

Similar soils:
• Soils that have a surface layer of muck less than 16 inches thick
• Soils that are similar to the Muskego soil but have coprogenous material at or near the surface

Use and Management

Habitat for wetland wildlife

Major management factors: Ponding
Potential for habitat elements: Good (fig. 13)
Management measures:
• Adapted plant species that provide food and cover for wildlife should be established, and food plots should be maintained nearby.

Interpretive Groups

Land capability classification: VIIIw
Windbreak suitability group: Not assigned

1083—Le Sueur-Urban land complex

Composition

Le Sueur soil and similar soils: 45 to 65 percent
Urban land: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Le Sueur—nearly level areas and slightly convex slopes on ground moraines; Urban land—gently undulating areas covered by paved roads, parking lots, and buildings in and around the city of North Mankato
Shape of areas: Irregular
Size of areas: 20 to 150 acres

Typical Profile

Le Sueur

0 to 12 inches—black, friable clay loam
12 to 15 inches—very dark gray, friable clay loam
15 to 30 inches—dark grayish brown, firm, mottled clay loam

Figure 13.—An area of Klossner and Muskego soils, ponded. This map unit provides good habitat for wetland wildlife.

30 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Le Sueur—moderately well drained and somewhat poorly drained
Permeability: Le Sueur—moderate
Available water capacity: Le Sueur—high
Organic matter content: Le Sueur—moderate
Surface runoff: Le Sueur—slow or medium
Depth to water table: Le Sueur—2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils, which are in the slightly lower landscape positions
• The well drained Lester soils, which are in the more sloping areas

Similar soils:
• Soils that have less clay in the subsoil
• Soils having a surface layer that is thinner or lighter colored
• Soils that have more clay

Use and Management

Major use: Urban development

Interpretive Groups

Land capability classification: Not assigned
Windbreak suitability group: Le Sueur—1

1901B—Le Sueur-Lester complex, 1 to 6 percent slopes

Composition

Le Sueur soil and similar soils: 45 to 65 percent
Lester soil and similar soils: 20 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Le Sueur—nearly level areas and slightly convex slopes on ground moraines; Lester—convex slopes on ground moraines
Slope range: Le Sueur—1 to 3 percent; Lester—2 to 6 percent
Slope length: 75 to 150 feet
Shape of areas: Irregular
Size of areas: 5 to 80 acres

Typical Profile

Le Sueur

0 to 15 inches—black, friable clay loam
15 to 24 inches—dark grayish brown, firm clay loam
24 to 37 inches—dark grayish brown, firm, mottled clay loam
37 to 60 inches—gray, friable, mottled, calcareous loam

Lester

0 to 8 inches—very dark brown, friable loam
8 to 25 inches—dark yellowish brown, firm clay loam
25 to 60 inches—light olive brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Le Sueur—moderately well drained and somewhat poorly drained; Lester—well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Le Sueur—slow; Lester—slow or medium
Depth to water table: Le Sueur—2 to 4 feet; Lester—more than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils, which are in the lower landscape positions
• The well drained Storden soils, which are on the steeper slopes and have a dark surface layer less than 7 inches thick

Similar soils:
• Soils that are similar to the Le Sueur soil but have a dark surface layer more than 24 inches thick
• Soils that have thin, variable layers of sandy and gravelly material
• Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Slope, low pH
Management measures:
• Chiseling the stubble field on the contour or across the slope, establishing terraces, diversions, and grassed waterways, and including high-residue crops in the rotation reduce the hazard of water erosion.
• In areas where the surface layer and subsoil are moderately acid, alfalfa responds well to applications of lime.

Interpretive Groups

Land capability classification: Le Sueur—I; Lester—IIe
Windbreak suitability group: Le Sueur—1; Lester—3

1917—Nishna silty clay, ponded

Composition

Nishna soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Backswamps on flood plains
Slope range: 0 to 1 percent
Shape of areas: Irregular or elongated
Size of areas: 4 to 80 acres

Typical Profile

0 to 20 inches—black, friable, calcareous silty clay
20 to 35 inches—very dark gray, friable, calcareous silty clay
35 to 60 inches—dark gray, friable, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Slow
Available water capacity: Moderate
Organic matter content: High or very high
Surface runoff: Ponded
Depth to water table: 1 foot above to 1 foot below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• The poorly drained Millington soils, which are in the slightly higher landscape positions

Similar soils:
• Soils that have less clay and more sand
• Soils having a surface layer that is leached of free lime
• Soils that have a surface layer of silty clay

Use and Management

Habitat for wetland wildlife

Major management factors: Ponding

Potential for habitat elements: Good
Management measures:
• Adapted plant species that provide food and cover for wildlife should be established, and food plots should be maintained nearby.

Interpretive Groups

Land capability classification: VIw
Windbreak suitability group: 10

1931—Essexville sandy loam

Composition

Essexville soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Beach ridges on ground moraines
Slope range: 0 to 2 percent
Shape of areas: Elongated
Size of areas: 4 to 20 acres

Typical Profile

0 to 12 inches—black, friable, calcareous sandy loam
12 to 25 inches—dark grayish brown, very friable, mottled, calcareous loamy fine sand
25 to 35 inches—grayish brown, friable, mottled, calcareous silty clay loam
35 to 60 inches—grayish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid or rapid in the upper part, moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Very slow
Depth to water table: 0 to 1 foot

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo soils, which are in landscape positions similar to those of the Essexville soil and are loamy throughout
• The very poorly drained Glencoe soils, which are in the lower landscape positions and are subject to ponding
• Poorly drained soils that are in landscape positions similar to those of the Essexville soil but have cobbles, stones, and boulders on the surface

Similar soils:
• Soils that have gravelly material in the surface layer
• Soils that have sandy material to a depth of 60 inches
• Soils that have a dark surface layer less than 8 inches thick

Use and Management

Cropland

Major management factors: Drainage, soil blowing, high pH
Management measures:
• Most suitable crops can be grown if adequate drainage is provided.
• Crop varieties that tolerate a high content of lime should be selected to avoid chlorosis.
• Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of soil blowing.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2K

1999—Minneiska-Kalmarville complex, frequently flooded

Composition

Minneiska soil and similar soils: 40 to 60 percent
Kalmarville soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Minneiska—nearly level areas on flood plains; Kalmarville—meander belts and nearly level areas on flood plains
Slope range: Minneiska, 0 to 2 percent; Kalmarville, 0 to 1 percent
Shape of areas: Irregular or elongated
Size of areas: 10 to 150 acres

Typical Profile

Minneiska

0 to 10 inches—very dark brown, very friable, calcareous sandy loam
10 to 60 inches—very dark grayish brown, black, and brown, very friable, calcareous, stratified silt loam, fine sandy loam, loamy fine sand, and sand

Kalmarville

0 to 46 inches—very dark gray, dark gray, and dark grayish brown, very friable, mottled, calcareous, stratified loam, silt loam, and loamy fine sand
46 to 60 inches—dark grayish brown, loose, calcareous sand

Soil Properties and Qualities

Drainage class: Minneiska—moderately well drained; Kalmarville—very poorly drained and poorly drained
Permeability: Minneiska—moderately rapid; Kalmarville—moderate or moderately rapid in the upper part, rapid in the lower part
Available water capacity: Minneiska—high; Kalmarville—moderate
Organic matter content: Moderate or high
Surface runoff: Minneiska—medium; Kalmarville—slow
Depth to water table: Minneiska—3 to 6 feet; Kalmarville—0 to 1 foot
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• The poorly drained Millington soils, which are nearly level, are finer textured throughout than the Minneiska and Kalmarville soils, and have a dark surface layer that is more than 24 inches thick
• The very poorly drained Oshawa soils, which are in abandoned river channels and oxbows
• The well drained Lester soils, which are on convex slopes on the flood plain along Little Rock Creek

Similar soils:
• Soils that have gravelly material in the lower part
• Soils having a surface layer that is leached of free lime

Use and Management

Pasture

Major management factors: Flooding, drainage
Management measures:
• Rotation grazing and mowing and clipping help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: Vw
Windbreak suitability group: Minneiska—1K; Kalmarville—2K

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 221,850 acres in the survey area, or nearly 74 percent of the total acreage, meets the soil requirements for prime farmland. Areas of this land are scattered throughout the county. Most of the acreage of prime farmland is used for crops. The main crops are corn and soybeans.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

By William J. Geary, district conservationist, Soil Conservation Service.

The general management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil in the section "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1988, approximately 229,000 acres in Nicollet County was cropland or pasture. Of a total of 223,000 acres of cropland, about 109,000 acres was used for corn; 75,000 acres for soybeans; 28,000 acres for oats, wheat, and other small grain; 8,500 acres for rotation hay; and 2,500 acres for sweet corn and sweet peas. During the last several years, the acreage used for corn and soybeans has increased as a result of the loss of woodland and a decrease in the number of dairy operations.

Few limitations affect crop production in areas of the Nicollet and Le Sueur soils. These soils are nearly level and are not significantly affected by erosion or wetness. They have a sufficient amount of available water for the major crops.

The gently undulating Clarion and Lester soils are deep and well drained. Such soils are subject to runoff and erosion. Using a system of conservation tillage that leaves a sufficient amount of crop residue on or near the surface increases the ability of the soils to absorb runoff and can keep soil losses within tolerable limits. In some areas, grassed waterways or terraces and a system of conservation tillage are needed to control runoff and erosion.

A subsurface drainage system is needed on wet soils used for crops, such as Canisteo, Webster, and Glencoe soils. Using a drainage system increases the depth of the root zone and helps to make all parts of the field accessible. A conservation tillage system and measures that maintain a high level of fertility are also needed on these soils.

On droughty soils, such as Dickinson, Dickman, and

Plainfield soils, irrigation is an effective method for increasing productivity. There is, however, very little irrigation in the county. Wind erosion is a serious problem on these soils. Field windbreaks, such as those west of St. Peter, and conservation tillage practices conserve moisture and help to prevent excessive soil loss.

Water erosion is generally high in areas that have rolling to steep soils. Clarion and Storden soils are the major soils in these areas. Conventional tillage methods, especially the use of a moldboard plow in the fall, are not suitable on these soils because they result in excessive soil loss. Conservation tillage is one of the most effective erosion-control methods that can be used on these soils. Other suitable conservation measures are grassed waterways, diversions, sediment-control basins, hay crops, and stripcropping. In areas that have long, uniform slopes, terraces and contour farming can be effective in reducing the hazard of water erosion.

The soils that are used as cropland on the low flood plains along the Minnesota River Valley and streams are poorly drained to moderately well drained. Many of these soils are quite productive, but they are occasionally or frequently flooded. Nishna, Millington, and Chaska soils are examples of soils on flood plains.

About 6,000 acres in the county is permanent pasture. Most of this acreage is not used as cropland because the soils are too steep or are flooded too frequently. Most of the pastureland is located on the steep slope of the Minnesota River Valley or in the low areas around the county's lakes. Many of the pastures are unmanaged and are often overgrazed. Existing pastures can be improved by applications of fertilizer, pasture rotation, deferment of grazing when the soil is wet, and weed control. In some areas the pasture can be renovated by reseeding to more productive plant species. Species selection should be based on the soil type and drainage conditions.

The deep, well drained to somewhat poorly drained soils, such as Clarion, Le Sueur, and Nicollet soils, are suited to the widest range of plant species, including alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, orchardgrass, Kentucky bluegrass, and reed canarygrass. They are well suited to warm-season grasses, including big bluestem, indiangrass, and switchgrass, which can be grazed during July and August. The poorly drained Canisteo, Delft, and Webster soils also are well suited to these cool- and warm-season species.

Unless a drainage system is installed, the very poorly drained Blue Earth, Okoboji, and Klossner soils are suited only to plant species that can tolerate wet conditions, such as reed canarygrass, creeping foxtail, redtop, birdsfoot trefoil, alsike clover, and ladino clover. If a drainage system is installed, the soils also are suitable for timothy, smooth bromegrass, Kentucky bluegrass, and red clover.

Well drained to excessively drained soils, including Dickinson, Estherville, Dickman, and Plainfield soils, generally produce forage in spring, early summer, and fall, when precipitation is adequate. During the summer months, droughty conditions limit production. Alfalfa, red clover, birdsfoot trefoil, smooth bromegrass, orchardgrass, timothy, Kentucky bluegrass, and intermediate wheatgrass grow well if an adequate moisture supply is available. The soils are well suited to warm-season grasses, including big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama. If proper grazing management is applied, these species provide good forage during the summer. If grown along with cool-season species, they help to provide a full season of forage production.

Current information about variety selection and species adaptation can be obtained from the Nicollet County Cooperative Extension Service or the Soil Conservation Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in

the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Windbreaks have been planted since the days of the early settlers to protect both farmsteads and livestock. They have been planted to control soil blowing since the 1930's, and in recent years they have been planted to trap snow and thus increase the moisture supply. Controlling weeds around new windbreaks helps to achieve maximum growth and survival rates.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

The soils in Nicollet County are assigned to 11 different windbreak suitability groups. The paragraphs that follow describe these windbreak suitability groups. Site preparation on soils that are subject to severe water erosion should be limited to spot treatment extending 2 feet from where a plant is established.

Windbreak suitability group 1.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. These soils are moderately permeable. They generally do not have free carbonates in the upper part.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 1K.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderate or moderately rapid in these soils. The soils generally have free carbonates in the upper part. This group also includes moderately well drained and somewhat poorly drained soils that are subject to flooding. Flooding is occasional or frequent for brief to long periods in spring or after heavy or prolonged periods of rain.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2K.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained. They generally have free carbonates in the upper part. This group also includes poorly drained soils that are subject to flooding. Flooding is occasional or frequent for brief periods in spring or after prolonged periods of rain.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Because of the wetness, the seedling mortality rate is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2(O).—This group consists dominantly of very poorly drained, depressional soils that have organic material more than 16 inches thick. These soils have been artificially drained.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2W.—This group consists dominantly of very poorly drained, depressional soils that are subject to ponding. These soils have been artificially drained.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 3.—This group consists dominantly of well drained, loamy soils. Permeability is moderate. The soils generally do not have free carbonates in the upper part.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 6G.—This group consists of well drained, loamy or clayey soils that have sand or sand and gravel at a depth of 20 to 40 inches. These soils have a low to moderate available water capacity.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Moisture stress caused by droughtiness can increase the seedling mortality rate. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 7.—This group consists dominantly of well drained to excessively drained soils that have a low available water capacity.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. The seedling mortality rate is moderate because of the moisture stress caused by droughtiness. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 8.—This group consists dominantly of well drained, loamy soils that have free carbonates.

The trees and shrubs grown as windbreaks and

environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 10.—This group consists dominantly of soils that generally are not suitable for windbreaks. One or more characteristics, such as soil depth, texture, wetness or ponding, available water capacity, or slope, limit the planting, survival, or growth of trees and shrubs. Onsite investigation may identify areas where trees and shrubs can be planted. Special management is needed in these areas.

The sloping to very steep soils in areas where slopes range from 12 to more than 45 percent are poorly suited to field and farmstead windbreaks but are well suited to trees and shrubs. Most areas of these soils are wooded and should be managed as woodland.

The wooded areas in Nicollet County generally are interspersed with fields and pasture. They most commonly are on stream bottoms, valley slopes, and uplands. The most common trees are basswood, American elm, green ash, maple, bur oak, red cedar, ironwood, black walnut, and cottonwood.

Competition from weeds is severe. Weeds should be controlled, but controlling them by cultivation increases the hazard of erosion. In areas that are too steep for cultivation, chemicals can be used. Because runoff is rapid, the soils in these areas have less favorable moisture conditions than other soils. Plantings are better suited to north- and east-facing slopes. Those on south- and west-facing slopes are exposed to direct sunlight and become too hot and dry.

Recreation

By William J. Geary, district conservationist, Soil Conservation Service.

The major recreational areas in Nicollet County are generally along the Minnesota River Valley and in the central part of the county around Swan Lake and Middle Lake. These areas provide opportunities for hunting, picnicking, hiking, cross-country skiing, trapping, golfing, snowmobiling, camping, fishing, and scenic viewing.

Fort Ridgely State Park is located in a wooded area at the west end of the county along Fort Ridgely Creek, which flows into the Minnesota River Valley. The area once served as an important military outpost around the time of the Civil War. The park contains the remains of the original fort as well as a historic cemetery. There are many hiking trails, picnic areas, camping sites, and natural scenic locations as well as a golf course.

A wildlife restoration project is attracting wildlife back to the county. The project encompasses about a third of the county, including over 12,000 acres of lakes, several state wildlife areas, and private wildlife developments. The Swan Lake Wildlife Area, in the central part of the county, is part of the restoration project and is a major hunting area in the county.

The Minnesota River Valley provides excellent areas for wildlife. Efforts to reestablish the wild turkey have been very successful, especially in the area between St. Peter and Mankato.

The Nicollet County Park at Seven Mile Creek provides hiking trails, picnic shelters, ball diamonds, and boat launch areas.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but

remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Catherine M. Fouchi, assistant area wildlife manager, Minnesota Department of Natural Resources, helped prepare this section.

The fertile soils in Nicollet County can support large wildlife populations. Hungarian partridge, pheasants, cottontail rabbits, squirrels, muskrats, raccoons, fox, waterfowl, and white-tailed deer are the most popular wildlife species for hunting or trapping. Numerous nongame species attract wildlife observers to the area.

At one time the county supported larger populations of pheasants, mallards, and other upland nesting species. Changing agricultural practices over the last three decades have led to a drastic decline in the populations of these species. Fence rows, odd areas, and pastures have been converted to row crops, reducing the number of nesting areas. Fall plowing has resulted in barren fields that are windswept and hold little snow. Drifting snow covers the available habitat in the winter. Many of the winter species, such as pheasants and Hungarian partridge, die as the winter progresses.

The county has lakes and wetlands that are 10 acres or more in size, and it is bound on three sides by the Minnesota River. Although these bodies of water are too shallow to support permanent fish populations, they provide fair to excellent waterfowl habitat.

Swan Lake covers 10,000 acres and is the largest prairie pothole marsh in North America. The Swan Lake and Middle Lake wetland complex is the center of a wildlife habitat restoration project that covers 150 square miles. The goals of the project include establishing 8,000 acres of upland and wetland habitat for wildlife in southeastern Nicollet County.

There are six wildlife management areas in the county, which make up a total of about 900 acres. The most common waterfowl species are mallard, blue-winged teal, wood duck, and Canada geese. Waterfowl populations have been declining steadily over the last two decades. This trend can be expected to continue as drainage of the wetlands and intensified agriculture continue to reduce the acreage of wetland and grassland habitat, which provide important nesting cover.

White-tailed deer are the only big game species in the county. The 1988 deer harvest was approximately 486 animals. An aerial census in January 1987 located 708 deer wintering in the county. Two major areas of deer concentration are the Swan Lake and Middle Lake complex and the Minnesota River Valley. These areas winter 129 and 411 deer, respectively. The drainages of Eight Mile Creek, Seven Mile Creek, and Barney Fry Creek, which empty into the Minnesota River, provide good to excellent winter habitat for deer. During the summer months, the deer disperse from the river valley and lake area into the farmland. The high-quality diet afforded by the agricultural areas keeps the deer in excellent health. Productivity is high. The average doe bears twin fawns, and a few have triplets or quadruplets.

The application of conservation measures that minimize soil blowing and the drifting of snow into areas of wildlife habitat can increase wildlife populations. In areas where field windbreaks have been established, winter losses of wildlife are less severe than in the more open areas of the county.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or

by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are timothy, orchardgrass, bromegrass, birdsfoot trefoil, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, quackgrass, and indiangrass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, hackberry, apple, hawthorn, dogwood, hickory, and black raspberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are plum, American elder, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, cedar, and eastern redcedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, reed canarygrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, wet meadows, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, red fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, swans, herons, grebes, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a

cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste

is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of

clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse

texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

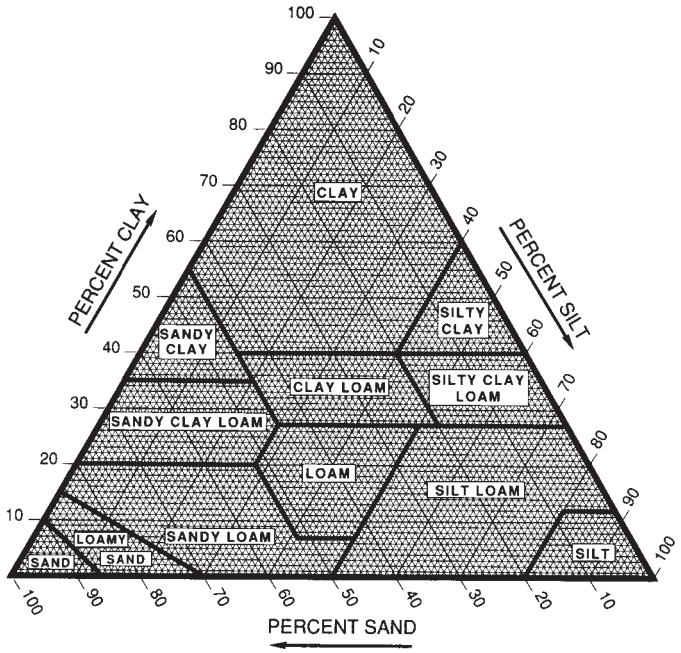

Figure 14.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 14). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 16 shows total subsidence, which usually results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and

is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(13)*. 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. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

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

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, depth 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 (calcareous), mesic Typic Haplaquolls.

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 underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(12)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(13)*. 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 of each soil series are described in the section "Detailed Soil Map Units."

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate

Landform: Depressions on ground moraines
Parent material: Coprogenous earth sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silt loam, 2,300 feet south and 1,700 feet west of the northeast corner of sec. 22, T. 110 N., R. 27 W.

Ap—0 to 8 inches; black (10YR 2/1) mucky silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; violent effervescence; slightly alkaline; abrupt smooth boundary.
C—8 to 60 inches; very dark gray (10YR 3/1) mucky silt loam; weak medium subangular blocky structure; very friable; common strong brown (7.5YR 5/6) iron stains in channels; strong effervescence; slightly alkaline.

Range in Characteristics

Content of shell fragments: 0 to 25 percent snail or clam shells, by volume, throughout the profile
Other characteristics: A Cg horizon of silt loam, loam, or silty clay loam in some pedons

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—mucky silt loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 or 4
Chroma—1 or 2
Texture—mucky silt loam, loam, silt loam, clay loam, or silty clay loam (coprogenous earth)

Brownton Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow in the upper part; moderately slow or moderate in the lower part
Landform: Ground moraines
Parent material: Lacustrine sediments overlying glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic (calcareous), mesic Typic Haplaquolls

Typical Pedon

Brownton silty clay, 2,500 feet south and 2,300 feet west of the northeast corner of sec. 15, T. 111 N., R. 27 W.

Ap—0 to 8 inches; black (N 2/0) silty clay, black (10YR 2/1) dry; moderate fine granular structure; firm; slight effervescence; slightly alkaline; abrupt smooth boundary.
A1—8 to 14 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; firm; slight effervescence; slightly alkaline; gradual smooth boundary.
A2—14 to 20 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; slight effervescence; slightly alkaline; gradual smooth boundary.
Bg—20 to 27 inches; olive gray (5Y 5/2) silty clay loam; few fine prominent olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; few very dark gray (10YR 3/1) streaks on faces of peds; strong effervescence; moderately alkaline; gradual wavy boundary.
Cg1—27 to 41 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent olive brown (2.5Y 4/4) mottles; massive; firm; strong effervescence; moderately alkaline; gradual wavy boundary.
2Cg2—41 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent olive brown (2.5Y 4/4) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; about 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—silty clay

A horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—1 or 2
Texture—silty clay, clay, or silty clay loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam, clay, or silty clay

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2
Texture—silty clay loam, silty clay, or clay

2Cg horizon:
Hue—2.5Y or 5Y

Value—4 to 6
Chroma—2
Texture—clay loam or loam
Content of gravel—2 to 8 percent

Canisteo Series

Depth class: Very deep
Drainage class: Very poorly drained and poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Canisteo clay loam, 300 feet south and 1,100 feet west of the northeast corner of sec. 24, T. 111 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common very fine roots; about 2 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

A—9 to 20 inches; very dark gray (N 3/0) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common very fine roots; about 3 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkg—20 to 26 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; common light brownish gray (10YR 6/2) calcium carbonate coatings on faces of peds; few olive gray (5Y 4/2) streaks on faces of peds; about 3 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg1—26 to 40 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; few very fine roots; about 4 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—40 to 60 inches; light brownish gray (2.5Y 6/2) loam; many medium prominent yellowish brown (10YR 5/6) and common fine prominent pale red (2.5YR 6/2) mottles; massive; friable; few very fine roots; about 4 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 14 to 24 inches
Content of rock fragments: 2 to 8 percent gravel, by volume, throughout the profile
Other characteristics: A Bg horizon in some pedons

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or silty clay loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or silty clay loam

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, loam, silty clay loam, or sandy loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam, loam, or fine sandy loam

Chaska Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part; moderately slow to moderately rapid in the lower part
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Aeric Fluvaquents

Typical Pedon

Chaska loam, 1,300 feet north and 600 feet east of the southwest corner of sec. 10, T. 111 N., R. 26 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; slight effervescence; slightly alkaline; clear smooth boundary.

Cg1—9 to 35 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) loam that has strata of silt loam, fine sandy loam, and silty clay loam; many fine distinct dark brown (7.5YR 3/2), common faint gray (10YR 5/1), and common fine prominent dark reddish brown (5YR 3/4) mottles; massive; very friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—35 to 60 inches; stratified gray (10YR 5/1) and dark gray (10YR 4/1) silt loam and silty clay loam; many fine prominent dark brown (7.5YR 3/2), common prominent olive brown (2.5Y 4/4), and common fine prominent dark reddish brown (5YR 3/4) mottles; massive; friable; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 5
Chroma—1 or 2
Texture—stratified loam, silt loam, fine sandy loam, fine sand, or silty clay loam (average content of clay is more than 18 percent)

Clarion Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 2 to 50 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Clarion loam, 2 to 6 percent slopes, 200 feet north and 300 feet east of the southwest corner of sec. 22, T. 111 N., R. 28 W.

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

A—10 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 3 percent gravel; slightly acid; clear smooth boundary.

Bw1—13 to 21 inches; dark brown (10YR 4/3) clay loam; weak medium and fine subangular blocky structure; friable; about 3 percent gravel; moderately acid; clear smooth boundary.

Bw2—21 to 39 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; about 4 percent gravel; moderately acid; clear smooth boundary.

C—39 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct olive yellow (2.5Y 6/6) and few fine distinct grayish brown (2.5Y 5/2) mottles; massive; friable; few light gray (10YR 7/1) streaks of calcium carbonate; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 50 inches
Thickness of the mollic epipedon: 8 to 20 inches
Content of rock fragments: 2 to 8 percent gravel, by volume, throughout the profile
Other characteristics: A BC horizon in some pedons

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

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

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or sandy loam

The Clarion soil in map units 920C2, 921C2, and 960D2 has a mollic epipedon that is thinner than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Copaston Series

Depth class: Very shallow and shallow
Drainage class: Well drained
Permeability: Moderate in the upper part; moderate or moderately rapid in the lower part
Landform: Terraces and uplands
Parent material: Alluvium or glacial drift overlying limestone bedrock
Slope range: 1 to 60 percent
Taxonomic class: Loamy, mixed, mesic Lithic Hapludolls

Typical Pedon

Copaston loam, 1 to 6 percent slopes, 100 feet south and 1,750 feet east of the northwest corner of sec. 9, T. 108 N., R. 28 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium granular structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

AB—7 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw—14 to 19 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

2R—19 inches; fractured limestone bedrock.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 14 inches
Depth to bedrock: 8 to 20 inches
Content of rock fragments: 0 to 15 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

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

R horizon:
Fractured limestone bedrock, Sioux quartzite, gneiss, or sandstone

Cordova Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow in the upper part; moderate in the lower part
Landform: Ground moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Cordova clay loam, 2,500 feet south and 1,700 feet east of the northwest corner of sec. 30, T. 110 N., R. 26 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; about 1 percent gravel; neutral; abrupt smooth boundary.

A—8 to 14 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine distinct dark grayish brown (2.5Y 4/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; about 2 percent gravel; slightly acid; clear wavy boundary.

Btg1—14 to 20 inches; olive gray (5Y 4/2) clay loam; common fine faint dark gray (5Y 4/1) and common fine prominent olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; common prominent very dark gray (10YR 3/1) clay films in channels; about 2 percent gravel; slightly acid; gradual wavy boundary.

Btg2—20 to 30 inches; olive gray (5Y 5/2) clay loam; common fine prominent dark brown (7.5YR 4/4) and common fine distinct dark gray (5Y 4/1) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; few prominent very dark gray (10YR 3/1) clay films in channels; about 2 percent gravel; slightly acid; gradual wavy boundary.

Cg—30 to 60 inches; olive gray (5Y 5/2) loam; common fine prominent dark brown (7.5YR 4/4) and common fine distinct olive brown (2.5Y 4/4) mottles; massive; friable; few white (10YR 8/2) threads of calcium carbonate; about 4 percent gravel and 1 percent cobbles; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 54 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of rock fragments: 2 to 6 percent gravel, by volume, throughout the profile
Other characteristics: A C horizon that is not gleyed in some pedons

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam

Btg horizon:
Hue—10YR, 5Y, or 2.5Y
Value—4 or 5
Chroma—1 or 2

Texture—clay loam or silty clay loam

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

Crippin Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Crippin loam, 1,475 feet north and 1,375 feet east of the southwest corner of sec. 29, T. 111 N., R. 29 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; common very fine roots; about 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few very fine roots; about 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Bw1—14 to 22 inches; dark grayish brown (2.5Y 4/2) clay loam; weak very fine subangular blocky structure; friable; few very fine roots; common black (10YR 2/1) streaks on faces of peds; about 2 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

Bw2—22 to 31 inches; olive brown (2.5Y 4/4) clay loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak very fine subangular blocky structure; friable; about 4 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg—31 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; friable; few calcium carbonate coatings in pores; about 6 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 12 to 20 inches
Content of rock fragments: 2 to 8 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam or clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam or loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

Delft Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Landform: Ground moraines
Parent material: Alluvium
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Delft clay loam, 1,250 feet south and 150 feet west of the northeast corner of sec. 2, T. 111 N., R. 29 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium granular structure parting to moderate fine granular; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—9 to 20 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; about 2 percent gravel; neutral; diffuse wavy boundary.

A2—20 to 36 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate medium subangular blocky; friable; about 2 percent gravel; slightly acid; diffuse wavy boundary.

A3—36 to 51 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak medium subangular

blocky; friable; about 2 percent gravel; slightly acid; clear wavy boundary.

Bg—51 to 60 inches; olive gray (5Y 4/2) clay loam; common medium prominent light olive brown (2.5Y 5/4) and common fine prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 60 inches
Thickness of the mollic epipedon: 24 to 60 inches
Content of rock fragments: 1 to 5 percent gravel, by volume, throughout the profile
Other characteristics: A Cg horizon in some pedons

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam, loam, or silty clay loam

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

Dickinson Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 0 to 6 percent
Taxonomic class: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickinson loam, 2 to 6 percent slopes, 400 feet south and 1,300 feet west of the northeast corner of sec. 18, T. 110 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

AB—9 to 16 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; common fine roots; slightly acid; gradual wavy boundary.

Bw—16 to 25 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; slightly acid; gradual wavy boundary.

BC—25 to 33 inches; dark yellowish brown (10YR 4/4) loamy fine sand; massive; very friable; few fine roots; slightly acid; gradual wavy boundary.

C—33 to 60 inches; brown (10YR 5/3) fine sand; single grain; loose; slightly acid.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 19 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam

AB horizon:
Hue—10YR
Value—3 or 4
Chroma—2 or 3
Texture—loam or sandy loam

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—fine sandy loam or sandy loam

BC horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy fine sand, loamy sand, fine sand, or sand

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—fine sand, loamy fine sand, or sand

Dickman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 0 to 6 percent
Taxonomic class: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickman sandy loam, 0 to 2 percent slopes, 900 feet south and 1,500 feet east of the northwest corner of sec. 20, T. 110 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

Bw—9 to 18 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; moderately acid; clear smooth boundary.

BC—18 to 45 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; slightly acid; gradual smooth boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 8 to 20 inches
Content of rock fragments: 0 to 15 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam

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

BC horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4
Texture—sand, fine sand, or coarse sand

C horizon:
Hue—7.5YR, 10YR, or 2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—sand

Du Page Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Du Page loam, 1,900 feet south and 950 feet east of the northwest corner of sec. 25, T. 111 N., R. 32 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few very fine roots; few dark grayish brown (10YR 4/2) concentrations on faces of peds; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—10 to 43 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few dark grayish brown (10YR 4/2) concentrations on faces of peds; slight effervescence; slightly alkaline; clear smooth boundary.

C—43 to 60 inches; very dark gray (10YR 3/1) loam; massive; friable; common fine prominent brown (7.5YR 4/4) mottles; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 24 to 60 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or silt loam

C horizon:
Hue—10YR
Value—3 or 4
Chroma—1 or 2
Texture—loam

Essexville Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid or rapid in the upper part; moderately slow in the lower part
Landform: Ground moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Sandy over loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Essexville sandy loam, 700 feet north and 700 feet east of the southwest corner of sec. 12, T. 110 N., R. 28 W.

A—0 to 12 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; many very fine roots; about 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bg—12 to 25 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; few fine prominent strong brown (7.5YR 5/6) mottles; weak very fine subangular blocky structure parting to single grain; very friable; few very fine roots; slight effervescence; slightly alkaline; clear smooth boundary.

2Cg1—25 to 35 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; few very fine roots; few calcium carbonate coatings in pores; strong effervescence; slightly alkaline; gradual smooth boundary.

2Cg2—35 to 60 inches; grayish brown (2.5Y 5/2) loam; many coarse prominent yellowish brown (10YR 5/8) and common medium prominent dark brown (7.5YR 4/4) mottles; massive; friable; about 2 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 8 to 14 inches
Content of rock fragments: 0 to 15 percent gravel, by volume, throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam

Bg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loamy fine sand or loamy sand

2Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—1 to 4
Texture—silty clay loam, clay loam, or loam

Estherville Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid or very rapid in the lower part
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 1 to 70 percent
Taxonomic class: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Estherville sandy loam, 1 to 6 percent slopes, 1,900 feet north and 300 feet east of the southwest corner of sec. 24, T. 111 N., R. 32 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; about 1 percent gravel; slightly acid; clear smooth boundary.

Bw—9 to 16 inches; dark yellowish brown (10YR 4/4) loam, dark brown (7.5YR 4/4) dry; weak fine subangular blocky structure; friable; few very fine roots; about 3 percent gravel; moderately acid; gradual smooth boundary.

2BC—16 to 23 inches; dark yellowish brown (10YR 3/4) gravelly loamy coarse sand, dark brown (7.5YR 4/4) dry; single grain; loose; few very fine roots; about 30 percent gravel; neutral; clear smooth boundary.

2C—23 to 60 inches; dark brown (10YR 4/3) gravelly coarse sand; single grain; loose; about 35 percent gravel and 5 percent cobbles; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Thickness of the mollic epipedon: 9 to 20 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of gravel—0 to 15 percent

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—loam, sandy loam, or coarse sandy loam
Content of gravel—0 to 15 percent

2BC horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—2 to 4
Texture—gravelly loamy coarse sand
Content of gravel—15 to 35 percent

2C horizon:
Hue—10YR
Value—4 to 7
Chroma—2 to 4

Texture—gravelly coarse sand, coarse sand, sand, or loamy coarse sand
Content of gravel—10 to 35 percent

Glencoe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow or moderate in the upper part; moderate in the lower part
Landform: Depressions on ground moraines
Parent material: Alluvium
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Glencoe silty clay loam, 200 feet north and 700 feet west of the southeast corner of sec. 12, T. 111 N., R. 31 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; few very fine roots; neutral; abrupt smooth boundary.

A—10 to 27 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

ABg—27 to 38 inches; very dark gray (5Y 3/1) clay loam; moderate fine subangular blocky structure; friable; very dark gray (10YR 3/1) streaks on faces of peds; about 2 percent gravel; slightly acid; gradual smooth boundary.

Cg—38 to 60 inches; olive gray (5Y 5/2) loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; iron stains in channels; about 6 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 24 to 46 inches
Other characteristics: A Bg horizon in some pedons

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam
Content of gravel—0 to 5 percent

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or clay loam
Content of gravel—0 to 5 percent

ABg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam
Content of gravel—0 to 8 percent

Cg or C horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam
Content of gravel—2 to 8 percent

Harps Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mesic Typic Calciaquolls

Typical Pedon

Harps clay loam, 900 feet south and 3,400 feet west of the northeast corner of sec. 36, T. 111 N., R. 29 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—10 to 19 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; disseminated lime; about 3 percent gravel; violent effervescence; moderately alkaline; clear smooth boundary.

ABk—19 to 23 inches; very dark gray (5Y 3/1) clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; disseminated lime; about 3 percent gravel; violent effervescence; moderately alkaline; clear smooth boundary.

Bkg—23 to 31 inches; grayish brown (2.5Y 5/2) clay loam, light gray (10YR 7/1) dry; few fine prominent yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; disseminated lime; about 4 percent gravel; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg—31 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 5

percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 11 to 24 inches
Content of rock fragments: 1 to 5 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

Ak horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or loam

ABk horizon:
Hue—10YR, 5Y, or neutral
Value—3
Chroma—0 or 1
Texture—clay loam or loam

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—clay loam, loam, or sandy clay loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—clay loam, loam, or sandy clay loam

Hawick Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part; rapid or very rapid in the lower part
Landform: Terraces and ground moraines
Parent material: Glacial outwash
Slope range: 2 to 70 percent
Taxonomic class: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Hawick sandy loam, 18 to 70 percent slopes, 1,500 feet north and 2,675 feet east of the southwest corner of sec. 9, T. 109 N., R. 29 W.

A—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; common fine roots; about 9 percent gravel; slight effervescence; slightly alkaline; gradual smooth boundary.

Bw—9 to 19 inches; dark brown (10YR 4/3) gravelly coarse sand; single grain; loose; few very fine roots; about 17 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

C—19 to 60 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; about 8 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 30 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 5 to 35 percent gravel, by volume, throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—sandy loam

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—gravelly coarse sand, loamy sand, coarse sand, or gravelly loamy coarse sand

C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—coarse sand, sand, or gravelly coarse sand

Joliet Series

Depth class: Shallow
Drainage class: Poorly drained
Permeability: Moderate
Landform: Terraces
Parent material: Alluvium or glacial drift overlying limestone bedrock
Slope range: 0 to 2 percent
Taxonomic class: Loamy, mixed, mesic Lithic Haplaquolls

The Joliet soils in Nicollet County are taxadjuncts to the series because they have free carbonates throughout. This difference, however, does not alter the use and management of the soils.

Typical Pedon

Joliet silty clay loam, 2,100 feet north and 1,700 feet west of the southeast corner of sec. 34, T. 109 N., R. 28 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular

blocky structure parting to weak fine granular; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bg—9 to 17 inches; very dark gray (10YR 3/1) silty clay loam; common medium prominent dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; clear wavy boundary.

2Cg—17 to 20 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/6) and common fine prominent dark grayish brown (10YR 4/2) mottles; massive; friable; about 5 percent gravel and 10 percent limestone channers; strong effervescence; slightly alkaline; clear wavy boundary.

2R—20 inches; fractured limestone bedrock.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 10 to 17 inches
Depth to bedrock: 10 to 20 inches

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

Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5
Chroma—0 to 2
Texture—silty clay loam, silt loam, or loam
Content of gravel—0 to 6 percent

2Cg horizon:
Texture—fine sandy loam
Content of limestone channers—0 to 10 percent
Content of gravel—3 to 5 percent

Kalmarville Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderate or moderately rapid in the upper part; rapid in the lower part
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents

The Kalmarville soils in Nicollet County are taxadjuncts to the series because they have free carbonates throughout. This difference, however, does not alter the use and management of the soils.

Typical Pedon

Kalmarville loam, in an area of Minneiska-Kalmarville complex, frequently flooded; 1,400 feet south and 1,800 feet east of the northwest corner of sec. 4, T. 110 N., R. 26 W.

A—0 to 46 inches; very dark gray (10YR 3/1) loam that has many fine strata of dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silt loam and loamy fine sand; common fine prominent dark reddish brown (5YR 3/4) and common fine prominent dark brown (7.5YR 4/4) mottles; weak very thin platy structure; very friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

2C—46 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loam
Content of gravel—0 to 5 percent

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 or 2
Texture—sand, loamy sand, or coarse sand
Content of gravel—0 to 10 percent

Kasota Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow in the upper part; rapid in the lower part
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic class: Clayey over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls

Typical Pedon

Kasota loam, 2,500 feet south and 200 feet east of the northwest corner of sec. 9, T. 110 N., R. 26 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak and moderate fine granular structure; friable; neutral; abrupt smooth boundary.

AB—10 to 14 inches; very dark grayish brown (10YR

3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bt1—14 to 20 inches; dark brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; common faint dark brown (10YR 4/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—20 to 26 inches; dark yellowish brown (10YR 4/4) clay; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; few faint dark brown (10YR 4/3) clay films on faces of peds; moderately acid; clear smooth boundary.

Bt3—26 to 33 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few faint dark brown (10YR 4/3) clay films on faces of peds; slightly acid; clear smooth boundary.

2C—33 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches
Thickness of the mollic epipedon: 9 to 18 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of gravel—0 to 10 percent

AB horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or silt loam
Content of gravel—0 to 10 percent

Bt horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—clay, silty clay, clay loam, or silty clay loam

2C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 5
Texture—sand or coarse sand
Content of gravel—0 to 15 percent

Klossner Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; moderately slow or moderate in the lower part
Landform: Depressions on ground moraines
Parent material: Muck overlying glacial till
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic, mesic Terric Medisaprists

Typical Pedon

Klossner muck, 2,600 feet north and 2,300 feet east of the southwest corner of sec. 12, T. 110 N., R. 28 W.

Op—0 to 10 inches; black (N 2/0) muck, very dark gray (10YR 3/1) dry; about 20 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; friable; many very fine roots; moderately acid; abrupt smooth boundary.

Oa—10 to 26 inches; black (10YR 2/1) muck, dark gray (10YR 4/1) dry; about 60 percent fiber, about 6 percent rubbed; weak fine subangular blocky structure; very friable; many very fine roots; moderately acid; gradual smooth boundary.

2A1—26 to 36 inches; black (N 2/0) mucky silty clay loam; weak medium subangular blocky structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

2A2—36 to 48 inches; black (N 2/0) silty clay loam; massive; friable; few dark reddish brown (2.5YR 3/4) iron oxide stains in root channels; about 1 percent gravel; neutral; gradual wavy boundary.

2Cg—48 to 60 inches; olive gray (5Y 5/2) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; dark yellowish brown (10YR 3/4) iron oxide stains in root channels; about 1 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to loamy material: 16 to 50 inches

Op horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—muck

Oa horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—muck

2A1 horizon:
Hue—2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Texture—mucky silt loam, mucky silty clay loam, silty clay loam, clay loam, or loam

2A2 horizon:
Hue—2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—silty clay loam, silt loam, loam, or clay loam

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—silty clay loam, loam, silt loam, or clay loam

Lester Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 2 to 70 percent
Taxonomic class: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Lester loam, 2 to 6 percent slopes, 100 feet south and 2,300 feet west of the northeast corner of sec. 2, T. 110 N., R. 27 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 16 inches; dark brown (10YR 4/3) clay loam; moderate medium and fine subangular blocky structure; firm; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bt2—16 to 40 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium and fine subangular blocky structure; friable; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 4 percent gravel; slightly acid; clear smooth boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; common light gray (10YR 7/1) streaks of calcium carbonate; 6 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 54 inches
Content of rock fragments: 2 to 8 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bt horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—clay loam or loam

C horizon:
Hue—2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—clay loam or loam

Le Sueur Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Le Sueur clay loam, 2,170 feet south and 950 feet east of the northwest corner of sec. 11, T. 110 N., R. 27 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; many roots; about 2 percent gravel; neutral; abrupt smooth boundary.

AB—9 to 15 inches; black (10YR 2/1) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common roots; about 2 percent gravel; neutral; clear wavy boundary.

Bt1—15 to 23 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine faint olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; firm; common roots; many black (10YR 2/1) organic coatings on faces of peds; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt2—23 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; firm; few roots; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Cg—32 to 60 inches; olive gray (5Y 4/2) clay loam; many medium prominent light olive brown (2.5Y 5/6) mottles; massive; friable; few white (5Y 8/1) threads of calcium carbonate; about 2 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 55 inches
Thickness of the mollic epipedon: 10 to 18 inches
Content of rock fragments: 2 to 8 percent gravel, by volume, throughout the profile
Other characteristics: A BC horizon in some pedons

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam

AB horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam or loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay loam, loam, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam or loam

Marna Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow in the upper part; moderately slow or moderate in the lower part
Landform: Ground moraines
Parent material: Lacustrine sediments overlying glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Haplaquolls

Typical Pedon

Marna silty clay loam, 2,200 feet north and 900 feet west of the southeast corner of sec. 12, T. 111 N., R. 27 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; neutral; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; firm; few very fine roots; neutral; clear smooth boundary.

Bg1—16 to 21 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine prismatic structure parting to weak fine angular blocky; firm; few very fine roots; very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg2—21 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to weak medium angular blocky; firm; common very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; gradual smooth boundary.

2BCg—25 to 39 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few streaks of calcium carbonate; about 5 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

2Cg—39 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6) and few fine distinct gray (10YR 5/1) mottles; massive; friable; few streaks of calcium carbonate; about 8 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 35 inches
Thickness of the mollic epipedon: 16 to 24 inches
Other characteristics: A Bkg horizon in some pedons

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—silty clay loam
Content of gravel—0 to 2 percent

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3

Chroma—0 to 2
Texture—silty clay loam or silty clay
Content of gravel—0 to 2 percent

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

2BC horizon:
Hue—2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of gravel—2 to 8 percent

2Cg horizon:
Hue—2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of gravel—2 to 8 percent

Millington Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Cumulic Haplaquolls

Typical Pedon

Millington clay loam, 1,500 feet south and 1,200 feet east of the northwest corner of sec. 15, T. 111 N., R. 32 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

A—8 to 31 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Bg—31 to 43 inches; very dark gray (10YR 3/1) clay loam; weak fine subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Cg—43 to 60 inches; olive gray (5Y 5/2) clay loam that has strata of silt loam and sandy loam; common fine prominent light olive brown (2.5Y 5/4) mottles; massive; friable; about 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 48 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam, loam, silty clay loam, or silt loam

Bg horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay loam, loam, silty clay loam, or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—3 to 5
Chroma—1 to 3
Texture—stratified silt loam, silty clay loam, sandy loam, or clay loam

Minneiska Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 4 percent
Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents

Typical Pedon

Minneiska sandy loam, 0 to 2 percent slopes, 2,400 feet south and 1,200 feet east of the northwest corner of sec. 24, T. 109 N., R. 27 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; about 3 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

C—9 to 60 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and brown (10YR 5/3) loam, silt loam, sand, and fine sandy loam; few fine faint grayish brown (10YR 5/2)

mottles; massive; very friable; about 3 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Content of rock fragments: 0 to 10 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam or loam

C horizon:
Hue—10YR or 2.5Y
Value—2 to 5
Chroma—2 or 3
Texture—stratified loam, silt loam, sand, or fine sandy loam

Muskego Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part; slow in the lower part
Landform: Depressions on ground moraines and flood plains
Parent material: Muck overlying coprogenous earth
Slope range: 0 to 1 percent
Taxonomic class: Coprogenous, euic, mesic Limnic Medisaprists

Typical Pedon

Muskego muck, 1,100 feet north and 2,000 feet east of the southwest corner of sec. 13, T. 110 N., R. 27 W.

Op—0 to 8 inches; black (10YR 2/1) muck; weak medium subangular blocky structure parting to weak fine granular; very friable; neutral; abrupt smooth boundary.

Oa1—8 to 18 inches; very dark brown (10YR 2/2) muck; weak medium subangular blocky structure parting to weak fine granular; very friable; neutral; clear smooth boundary.

Oa2—18 to 25 inches; black (10YR 2/1) muck; weak medium subangular blocky structure; very friable; neutral; clear smooth boundary.

C—25 to 60 inches; very dark gray (10YR 3/1) mucky silt loam; massive; very friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to coprogenous earth: 16 to 51 inches

Op horizon:
Hue—7.5YR, 10YR, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—muck

Oa horizon:
Hue—7.5YR, 10YR, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—muck

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 5
Chroma—1 to 3
Texture—mucky silt loam

Nicollet Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 250 feet north and 2,000 feet west of the southeast corner of sec. 23, T. 111 N., R. 28 W.

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

A—10 to 17 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

BA—17 to 23 inches; very dark grayish brown (2.5Y 3/2) clay loam; weak medium subangular blocky structure; friable; few faint dark brown (10YR 4/3) and dark grayish brown (2.5Y 4/2) streaks on faces of peds; about 4 percent gravel; neutral; clear smooth boundary.

Bw—23 to 34 inches; dark grayish brown (10YR 4/2) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few distinct dark grayish brown (2.5Y 4/2) and very dark grayish brown (10YR 3/2) streaks on faces of peds; about 4 percent gravel; neutral; clear smooth boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common fine prominent light gray (10YR 6/1) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 48 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of rock fragments: 1 to 8 percent gravel, by volume, throughout the profile
Other characteristics: A Bk horizon in some pedons

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam

BA horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay loam, loam, or silty clay loam

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

C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam

Nishna Series

Depth class: Very deep
Drainage class: Very poorly drained and poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls

Typical Pedon

Nishna silty clay loam, 1,500 feet south and 2,100 feet east of the northwest corner of sec. 17, T. 110 N., R. 30 W.

A1—0 to 20 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

A2—20 to 38 inches; black (10YR 2/1) silty clay; weak medium subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Bkg—38 to 60 inches; very dark gray (10YR 3/1) silty clay; very weak medium subangular blocky structure; very firm; few light brownish gray (10YR 6/2) accumulations of soft calcium carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 36 to 60 inches
Other characteristics: A Bg horizon in some pedons; a Cg horizon in some pedons

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silty clay

Bkg horizon:
Hue—10YR, 5Y, or neutral
Value—3
Chroma—0 or 1
Texture—silty clay or silty clay loam

Okoboji Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow in the upper part; moderate in the lower part
Landform: Depressions on ground moraines
Parent material: Alluvium
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Cumulic Haplaquolls

Typical Pedon

Okoboji silty clay loam, 1,600 feet south and 2,300 feet west of the northeast corner of sec. 10, T. 111 N., R. 27 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; moderate fine and very fine subangular blocky structure; common very fine roots; slight effervescence; neutral; abrupt smooth boundary.

A1—10 to 18 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong fine subangular blocky structure; friable; common very fine roots; neutral; gradual smooth boundary.

A2—18 to 26 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine

subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

Bg1—26 to 33 inches; olive gray (5Y 4/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/4) and dark brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bg2—33 to 50 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent light olive brown (2.5Y 5/6) and common fine prominent light olive brown (2.5Y 5/4) mottles; very weak medium subangular blocky structure; friable; common prominent reddish yellow (7.5YR 6/8) iron stains on faces of peds; about 1 percent gravel; neutral; gradual wavy boundary.

Cg—50 to 60 inches; gray (5Y 5/1), stratified loam, silt loam, and silty clay loam; common medium prominent light olive brown (2.5Y 5/6) and common fine prominent dark brown (7.5YR 4/4) mottles; massive; friable; about 1 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches
Thickness of the mollic epipedon: 24 to 35 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or mucky silty clay loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, silty clay, or silt loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silty clay

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—stratified loam, silt loam, or silty clay loam

Oshawa Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Fluvaquentic Haplaquolls

Typical Pedon

Oshawa silty clay loam, 2,400 feet south and 500 feet east of the northwest corner of sec. 10, T. 111 N., R. 26 W.

A—0 to 10 inches; very dark gray (5Y 3/1) silty clay loam, gray (10YR 5/1) dry; common fine prominent olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; strong effervescence; slightly alkaline; clear smooth boundary.

Cg1—10 to 36 inches; stratified dark olive gray (5Y 3/2) and dark grayish brown (2.5Y 4/2) silt loam; common medium prominent dark brown (7.5YR 3/2) and common fine distinct dark gray (N 4/0) mottles; massive; friable; common dark grayish brown (2.5Y 4/2) sand coatings on faces of peds; strong effervescence; slightly alkaline; clear wavy boundary.

Cg2—36 to 60 inches; black (5Y 2/2) silty clay loam; common fine prominent dark brown (7.5YR 3/2) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

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

A horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—silt loam, loam, clay loam, or silty clay loam

Plainfield Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 0 to 15 percent
Taxonomic class: Mixed, mesic Typic Udipsamments

Typical Pedon

Plainfield loamy sand, 2 to 6 percent slopes, 2,300 feet west and 2,100 feet south of the northeast corner of sec. 5, T. 110 N., R. 26 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

Bw1—9 to 20 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw2—20 to 33 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; slightly acid; clear smooth boundary.

C—33 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 10 percent gravel, by volume, throughout the profile

Other characteristics: An A horizon in some pedons

Ap horizon:
- Hue—7.5YR or 10YR
- Value—2 or 3
- Chroma—1 to 3
- Texture—loamy sand

Bw horizon:
- Hue—7.5YR or 10YR
- Value—3 to 6
- Chroma—3 to 6
- Texture—loamy sand, fine sand, sand, or loamy fine sand

C horizon:
- Hue—7.5YR or 10YR
- Value—4 to 6
- Chroma—4 to 8
- Texture—sand or fine sand

Rolfe Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate to slow in the upper part; moderately slow or moderate in the lower part

Landform: Depressions on ground moraines

Parent material: Glacial till

Slope range: 0 to 1 percent

Taxonomic class: Fine, montmorillonitic, mesic Typic Argialbolls

Typical Pedon

Rolfe silt loam, in an area of Cordova-Rolfe complex; 1,700 feet south and 1,400 feet east of the northwest corner of sec. 18, T. 111 N., R. 26 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

E—10 to 17 inches; dark gray (10YR 4/1) silt loam, gray (10YR 5/1) dry; moderate thin platy structure; friable; strongly acid; clear smooth boundary.

Btg1—17 to 26 inches; very dark gray (5Y 3/1) clay; moderate medium prismatic structure parting to strong medium angular blocky; firm; few very fine roots; common prominent very dark gray (10YR 3/1) clay films on faces of peds; slightly acid; gradual smooth boundary.

Btg2—26 to 36 inches; dark gray (5Y 4/1) silty clay; moderate medium subangular blocky structure; common prominent very dark gray (10YR 3/1) clay films on faces of peds; slightly acid; gradual smooth boundary.

2Cg1—36 to 47 inches; olive gray (5Y 4/2) clay loam; few fine prominent strong brown (7.5YR 5/8) and common fine distinct olive yellow (2.5Y 6/6) mottles; massive; friable; dark gray (10YR 4/1) streaks in channels; about 3 percent gravel; neutral; gradual smooth boundary.

2Cg2—47 to 60 inches; olive gray (5Y 5/2) loam; many coarse prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 6 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

Thickness of the mollic epipedon: 10 to 18 inches

Ap horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1
- Texture—silt loam

E horizon:
- Hue—10YR
- Value—3 to 6
- Chroma—1
- Texture—silt loam

Btg horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—3 to 6
- Chroma—1 or 2
- Texture—clay loam, clay, or silty clay

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

Texture—loam or clay loam
Content of gravel—2 to 6 percent

Storden Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 2 to 70 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Storden loam, in an area of Storden-Clarion complex, 12 to 18 percent slopes, eroded; 1,800 feet south and 2,000 feet west of the northeast corner of sec. 22, T. 111 N., R. 30 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common very fine roots; about 4 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

C1—9 to 24 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few very fine roots; common strong brown (7.5YR 5/6) iron stains on faces of peds; about 5 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

C2—24 to 60 inches; yellowish brown (10YR 5/4) loam; common fine distinct yellowish brown (10YR 5/6) mottles and common fine distinct gray (10YR 6/1) relict mottles; massive; friable; about 7 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Content of rock fragments: 2 to 10 percent gravel, by volume, throughout the profile
Other characteristics: A Bk horizon in some pedons

Ap horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 6
Texture—loam or clay loam

Terril Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Terraces and ground moraines
Parent material: Alluvium
Slope range: 1 to 12 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Terril loam, 6 to 12 percent slopes, 200 feet north and 1,500 feet east of the southwest corner of sec. 36, T. 109 N., R. 28 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and fine granular structure; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—10 to 23 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; many fine roots; about 2 percent gravel; neutral; gradual wavy boundary.

A2—23 to 29 inches; very dark gray (10YR 3/1) clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; many fine roots; about 3 percent gravel; neutral; gradual wavy boundary.

AB—29 to 38 inches; very dark grayish brown (10YR 3/2) loam; moderate medium subangular blocky structure; friable; many fine roots; about 3 percent gravel; neutral; gradual wavy boundary.

Bw—38 to 50 inches; dark brown (10YR 3/3) loam; weak medium subangular blocky structure; friable; many fine roots; about 4 percent gravel; neutral; gradual wavy boundary.

C—50 to 60 inches; dark yellowish brown (10YR 4/4) loam; massive; friable; many fine roots; about 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 34 to 60 inches
Thickness of the mollic epipedon: 24 to 50 inches
Content of rock fragments: 1 to 7 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

A horizon:
Hue—10YR
Value—2 or 3

Chroma—1 or 2
Texture—loam or clay loam

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

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 5
Texture—loam, clay loam, or sandy loam

Tilfer Series

Depth class: Moderately deep
Drainage class: Very poorly drained and poorly drained
Permeability: Moderate
Landform: Terraces
Parent material: Alluvium or glacial drift overlying limestone bedrock
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Tilfer silty clay loam, 1,700 feet north and 2,400 feet east of the southwest corner of sec. 35, T. 109 N., R. 28 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam; weak fine subangular blocky structure; friable; common fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

A1—10 to 13 inches; black (N 2/0) clay loam; weak medium subangular blocky structure; friable; few fine roots; strong effervescence; slightly alkaline; gradual wavy boundary.

A2—13 to 20 inches; very dark gray (10YR 3/1) clay loam; weak medium subangular blocky structure; friable; strong effervescence; slightly alkaline; gradual wavy boundary.

Bg—20 to 27 inches; dark grayish brown (2.5Y 4/2) loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few light brownish gray (2.5Y 6/2) streaks of calcium carbonate; about 7 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

2R—27 inches; fractured limestone bedrock.

Range in Characteristics

Thickness of the mollic epipedon: 12 to 24 inches
Content of rock fragments: 0 to 10 percent gravel in the Bkg horizon
Other characteristics: A BCg horizon in some pedons

Ap horizon:
Hue—10YR or neutral
Value—1 or 2
Chroma—0 or 1
Texture—silty clay loam

A horizon:
Hue—10YR or neutral
Value—1 or 2
Chroma—0 or 1
Texture—clay loam, silty clay loam, or loam

Bkg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 to 3
Texture—loam or sandy loam

Wadena Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the upper part; very rapid in the lower part
Landform: Stream terraces
Parent material: Glacial outwash
Slope range: 0 to 6 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Wadena loam, 0 to 2 percent slopes, 1,300 feet north and 300 feet east of the southwest corner of sec. 17, T. 110 N., R. 26 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bw1—11 to 19 inches; dark brown (10YR 3/3) loam; weak fine subangular blocky structure; friable; common fine roots; few very dark gray (10YR 3/1) and black (10YR 2/1) streaks on faces of peds; slightly acid; gradual wavy boundary.

Bw2—19 to 36 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; friable; common very fine roots; slightly acid; gradual wavy boundary.

2C—36 to 60 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; few very fine roots; neutral.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 12 to 20 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of gravel—0 to 15 percent

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4
Texture—loam, clay loam, or sandy loam
Content of gravel—0 to 15 percent

2C horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 4
Texture—sand, coarse sand, or gravelly coarse sand
Content of gravel—0 to 35 percent

Webster Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Ground moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Haplaquolls

Typical Pedon

Webster clay loam, 1,300 feet south and 350 feet east of the northwest corner of sec. 13, T. 110 N., R. 30 W.

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

A—10 to 19 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; few very fine roots; about 1 percent gravel; neutral; gradual smooth boundary.

Bg—19 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct light olive brown (2.5Y 5/6) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few black (10YR 2/1) streaks on faces of peds; about 4 percent gravel; neutral; gradual wavy boundary.

BCg—26 to 36 inches; olive gray (5Y 5/2) loam; common fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; about 6 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg—36 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 7 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 30 inches
Thickness of the mollic epipedon: 12 to 24 inches
Content of rock fragments: 1 to 8 percent gravel, by volume, throughout the profile

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam, loam, or silty clay loam

Bg horizon:
Hue—2.5YR or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam

BCg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam

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

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Formation of the Soils

Soils form as a result of the interaction of five factors. These factors are parent material, climate, plant and animal life, relief, and time. Climate and plant and animal life are active factors of soil formation. They act on the parent material and slowly change it into soil that has distinct horizons. The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

The soils of Nicollet County formed mainly in glacial till and in material sorted out of the till by the action of water. About 92 percent of the soils formed in till, 2 percent in glacial outwash, and 6 percent in alluvium. A small percentage of the soils formed in coprogenous earth, organic deposits, or material weathered from rocks of nonglacial origin.

Glacial till is an unsorted mass of boulders, rock, sand, silt, and clay that was deposited by continental glaciers. Canisteo, Clarion, and Lester soils are examples of soils that formed in glacial till.

Glacial outwash deposits formed in the meltwater of disintegrating glacial ice. These deposits are mainly in meltwater channels and on terraces. Soils in these areas commonly have a sandy and gravelly substratum and a sandy to loamy upper layer. Estherville, Plainfield, and Wadena soils are dominant in these areas.

Alluvial sediments are on most flood plains in stream valleys. These sediments are generally stratified, and the particle size ranges from silt or clay to sand and cobbles. Chaska, Millington, and Minneiska soils are examples of alluvial soils.

Climate

Climate is perhaps the most influential factor determining the kind of vegetation, animals, bacteria, and other organisms that exist on or in the soil. Temperature and precipitation have a profound effect on the rates of chemical and physical processes, which play an essential part in the development of the soil profile.

The parent material in the county was deposited during a glacial period about 12,000 years ago. The postglacial climate progressively warmed and then stabilized about 5,000 years ago. The warming climate is evidenced by successive vegetation types. The initial postglacial vegetation was a spruce forest. It was replaced by a deciduous forest. After the climate stabilized, the deciduous forest was replaced by prairie.

Nicollet County has a subhumid, continental climate that results in hot summers and cold winters. The climate is essentially uniform throughout the county. Alternate periods of freezing and thawing, especially in the spring, play a role in the development of soil structure. Precipitation during frost-free periods transfers soluble nutrients, organic matter, and clayey materials from the upper part of the soil to the lower part. Freezing of the soil in winter slows these soil-forming processes.

Plant and Animal Life

Plants, animals, bacteria, and other organisms are active in the soil-forming process. The presence of these organisms in the soil results in the accumulation of organic matter, the mixing of organic and mineral material in the soil profile, the cycling of nutrients, and the improvement of structural stability. Vegetation affects soil formation by recycling plant nutrients within the soil. It protects the soil from natural erosion by leaving residue on the surface. The kind of plants and animals that live on and in the soil is determined by climate, parent material, relief, and the age of the soil.

The soils in Nicollet County formed under prairie and forest vegetation. The native vegetation consisted mainly of tall and mid grasses, varying with the kind of soil, drainage, and other site factors. Canisteo, Nicollet, and Webster soils, which formed under prairie vegetation, have a thick, dark surface layer. A gradual increase in precipitation in the eastern part of the county has produced wooded areas, which have slowly replaced the prairie grasses.

The change in vegetation from prairie to scattered woods produced changes in the soils. Cordova and Le Sueur soils are examples of soils that are characterized

by an increased amount of clay in the subsoil, which is typical of a forested soil, and the thick, dark surface layer of a prairie soil. Soils that formed primarily under forest vegetation, such as Lester soils, have a thinner, lighter colored surface layer in addition to an increased content of clay in the subsoil.

Human activities have influenced some of the soil-forming processes. Farming activities have accelerated erosion of the surface layer in the more sloping areas. The surface layer of some of the well drained soils has become browner and has a lower content of organic matter because it has been mixed with the subsoil by plowing. On many soils, tillage has partially altered the original structure and applications of fertilizer have increased fertility.

Relief

Relief is an important factor of soil formation because it affects drainage, erosion, soil moisture, and soil temperature. Generally, soils in sloping landscape positions, such as Clarion or Lester soils, are well drained. They generally have good aeration, which results in bright internal colors, and show less profile development because more water runs off the surface.

Soils in nearly level or concave landscape positions are generally poorly drained or very poorly drained. Canisteo, Glencoe, and Webster soils are examples. In the nearly level areas, more of the precipitation percolates into the ground than in the sloping areas. Also, runoff from adjoining sloping areas accumulates in these level areas. This concentration of moisture results in soils that have a thicker, darker surface layer and a high content of organic matter. Soils in these landscape positions typically have mottled, dull-colored subsoils, indicating poor aeration resulting from slow internal drainage. The degree of profile development is mostly a function of the amount of water passing through the soil. Typically, Clarion and Lester soils are not developed as extensively as Cordova or Webster soils.

Relief also affects soil temperatures. Soils on south- or west-facing slopes are warmer than those on north- or east-facing slopes. The southern and western aspects of the steep valley side slopes between Courtland and Ft. Ridgely result in sparse vegetation compared to the northern and eastern aspects of the heavily wooded valley side slopes between Mankato and St. Peter.

Time

Soil characteristics are determined by the length of time involved in the soil-forming process. The age of the soil is characterized by changes in the appearance of the profile. Soluble materials are first leached out. Organic matter then begins to accumulate, and the development of distinct horizons begins. The time needed for a horizon to develop is related to the parent material, climate, and vegetation.

The soils in Nicollet County are geologically young because the last glacial period ended only 12,000 years ago. A geologically young soil has more natural plant nutrients and commonly is more fertile than the older soils of mature landscapes. Young soils may exhibit many properties of the parent material because soil-forming processes have not had enough time to significantly alter the fresh material. The soils on flood plains show little evidence of soil formation because the alluvial parent material is extremely young.

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Glossary

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.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

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.

Association, soil. A group of soils 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

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

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

Bottom land. The normal flood plain of a stream, subject to flooding.

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

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

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.

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.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

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 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.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in

diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

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

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 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 are somewhat similar in all areas.

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

Consistence, soil. 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.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, 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. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

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

Coprogenous earth (sedimentary peat). 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.

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

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.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly

below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

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.

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.

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, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

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

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

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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

Foot slope. The inclined surface at the base of a hill.

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.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). 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.

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 up to 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, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of the 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.

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

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 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, any plowed or disturbed surface layer.

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 O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon 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) granular, 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 horizon. 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.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but 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.

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.

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.

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

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.

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.

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

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.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

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. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are 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.)

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.)

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.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

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.

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 downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting 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:

Very slow	less than 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. For example, 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.

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 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.

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	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly 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

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.

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.

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.

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.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. 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.

Shrink-swell. 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.

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.

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.

Slow intake (in tables). The slow movement of water into 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.

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 underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse 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 which 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 soil blowing 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.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 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. It includes all subdivisions of these horizons.

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.

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 that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

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.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1954-84 at North Mankato, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	22.6	2.7	12.7	47	-28	0	0.79	0.16	1.25	2	8.6
February	29.4	8.7	19.1	52	-25	0	.86	.35	1.32	3	7.8
March	41.2	21.4	31.3	73	-10	20	1.68	.69	2.37	4	8.9
April	58.9	36.1	47.5	88	16	86	2.44	1.36	3.48	6	1.6
May	72.3	47.6	60.0	93	27	323	3.66	1.86	5.08	7	.0
June	81.0	56.7	68.9	96	39	567	3.93	2.06	5.22	7	.0
July	85.3	62.0	73.7	98	47	735	3.79	1.69	5.31	6	.0
August	82.9	59.7	71.3	96	43	660	4.01	2.10	5.57	7	.0
September	73.8	50.3	62.1	93	31	363	2.87	1.50	4.20	5	.0
October	62.1	39.5	50.8	86	19	131	2.15	.76	3.39	5	.3
November	43.0	25.5	34.3	69	-2	0	1.41	.33	2.26	4	3.3
December	28.3	11.0	19.7	54	-21	0	1.04	.40	1.63	3	9.5
Yearly:											
Average	56.7	35.1	46.0	---	---	---	---	---	---	---	---
Extreme	---	---	---	100	-29	---	---	---	---	---	---
Total	---	---	---	---	---	2,885	28.63	22.90	34.04	59	40.0

* 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 (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1954-84 at North Mankato, 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. 22	May 5	May 15
2 years in 10 later than--	Apr. 17	Apr. 30	May 10
5 years in 10 later than--	Apr. 9	Apr. 21	Apr. 30
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 7	Sept. 30	Sept. 20
2 years in 10 earlier than--	Oct. 12	Oct. 5	Sept. 25
5 years in 10 earlier than--	Oct. 24	Oct. 15	Oct. 4

TABLE 3.--GROWING SEASON

(Recorded in the period 1954-84 at North Mankato, 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	176	156	138
8 years in 10	184	163	144
5 years in 10	197	176	156
2 years in 10	211	189	168
1 year in 10	218	196	175

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
27A	Dickinson loam, 0 to 2 percent slopes	1,293	0.4
27B	Dickinson loam, 2 to 6 percent slopes	1,213	0.4
35	Blue Earth mucky silt loam	1,351	0.4
39A	Wadena loam, 0 to 2 percent slopes	442	0.1
39B	Wadena loam, 2 to 6 percent slopes	446	0.1
41B	Estherville sandy loam, 1 to 6 percent slopes	766	0.2
84	Brownton silty clay	795	0.2
86	Canisteo clay loam	17,953	6.0
94B	Terril loam, 1 to 6 percent slopes	2,553	0.9
94C	Terril loam, 6 to 12 percent slopes	1,216	0.4
100B	Copaston loam, 1 to 6 percent slopes	929	0.3
102B	Clarion loam, 2 to 6 percent slopes	16,285	5.4
106B	Lester loam, 2 to 6 percent slopes	12,432	4.1
106C2	Lester loam, 6 to 12 percent slopes, eroded	2,364	0.8
109	Cordova clay loam	17,476	5.8
110	Marna silty clay loam	1,625	0.5
112	Harps clay loam	13,343	4.5
113	Webster clay loam	17,335	6.0
114	Glencoe silty clay loam	10,028	3.4
118	Crippin loam	766	0.2
130	Nicollet clay loam	18,123	6.1
134	Okoboji silty clay loam	1,445	0.5
196	Joliet silty clay loam	259	0.1
206	Kasota loam	567	0.2
221	Canisteo silty clay loam, depressional	879	0.3
239	Le Sueur clay loam	16,213	5.4
269	Millington clay loam	2,601	0.9
283A	Plainfield loamy sand, 0 to 2 percent slopes	202	0.1
283B	Plainfield loamy sand, 2 to 6 percent slopes	853	0.3
283C	Plainfield loamy sand, 6 to 15 percent slopes	528	0.2
317	Oshawa silty clay loam	1,047	0.4
321	Tilfer silty clay loam	633	0.2
327A	Dickman sandy loam, 0 to 2 percent slopes	365	0.1
327B	Dickman sandy loam, 2 to 6 percent slopes	271	0.1
329	Chaska loam	2,372	0.8
336	Delft clay loam	10,074	3.4
386	Okoboji mucky silty clay loam	5,093	1.7
463A	Minneiska sandy loam, 0 to 2 percent slopes	2,191	0.7
463B	Minneiska loam, 1 to 4 percent slopes	713	0.2
525	Muskego muck	1,909	0.6
539	Klossner muck	8,293	2.8
574	Du Page loam	282	0.1
575	Nishna silty clay loam	2,432	0.8
611F	Hawick sandy loam, 18 to 70 percent slopes	487	0.2
851	Chaska-Minneiska-Urban land complex	554	0.2
852	Copaston-Urban land complex	346	0.1
854	Cordova-Urban land complex	637	0.2
864B	Plainfield-Urban land complex, 0 to 6 percent slopes	946	0.3
864C	Plainfield-Urban land complex, 6 to 15 percent slopes	313	0.1
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes	2,215	0.7
920C2	Clarion-Storden-Hawick complex, 6 to 12 percent slopes, eroded	1,020	0.3
921B	Clarion-Storden complex, 2 to 6 percent slopes	7,034	2.4
921C2	Clarion-Storden complex, 6 to 12 percent slopes, eroded	8,347	3.0
923	Copaston-Rock outcrop complex, 2 to 60 percent slopes	681	0.2
944F	Lester-Storden-Estherville complex, 18 to 70 percent slopes	579	0.2
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded	720	0.2
945F	Lester-Storden complex, 18 to 70 percent slopes	8,194	2.7
956	Canisteo-Glencoe complex	26,560	9.0
960D2	Storden-Clarion complex, 12 to 18 percent slopes, eroded	780	0.3
960F	Storden-Clarion complex, 18 to 50 percent slopes	1,671	0.6
978	Cordova-Rolfe complex	6,712	2.3
1030	Udorthents-Pits, gravel, complex	693	0.2
1075	Klossner and Muskego soils, ponded	5,486	1.8
1083	Le Sueur-Urban land complex	526	0.2
1901B	Le Sueur-Lester complex, 1 to 6 percent slopes	5,370	1.8

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1917	Nishna silty clay, ponded	1,205	0.4
1931	Essexville sandy loam	430	0.1
1999	Minneiska-Kalmarville complex, frequently flooded	2,338	0.8
	Water	17,000	5.6
	Total	298,800	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
27A	Dickinson loam, 0 to 2 percent slopes
27B	Dickinson loam, 2 to 6 percent slopes
39A	Wadena loam, 0 to 2 percent slopes
39B	Wadena loam, 2 to 6 percent slopes
84	Brownton silty clay (where drained)
86	Canisteo clay loam (where drained)
94B	Terril loam, 1 to 6 percent slopes
102B	Clarion loam, 2 to 6 percent slopes
106B	Lester loam, 2 to 6 percent slopes
109	Cordova clay loam (where drained)
110	Marna silty clay loam (where drained)
112	Harps clay loam (where drained)
113	Webster clay loam (where drained)
114	Glencoe silty clay loam (where drained)
118	Crippin loam
130	Nicollet clay loam
134	Okoboji silty clay loam (where drained)
206	Kasota loam
221	Canisteo silty clay loam, depressional (where drained)
239	Le Sueur clay loam
269	Millington clay loam (where drained)
329	Chaska loam (where drained)
336	Delft clay loam (where drained)
386	Okoboji mucky silty clay loam (where drained)
463A	Minneiska sandy loam, 0 to 2 percent slopes
463B	Minneiska loam, 1 to 4 percent slopes
574	Du Page loam
575	Nishna silty clay loam (where drained)
921B	Clarion-Storden complex, 2 to 6 percent slopes
956	Canisteo-Glencoe complex (where drained)
978	Cordova-Rolfe complex (where drained)
1901B	Le Sueur-Lester complex, 1 to 6 percent slopes
1917	Nishna silty clay, ponded (where drained)
1999	Minneiska-Kalmarville complex, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Spring wheat	Soybeans	Oats	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
27A---------- Dickinson	IIIs	91	31	28	67	3.1	2.7
27B---------- Dickinson	IIIe	89	30	27	65	3.0	2.7
35---------- Blue Earth	IIIw	124	42	33	70	4.2	---
39A---------- Wadena	IIs	103	39	35	74	3.8	3.7
39B---------- Wadena	IIe	99	38	34	72	3.7	3.7
41B---------- Estherville	IIIs	72	26	24	35	2.6	2.0
84---------- Brownton	IIw	139	27	43	85	4.7	3.0
86---------- Canisteo	IIw	149	51	46	75	5.1	3.0
94B---------- Terril	IIe	152	49	44	101	4.9	4.2
94C---------- Terril	IIIe	142	47	43	92	4.7	3.8
100B---------- Copaston	IIIe	98	30	27	50	2.9	2.0
102B---------- Clarion	IIe	144	49	44	101	4.9	4.2
106B---------- Lester	IIe	143	49	44	80	4.6	3.5
106C2---------- Lester	IIIe	134	45	41	65	4.5	3.3
109---------- Cordova	IIw	152	51	46	75	5.0	4.2
110---------- Marna	IIw	149	45	45	75	4.4	---
112---------- Harps	IIw	135	49	44	87	4.9	3.3
113---------- Webster	IIw	152	51	46	102	5.1	4.2
114---------- Glencoe	IIIw	136	48	44	75	4.8	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Spring wheat	Soybeans	Oats	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
118--Crippin	I	152	49	45	105	4.9	4.2
130--Nicollet	I	157	49	45	80	4.9	3.5
134--Okoboji	IIIw	136	48	44	73	4.8	3.3
196--Joliet	IVw	84	33	26	54	2.8	2.0
206--Kasota	IIs	116	39	36	65	3.9	3.4
221--Canisteo	IIIw	141	48	44	70	4.8	3.0
239--Le Sueur	I	157	46	44	80	4.9	3.3
269--Millington	IIw	134	43	40	68	4.3	3.1
283A, 283B--Plainfield	IVs	76	25	24	45	2.5	1.2
283C--Plainfield	VIs	---	---	---	---	2.5	0.8
317--Oshawa	VIw	---	---	---	---	---	3.5
321--Tilfer	IIIw	125	44	40	68	4.3	3.4
327A--Dickman	IIIs	77	27	24	50	2.7	1.2
327B--Dickman	IIIe	75	27	24	45	2.7	1.2
329--Chaska	IIw	131	43	40	75	4.3	3.0
336--Delft	IIw	152	51	46	80	5.1	4.0
386--Okoboji	IIIw	134	46	42	73	4.6	3.3
463A--Minneiska	IIw	120	41	37	85	4.0	4.0
463B--Minneiska	IIe	116	40	36	80	4.0	3.9
525--Muskego	IVw	127	42	38	70	4.2	3.7

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Spring wheat	Soybeans	Oats	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
539---------- Klossner	IIIw	124	42	38	75	4.2	---
574---------- Du Page	IIw	133	43	40	53	4.3	---
575---------- Nishna	IIIw	130	43	40	61	4.3	3.7
611F---------- Hawick	VIIs	---	---	---	---	---	0.6
851**. Chaska-Minneiska-Urban land							
852**. Copaston-Urban land							
854**. Cordova-Urban land							
864B**. Plainfield-Urban land							
864C**. Plainfield-Urban land							
920B----------		127	40	37	64	4.0	2.9
Clarion--------	IIe						
Storden--------	IIe						
Hawick---------	IVs						
920C2----------		104	36	33	59	3.4	2.6
Clarion--------	IIIe						
Storden--------	IIIe						
Hawick---------	IVs						
921B---------- Clarion-Storden	IIe	139	47	43	86	4.7	3.8
921C2---------- Clarion-Storden	IIIe	129	45	41	79	4.5	3.5
923**:							
Copaston-------	VIIs	---	---	---	---	---	---
Rock outcrop.							
944F---------- Lester-Storden-Estherville	VIIe	---	---	---	---	---	---
945D2---------- Lester-Storden	IVe	106	36	33	53	3.6	2.7
945F---------- Lester-Storden	VIIe	---	---	---	---	---	1.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Spring wheat	Soybeans	Oats	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
956---------- Canisteo------- Glencoe--------	IIw IIIw	139	48	44	75	4.8	---
960D2---------- Storden-Clarion	IVe	106	36	33	57	3.6	2.9
960F---------- Storden-Clarion	VIIe	---	---	---	---	---	1.8
978---------- Cordova-------- Rolfe----------	IIw IIIw	132	45	41	77	4.5	---
1030**. Udorthents-Pits							
1075---------- Klossner- Muskego	VIIIw	---	---	---	---	---	---
1083**. Le Sueur-Urban land							
1901B---------- Le Sueur------- Lester----------	I IIe	154	49	44	80	4.8	3.4
1917---------- Nishna	VIw	---	---	---	---	---	---
1931---------- Essexville	IIIw	126	36	33	80	4.2	---
1999---------- Minneiska- Kalmarville	Vw	---	---	---	---	---	3.7

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil. Only the soils suited to windbreaks and environmental plantings are listed)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
27A, 27B---------- Dickinson	Lilac----------	Eastern redcedar, Russian-olive, Siberian peashrub.	Eastern white pine, green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	---	---
35---------- Blue Earth	---	Redosier dogwood	Black ash, tall purple willow.	Black ash, golden willow, white willow.	---
39A, 39B---------- Wadena	Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, hackberry, Manchurian crabapple.	Jack pine, eastern white pine, bur oak, green ash.	---	---
41B---------- Estherville	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, jack pine, green ash, Russian-olive, Siberian elm, red pine, Austrian pine.	Eastern white pine	---
84---------- Brownton	---	Siberian peashrub, honeysuckle, lilac, northern whitecedar.	White spruce, hackberry, bur oak, eastern redcedar.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
86---------- Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
94B, 94C---------- Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern whitecedar, eastern redcedar.	Eastern white pine, green ash.	---
102B---------- Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
106B, 106C2------- Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
109---------- Cordova	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
110---------- Marna	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, tall purple willow, Amur maple, hackberry.	Golden willow, green ash.	Eastern cottonwood, silver maple.
112---------- Harps	---	Lilac, northern whitecedar, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
113---------- Webster	---	Redosier dogwood, American plum, cotoneaster.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
114---------- Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
118---------- Crippin	---	Northern whitecedar, cotoneaster, Siberian peashrub, lilac.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
130---------- Nicollet	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
134---------- Okoboji	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
206---------- Kasota	American plum, lilac.	Eastern redcedar, Siberian peashrub, hackberry, cotoneaster.	Honeylocust, Russian-olive, green ash, bur oak.	Siberian elm------	---
221---------- Canisteo	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
239---------- Le Sueur	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
269---------- Millington	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar.	Honeylocust, silver maple, green ash, red maple, white ash.	Eastern cottonwood.
283A, 283B, 283C-- Plainfield	Lilac, Siberian peashrub.	Eastern redcedar	Red pine, Austrian pine, jack pine.	Eastern white pine	---
321---------- Tilfer	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
327A, 327B-------- Dickman	Siberian peashrub	Eastern redcedar, lilac.	Green ash, honeylocust, jack pine, Austrian pine, Russian-olive.	Eastern white pine, red pine, Siberian elm.	---
329---------- Chaska	---	Siberian peashrub, lilac, northern whitecedar.	Eastern redcedar, bur oak, white spruce, hackberry.	Green ash, golden willow, honeylocust.	Eastern cottonwood.
336---------- Delft	---	American plum, redosier dogwood.	Hackberry, Amur maple, white spruce, northern whitecedar, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
386---------- Okoboji	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
463A, 463B-------- Minneiska	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
525---------- Muskego	---	Nannyberry viburnum, silky dogwood, common ninebark, northern whitecedar, American cranberrybush, redosier dogwood, late lilac.	White spruce, Japanese tree lilac, Manchurian crabapple.	Siberian crabapple	Imperial Carolina poplar.
539---------- Klossner	---	Nannyberry viburnum, silky dogwood.	White spruce------	Green ash, Norway spruce.	Imperial Carolina poplar.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
574---------- Du Page	---	Northern whitecedar, Siberian peashrub, lilac.	Hackberry, bur oak, eastern redcedar, white spruce.	Green ash, golden willow, honeylocust.	Eastern cottonwood.
575---------- Nishna	Lilac----------	Siberian peashrub	Russian-olive, hackberry, eastern redcedar, blue spruce, ponderosa pine.	Honeylocust, green ash, golden willow.	Eastern cottonwood.
611F---------- Hawick	Siberian peashrub	Late lilac, honeysuckle, Persian lilac, common chokecherry, Manchurian crabapple, northern whitecedar, sargent crabapple, silver buffaloberry, birchleaf buckthorn.	Jack pine, Austrian pine, eastern redcedar, green ash, thornless honeylocust, Russian-olive, ponderosa pine, white spruce, silver maple.	Eastern white pine, red pine, Siberian elm, Scotch pine, eastern cottonwood.	---
851*: Chaska----------	---	Siberian peashrub, lilac, northern whitecedar.	Eastern redcedar, bur oak, white spruce, hackberry.	Green ash, golden willow, honeylocust.	Eastern cottonwood.
Minneiska--------	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
Urban land.					
854*: Cordova----------	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
Urban land.					
864B*, 864C*: Plainfield-------	Lilac, Siberian peashrub.	Eastern redcedar	Red pine, Austrian pine, jack pine.	Eastern white pine	---
Urban land.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
920B*, 920C2*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
Hawick	Siberian peashrub	Late lilac, honeysuckle, Persian lilac, common chokecherry, Manchurian crabapple, northern whitecedar, sargent crabapple, silver buffaloberry, birchleaf buckthorn.	Jack pine, Austrian pine, eastern redcedar, green ash, thornless honeylocust, Russian-olive, ponderosa pine, white spruce, silver maple.	Eastern white pine, red pine, Siberian elm, Scotch pine, eastern cottonwood.	---
921B*, 921C2*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
944F*:					
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
944F*:					
Estherville	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, jack pine, green ash, Russian-olive, Siberian elm, red pine, Austrian pine.	Eastern white pine.	---
945D2*, 945F*:					
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
956*:					
Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
960D2*, 960F*:					
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
978*:					
Cordova	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
Rolfe	---	Redosier dogwood, American plum.	Amur maple, northern whitecedar, hackberry, tall purple willow, white spruce.	Golden willow, green ash.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1083*:					
Le Sueur	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
Urban land.					
1901B*:					
Le Sueur	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
1931 Essexville	---	Siberian peashrub, lilac, bur oak, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
1999*:					
Minneiska	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
Kalmarville	---	American plum, redosier dogwood.	Tall purple willow, hackberry, northern whitecedar, white spruce, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
27A Dickinson	Slight	Slight	Slight	Slight	Slight.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
35 Blue Earth	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.
39A Wadena	Slight	Slight	Slight	Slight	Slight.
39B Wadena	Slight	Slight	Moderate: slope.	Slight	Slight.
41B Estherville	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
84 Brownton	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
86 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
94B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
94C Terril	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
100B Copaston	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer.	Slight	Severe: thin layer, area reclaim.
102B Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
106B Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
106C2 Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
109 Cordova	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
110 Marna	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Severe: too clayey.
112 Harps	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
113 Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
114 Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
118 Crippin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
130 Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
134 Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
196 Joliet	Severe: flooding, wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: wetness, depth to rock.
206 Kasota	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: small stones, percs slowly.	Slight	Slight.
221 Canisteo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
239 Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
269 Millington	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
283A Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: small stones, too sandy.	Moderate: too sandy.	Severe: droughty.
283B Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
283C Plainfield	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
317 Oshawa	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
321 Tilfer	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
327A Dickman	Slight	Slight	Slight	Slight	Moderate: droughty.
327B Dickman	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
329 Chaska	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
336 Delft	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
386 Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
463A Minneiska	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
463B Minneiska	Severe: flooding.	Slight	Slight	Slight	Slight.
525 Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
539 Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
574 Du Page	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
575 Nishna	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
611F Hawick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
851*: Chaska	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Minneiska	Slight	Slight	Slight	Slight	Slight.
Urban land.					
852*: Copaston	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer.	Slight	Severe: thin layer, area reclaim.
Urban land.					
854*: Cordova	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Urban land.					
864B*: Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
Urban land.					

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
864C*:					
Plainfield	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
Urban land.					
920B*:					
Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Storden	Slight	Slight	Moderate: slope.	Slight	Slight.
Hawick	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
920C2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
921B*:					
Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Storden	Slight	Slight	Moderate: slope.	Slight	Slight.
921C2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
923*:					
Copaston	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer.	Severe: slope.	Severe: slope, thin layer, area reclaim.
Rock outcrop.					
944F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Estherville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
945D2*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
945F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
956*:					
Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Glencoe	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
960D2*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
960F*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
978*:					
Cordova	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Rolfe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1030*:					
Udorthents.					
Pits.					
1075*:					
Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1083*:					
Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
Urban land.					
1901B*:					
Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
1901B*:					
Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
1917	Severe:	Severe:	Severe:	Severe:	Severe:
Nishna	flooding, ponding.	ponding.	ponding, flooding.	ponding.	ponding, flooding.
1931	Severe:	Severe:	Severe:	Severe:	Severe:
Essexville	wetness.	wetness.	wetness.	wetness.	wetness.
1999*:					
Minneiska	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Kalmarville	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
27A, 27B--Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
35--Blue Earth	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
39A, 39B--Wadena	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
41B--Estherville	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
84--Brownton	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
86--Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
94B--Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
94C--Terril	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
100B--Copaston	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
102B--Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
106B--Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
106C2--Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
109--Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
110--Marna	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
112--Harps	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
113--Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
114--Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
118--Crippin	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor.
130--Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life
134---- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
196---- Joliet	Poor	Poor	Fair	Fair	Fair	Good	Poor	Poor	Fair	Fair.
206---- Kasota	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
221---- Canisteo	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
239---- Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
269---- Millington	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
283A, 283B---- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
283C---- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
317---- Oshawa	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
321---- Tilfer	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
327A, 327B---- Dickman	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
329---- Chaska	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
336---- Delft	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
386---- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
463A---- Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
463B---- Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
525---- Muskego	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
539---- Klossner	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
574---- Du Page	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
575---- Nishna	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Good.
611F---- Hawick	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
851*:										
Chaska	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										
852*:										
Copaston	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Urban land.										
854*:										
Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Urban land.										
864B*:										
Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Urban land.										
864C*:										
Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Urban land.										
920B*:										
Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Storden	Good	Good	Good	Fair	Poor	Very poor.	Very poor.	Good	Fair	Very poor.
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
920C2*:										
Clarion	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
921B*:										
Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Storden	Good	Good	Good	Fair	Poor	Very poor.	Very poor.	Good	Fair	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
921C2*:										
Clarion	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
923*:										
Copaston	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Rock outcrop.										
944F*:										
Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Estherville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
945D2*:										
Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
945F*:										
Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
956*:										
Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
960D2*:										
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
960F*:										
Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
978*:										
Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Rolfe	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1030*:										
Udorthents.										
Pits.										
1075*:										
Klossner	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Muskego	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
1083*:										
Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										
1901B*:										
Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1917 Nishna	Very poor.	Poor	Fair	Poor	Very poor.	Good	Good	Poor	Poor	Good.
1931 Essexville	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Fair.
1999*:										
Minneiska	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Kalmarville	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
27A Dickinson	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
27B Dickinson	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
35 Blue Earth	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
39A Wadena	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
39B Wadena	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
41B Estherville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
84 Brownton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.
86 Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
94B Terril	Slight	Slight	Slight	Slight	Severe: low strength.	Slight.
94C Terril	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
100B Copaston	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer, area reclaim.
102B Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
106B Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
106C2 Lester	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
109 Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
110 Marna	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
112 Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
113 Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
114 Glencoe	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
118 Crippin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.	Slight.
130 Nicollet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
134 Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
196 Joliet	Severe: depth to rock, wetness.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness, low strength.	Severe: depth to rock, low strength, wetness.	Severe: wetness, depth to rock.
206 Kasota	Severe: cutbanks cave.	Severe: shrink-swell.	Slight	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
221 Canisteo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
239 Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
269 Millington	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding.
283A Plainfield	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
283B Plainfield	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
283C Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
317 Oshawa	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
321 Tilfer	Severe: depth to rock, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
327A Dickman	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
327B Dickman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
329 Chaska	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
336 Delft	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
386 Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
463A Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
463B Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
525 Muskego	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
539 Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
574 Du Page	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
575 Nishna	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: wetness, flooding.
611F Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
851*:						
Chaska	Severe: cutbanks cave, wetness	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Urban land.						
852*:						
Copaston	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer, area reclaim.
Urban land.						
854*:						
Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Urban land.						
864B*:						
Plainfield	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Urban land.						
864C*:						
Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Urban land.						
920B*:						
Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Storden	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
920C2*:						
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
921B*:						
Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
921B*:						
Storden	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
921C2*:						
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
923*:						
Copaston	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer, area reclaim.
Rock outcrop.						
944F*:						
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Estherville	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
945D2*, 945F*:						
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
956*:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Glencoe	Severe: ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
960D2*, 960F*:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
978*:						
Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
978*:						
Rolfe	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1030*:						
Udorthents.						
Pits.						
1075*:						
Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, low strength, ponding.	Severe: ponding, excess humus.
Muskego	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
1083*:						
Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
Urban land.						
1901B*:						
Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
1917 Nishna	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, flooding.
1931 Essexville	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1999*:						
Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Kalmarville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
27A, 27B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
35 Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
39A, 39B Wadena	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
41B Estherville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
84 Brownton	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
86 Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94B Terril	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
94C Terril	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
100B Copaston	Severe: thin layer, seepage.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
102B Clarion	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
106B Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
106C2 Lester	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
109 Cordova	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
110 Marna	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
112---------- Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
113---------- Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114---------- Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
118---------- Crippin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
130---------- Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
134---------- Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
196---------- Joliet	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: depth to rock, hard to pack, wetness.
206---------- Kasota	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
221---------- Canisteo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
239---------- Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
269---------- Millington	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
283A, 283B---------- Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
283C---------- Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
317---------- Oshawa	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
321---------- Tilfer	Severe: flooding, thin layer, seepage.	Severe: depth to rock, seepage, flooding.	Severe: flooding, depth to rock, seepage.	Severe: flooding, wetness.	Poor: area reclaim, wetness, thin layer.
327A, 327B---------- Dickman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
329---------- Chaska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, thin layer.
336---------- Delft	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
386---------- Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
463A, 463B---------- Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy.
525---------- Muskego	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
539---------- Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
574---------- Du Page	Severe: flooding.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
575---------- Nishna	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
611F---------- Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
851*:					
Chaska----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, thin layer.
Minneiska----------	Severe: wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: seepage, wetness.	Poor: too sandy.
Urban land.					
852*:					
Copaston----------	Severe: thin layer, seepage.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
852*: Urban land.					
854*: Cordova	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Urban land.					
864B*: Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Urban land.					
864C*: Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Urban land.					
920B*: Clarion	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Storden	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Hawick	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
920C2*: Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
921B*: Clarion	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Storden	Slight	Moderate: seepage, slope.	Slight	Slight	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
921C2*:					
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
923*:					
Copaston	Severe: thin layer, seepage, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, slope, thin layer.
Rock outcrop.					
944F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Estherville	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
945D2*, 945F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
956*:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
960D2*, 960F*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
978*:					
Cordova	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Rolfe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1030*:					
Udorthents.					
Pits.					
1075*:					
Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Muskego	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
1083*:					
Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Urban land.					
1901B*:					
Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
1917 Nishna	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
1931 Essexville	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
1999*:					
Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy.
Kalmarville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness, seepage.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
27A, 27B Dickinson	Good	Probable	Improbable: too sandy.	Good.
35 Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
39A, 39B Wadena	Good	Probable	Probable	Poor: small stones, area reclaim.
41B Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
84 Brownton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
86 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
94B Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
94C Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
100B Copaston	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
102B Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
106B Lester	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
106C2 Lester	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
109 Cordova	Fair: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
110 Marna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
112 Harps	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
113 Webster	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
114 Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
118 Crippin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
130 Nicollet	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
134 Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
196 Joliet	Poor: depth to rock, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, wetness.
206 Kasota	Good	Probable	Improbable: too sandy.	Poor: too clayey.
221 Canisteo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
239 Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
269 Millington	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
283A, 283B, 283C Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
317 Oshawa	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
321 Tilfer	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
327A, 327B Dickman	Good	Probable	Improbable: too sandy.	Poor: thin layer.
329 Chaska	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
336 Delft	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
386--Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
463A, 463B--Minneiska	Good	Probable	Improbable: too sandy.	Poor: too sandy.
525--Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
539--Klossner	Poor: thin layer, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
574--Du Page	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
575--Nishna	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
611F--Hawick	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
851*:				
Chaska	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Minneiska	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Urban land.				
852*:				
Copaston	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Urban land.				
854*:				
Cordova	Fair: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
864B*, 864C*:				
Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Urban land.				
920B*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
920B*:				
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
920C2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
921B*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
921C2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
923*:				
Copaston	Poor: area reclaim, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Rock outcrop.				
944F*:				
Lester	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Estherville	Good	Probable	Probable	Poor: small stones, area reclaim, slope.
945D2*:				
Lester	Fair: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
945D2*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
945F*:				
Lester	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
956*:				
Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
960D2*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Clarion	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
960F*:				
Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Clarion	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
978*:				
Cordova	Fair: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1030*: Udorthents. Pits.				
1075*:				
Klossner	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1083*:				
Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Urban land.				
1901B*:				
Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1917 Nishna	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1931 Essexville	Poor: thin layer, wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: wetness.
1999*:				
Minneiska	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Kalmarville	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
27A---------- Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy------	Favorable.
27B---------- Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy------	Favorable.
35---------- Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Ponding, frost action.	Ponding--------	Wetness.
39A---------- Wadena	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy------	Favorable.
39B---------- Wadena	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy------	Favorable.
41B---------- Estherville	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy, soil blowing.	Droughty.
84---------- Brownton	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness--------	Wetness, percs slowly.
86---------- Canisteo	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness.
94B---------- Terril	Moderate: seepage, slope.	Severe: piping.	Deep to water	Favorable------	Favorable.
94C---------- Terril	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope.
100B---------- Copaston	Severe: depth to rock, seepage.	Severe: piping, thin layer.	Deep to water	Depth to rock, area reclaim.	Depth to rock, area reclaim.
102B---------- Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Erodes easily	Erodes easily.
106B---------- Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Erodes easily	Erodes easily.
106C2---------- Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, erodes easily.	Slope erodes easily.
109---------- Cordova	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
110---------- Marna	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness--------	Wetness, percs slowly.
112---------- Harps	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness.
113---------- Webster	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness.
114---------- Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding--------	Wetness.
118---------- Crippin	Moderate: seepage.	Moderate: wetness, piping.	Frost action---	Wetness, erodes easily.	Erodes easily.
130---------- Nicollet	Moderate: seepage.	Moderate: piping.	Frost action---	Wetness--------	Favorable.
134---------- Okoboji	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Not needed-----	Not needed.
196---------- Joliet	Severe: depth to rock.	Severe: excess humus, wetness.	Depth to rock, flooding, frost action.	Depth to rock, wetness.	Wetness, depth to rock.
206---------- Kasota	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy------	Favorable.
221---------- Canisteo	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Ponding--------	Wetness.
239---------- Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action---	Wetness--------	Favorable.
269---------- Millington	Moderate: seepage.	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding--------	Wetness.
283A---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.
283B---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.
283C---------- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
317---------- Oshawa	Slight---------	Severe: ponding.	Ponding, flooding, frost action.	Ponding--------	Wetness.
321---------- Tilfer	Moderate: seepage, depth to rock.	Severe: thin layer, wetness.	Thin layer, flooding, frost action.	Depth to rock, area reclaim, wetness.	Wetness, depth to rock, area reclaim.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
327A---------- Dickman	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy, soil blowing.	Droughty.
327B---------- Dickman	Severe: seepage.	Severe: seepage.	Deep to water	Too sandy, soil blowing.	Droughty.
329---------- Chaska	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness--------	Wetness.
336---------- Delft	Slight---------	Severe: wetness.	Frost action---	Wetness--------	Wetness.
386---------- Okoboji	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Not needed-----	Not needed.
463A---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Too sandy, soil blowing.	Favorable.
463B---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Too sandy------	Favorable.
525---------- Muskego	Severe: seepage.	Severe: excess humus, ponding.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
539---------- Klossner	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
574---------- Du Page	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable------	Favorable.
575---------- Nishna	Slight---------	Severe: wetness.	Percs slowly, flooding.	Wetness, percs slowly, erodes easily.	Wetness, percs slowly, erodes easily.
611F---------- Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
851*:					
Chaska----------	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness--------	Wetness.
Minneiska--------	Severe: seepage.	Severe: piping.	Deep to water	Too sandy, soil blowing.	Favorable.
Urban land.					
852*:					
Copaston---------	Severe: depth to rock, seepage.	Severe: piping, thin layer.	Deep to water	Depth to rock, area reclaim.	Depth to rock, area reclaim.
Urban land.					

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
854*:					
Cordova	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness.
Urban land.					
864B*:					
Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.
Urban land.					
864C*:					
Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
Urban land.					
920B*:					
Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Erodes easily	Erodes easily.
Storden	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily.
Hawick	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.
920C2*:					
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
921B*:					
Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Erodes easily	Erodes easily.
Storden	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily.
921C2*:					
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
923*:					
Copaston	Severe: depth to rock, seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, depth to rock, area reclaim.	Slope, depth to rock, area reclaim.
Rock outcrop.					
944F*:					
Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Estherville	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
945D2*, 945F*:					
Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
956*:					
Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness.
Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding	Wetness.
960D2*, 960F*:					
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
978*:					
Cordova	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness.
Rolfe	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding	Wetness, percs slowly.
1030*:					
Udorthents.					
Pits.					

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
1075*:					
Klossner	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding	Wetness.
Muskego	Severe: seepage.	Severe: piping, excess humus, ponding.	Ponding, subsides, frost action.	Ponding	Wetness.
1083*:					
Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action	Wetness	Favorable.
1083*:					
Urban land.					
1901B*:					
Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action	Wetness	Favorable.
Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Erodes easily	Erodes easily.
1917 Nishna	Slight	Severe: ponding.	Ponding, percs slowly, flooding.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
1931 Essexville	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Wetness.
1999*:					
Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Too sandy, soil blowing.	Favorable.
Kalmarville	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness flooding.	Wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
27A---------- Dickinson	0-19	Loam----------	ML, CL-ML, CL	A-4	0	100	100	85-95	50-60	15-30	NP-10
	19-29	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-4	0	100	100	85-95	35-50	15-30	NP-10
	29-36	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SC-SM	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	36-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
27B---------- Dickinson	0-16	Loam----------	ML, CL-ML, CL	A-4	0	100	100	85-95	50-60	15-30	NP-10
	16-25	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-4	0	100	100	85-95	35-50	15-30	NP-10
	25-33	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SC-SM	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	33-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
35---------- Blue Earth	0-8	Mucky silt loam	OL, ML	A-5	0	95-100	95-100	85-95	80-95	41-50	2-8
	8-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	95-100	80-100	80-95	80-95	41-50	2-8
39A---------- Wadena	0-11	Loam----------	ML	A-4	0	95-100	90-100	75-95	50-65	25-40	2-10
	11-36	Loam, sandy loam, clay loam.	SM, ML, CL, SC	A-4, A-6	0	95-100	80-100	75-95	40-60	25-40	5-12
	36-60	Gravelly coarse sand, gravelly sand, sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	45-100	35-100	10-80	2-10	---	NP
39B---------- Wadena	0-13	Loam----------	ML	A-4	0	95-100	90-100	75-95	50-65	25-40	2-10
	13-37	Loam, sandy loam, clay loam.	SM, ML, CL	A-4, A-6	0	95-100	80-100	75-95	40-60	25-40	5-12
	37-60	Gravelly coarse sand, gravelly sand, sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	45-100	35-100	10-80	2-10	---	NP
41B---------- Estherville	0-9	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	9-16	Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	16-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
84---------- Brownton	0-20	Silty clay-------	MH, CH	A-7	0	100	95-100	90-100	85-95	50-65	20-35
	20-41	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	100	95-100	90-100	85-95	50-80	25-40
	41-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	75-90	60-75	30-50	15-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
86---------- Canisteo	0-20	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	20-26	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	26-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
94B---------- Terril	0-26	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	26-34	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	34-60	Clay loam, loam, sandy loam.	CL, SC, SC-SM, CL-ML	A-6, A-4	0-5	95-100	90-100	65-95	35-85	20-40	5-20
94C---------- Terril	0-23	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	23-50	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	50-60	Clay loam, loam, sandy loam.	CL, SC, SC-SM, CL-ML	A-6, A-4	0-5	95-100	90-100	65-95	35-85	20-40	5-20
100B---------- Copaston	0-14	Loam----------	SM, ML	A-4	0	95-100	90-100	65-80	40-80	30-40	NP-10
	14-19	Fine sandy loam, sandy loam, loam.	SM	A-2, A-4	0-5	95-100	70-100	55-75	25-50	<35	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
102B---------- Clarion	0-13	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	13-39	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	39-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
106B---------- Lester	0-9	Loam----------	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	9-40	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	40-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
106C2---------- Lester	0-7	Loam----------	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	7-24	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	24-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
109---------- Cordova	0-14	Clay loam--------	CL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	14-30	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	30-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
110---------- Marna	0-16	Silty clay loam	MH, ML	A-7	0	95-100	90-100	90-100	85-95	45-65	15-30
	16-25	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	95-100	90-100	90-100	85-95	50-80	20-45
	25-60	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	60-80	35-50	15-25
112---------- Harps	0-19	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	35-55	15-35
	19-31	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	31-60	Loam, sandy clay loam, clay loam.	CL	A-6	0-5	95-100	90-100	70-80	50-75	25-40	10-25
113---------- Webster	0-19	Clay loam--------	CL, CH	A-7, A-6	0-5	95-100	95-100	85-95	70-90	35-60	15-30
	19-26	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	26-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
114---------- Glencoe	0-10	Silty clay loam	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
	10-27	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	27-38	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	38-60	Loam, clay loam	CL, ML	A-6	0	90-100	85-100	60-95	55-75	30-40	10-20
118---------- Crippin	0-14	Loam----------	CL	A-6, A-7	0	95-100	95-100	80-90	60-80	30-45	10-20
	14-31	Loam, clay loam	CL	A-6	0-5	95-100	90-100	80-90	60-80	30-40	10-20
	31-60	Loam, clay loam	CL	A-6	2-5	90-100	85-100	75-90	55-80	30-40	10-20
130---------- Nicollet	0-17	Clay loam--------	ML, CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	35-50	10-25
	17-34	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	34-60	Loam, clay loam	CL	A-6	0-5	95-100	90-100	75-90	50-75	30-40	15-25
134---------- Okoboji	0-10	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	10-26	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	26-50	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	50-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	45-55	20-30
196---------- Joliet	0-17	Silty clay loam	CL, OL	A-7, A-6	0-15	90-100	90-100	80-100	60-85	35-50	10-22
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
206---------- Kasota	0-14	Loam----------	ML, CL	A-6, A-4, A-7	0	95-100	85-100	65-90	50-80	25-45	8-20
	14-33	Clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	85-100	80-95	65-90	45-75	20-45
	33-60	Sand, coarse sand	SP, SP-SM	A-3, A-1, A-2	0-3	85-100	65-100	20-65	2-10	<20	NP
221---------- Canisteo	0-16	Silty clay loam	ML, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	16-36	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	85-95	65-85	35-50	15-25
	36-60	Clay loam, loam	CL	A-6	0-5	95-100	90-100	80-95	60-75	30-40	12-20
239---------- Le Sueur	0-15	Clay loam--------	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
	15-32	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	32-60	Loam, clay loam	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20
269---------- Millington	0-31	Clay loam--------	CL, ML, OL	A-7, A-6	0	100	90-100	90-100	90-100	35-50	11-20
	31-43	Loam, silty clay loam, clay loam.	CL	A-7, A-6	0	95-100	90-100	80-100	70-95	28-50	10-22
	43-60	Stratified sandy loam to silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	80-100	80-100	80-100	60-95	20-45	5-20
283A---------- Plainfield	0-10	Loamy sand-------	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	10-21	Loamy sand-------	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	21-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
283B---------- Plainfield	0-9	Loamy sand-------	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	9-20	Sand, loamy sand	SP, SM, SP-SM	A-3, A-1, A-2, A-4	0	75-100	75-100	40-70	1-40	---	NP
	20-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
283C---------- Plainfield	0-8	Loamy sand-------	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	8-20	Loamy sand, sand	SP, SM, SP-SM	A-3, A-1, A-2, A-4	0	75-100	75-100	40-90	1-40	---	NP
	20-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
317---------- Oshawa	0-10	Silty clay loam	MH, CH	A-7	0	95-100	95-100	95-100	90-100	50-70	20-40
	10-60	Loam, silt loam, silty clay loam.	CL	A-6	0	95-100	95-100	90-100	85-95	30-40	10-15
321---------- Tilfer	0-10	Silty clay loam	MH, OL, ML, OH	A-7, A-6	0	90-95	85-95	80-90	65-75	35-55	10-25
	10-27	Loam, clay loam, silty clay loam.	SC, CL	A-6, A-7	2-5	90-95	85-90	60-70	45-70	35-45	11-20
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
327A---------- Dickman	0-9	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0	95-100	95-100	55-95	25-40	20-30	2-8
	9-18	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	95-100	85-100	55-95	25-45	15-25	2-8
	18-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	95-100	75-100	50-80	5-10	---	NP
327B---------- Dickman	0-10	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0	95-100	95-100	55-95	25-40	20-30	2-8
	10-14	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	95-100	85-100	55-95	25-45	15-25	2-8
	14-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	95-100	75-100	50-80	5-10	---	NP
329---------- Chaska	0-9	Loam----------	OL, CL, ML	A-4, A-6	0	100	100	90-100	70-80	30-40	5-15
	9-35	Stratified fine sandy loam to silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-95	60-75	20-50	5-25
	35-60	Stratified silt loam to silty clay loam.	SM, ML	A-4, A-7	0	100	100	85-95	65-75	30-50	5-25
336---------- Delft	0-20	Clay loam--------	CL, ML	A-6, A-7	0	95-100	90-100	75-90	60-80	30-45	10-20
	20-36	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-90	60-80	30-45	10-20
	36-51	Loam, clay loam, silt loam.	CL, ML	A-6, A-4	0	95-100	90-100	70-90	50-75	25-40	7-15
	51-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-6, A-4	0-5	90-100	85-100	55-90	50-85	20-40	3-15

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
386---------- Okoboji	0-12	Mucky silty clay loam.	MH	A-7	0	100	100	95-100	90-95	60-90	10-30
	12-30	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	30-48	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	48-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	45-55	20-30
463A---------- Minneiska	0-9	Sandy loam-------	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
	9-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	<20	NP-4
463B---------- Minneiska	0-8	Loam----------	ML, CL, CL-ML	A-4	0	100	95-100	70-90	50-75	20-35	3-10
	8-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	<20	NP-4
525---------- Muskego	0-8	Muck----------	PT	A-8	0	---	---	---	---	---	---
	8-25	Muck----------	PT	A-8	0	---	---	---	---	---	---
	25-60	Coprogenous earth	OL	A-5	0	95-100	95-100	85-100	75-96	40-50	2-8
539---------- Klossner	0-26	Muck----------	PT	A-8	0	---	---	---	---	---	---
	26-36	Mucky silt loam, mucky silty clay loam.	MH	A-7	0	100	95-100	90-100	85-95	60-90	10-30
	36-48	Clay loam, loam, silty clay loam.	CL-ML, CL	A-7, A-6	0	95-100	90-100	80-100	60-90	35-65	20-30
	48-60	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	90-100	85-100	60-95	55-80	30-55	10-25
574---------- Du Page	0-10	Loam----------	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-45	11-21
	10-60	Loam, silt loam	CL, ML	A-4, A-6	0	95-100	95-100	90-100	70-95	30-45	11-21
575---------- Nishna	0-20	Silty clay loam	CH, MH	A-7	0	100	100	95-100	90-100	55-65	25-35
	20-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	60-70	30-40
611F---------- Hawick	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	9-19	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-25	---	NP
	19-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-95	50-95	30-65	2-10	---	NP
851*:											
Chaska----------	0-7	Loam----------	OL, CL, ML	A-4, A-6	0	100	100	90-100	70-80	30-40	5-15
	7-60	Stratified loam to sand.	SM, ML	A-4	0	100	100	85-95	35-75	<35	NP-7
Minneiska-------	0-10	Sandy loam-------	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
	10-60	Stratified loam to sand.	SM, ML, CL	A-4, A-6	0	100	85-100	50-90	35-60	<20	NP-4

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
851*:											
Urban land.											
852*:											
Copaston	0-10	Loam	SM, ML	A-4	0	95-100	90-100	65-80	40-80	30-40	NP-10
	10-20	Fine sandy loam, sandy loam, loam.	SM	A-2, A-4	0-5	95-100	70-100	55-75	25-50	<35	NP-10
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
854*:											
Cordova	0-21	Clay loam	CL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	21-44	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	44-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
Urban land.											
864B*:											
Plainfield	0-10	Loamy sand	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	10-15	Sand, loamy sand	SP, SM, SP-SM	A-3, A-1, A-2, A-4	0	75-100	75-100	40-90	1-40	---	NP
	15-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
Urban land.											
864C*:											
Plainfield	0-8	Loamy sand	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	8-20	Sand, loamy sand	SP, SM, SP-SM	A-3, A-1, A-2, A-4	0	75-100	75-100	40-90	1-40	---	NP
	20-60	Sand, fine sand, coarse sand.	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
Urban land.											
920B*:											
Clarion	0-10	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	10-29	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	29-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
920B*:											
Hawick----------	0-10	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	10-22	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-25	---	NP
	22-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-95	50-95	30-65	2-10	---	NP
920C2*:											
Clarion---------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-29	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	29-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden---------	0-6	Loam-------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	6-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Hawick----------	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	9-23	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-25	---	NP
	23-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-95	50-95	30-65	2-10	---	NP
921B*:											
Clarion---------	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	10-21	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	21-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden---------	0-8	Loam-------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
921C2*:											
Clarion---------	0-7	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	7-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	23-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden---------	0-6	Loam-------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	6-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
923*:											
Copaston--------	0-6	Loam-------------	SM, ML	A-4	0	95-100	90-100	65-80	40-80	30-40	NP-10
	6-9	Fine sandy loam, sandy loam, loam.	SM	A-2, A-4	0-5	95-100	70-100	55-75	25-50	<35	NP-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
944F*:											
Lester	0-6	Loam	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	6-20	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	20-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
Storden	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Estherville	0-7	Sandy loam	SM, SC-SM, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	7-13	Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	13-60	Coarse sand, gravelly coarse sand, loamy coarse sand, sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
945D2*:											
Lester	0-7	Loam	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	7-20	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	20-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
Storden	0-9	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	9-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
945F*:											
Lester	0-8	Loam	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	8-26	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	26-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
Storden	0-4	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	4-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
956*:											
Canisteo	0-10	Clay loam	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	10-22	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	22-30	Clay loam, loam, sandy loam.	CL, ML, SM, SC	A-6, A-4	0-5	90-100	80-95	60-90	40-80	30-40	5-15
	30-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
Glencoe	0-10	Silty clay loam	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
	10-20	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	20-28	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	28-60	Loam, clay loam	CL, ML	A-6	0	90-100	85-100	60-95	55-75	30-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
960D2*:											
Storden	0-9	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	9-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	25-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
960F*:											
Storden	0-6	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	6-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	9-24	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	24-60	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
978*:											
Cordova	0-17	Clay loam	CL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	17-41	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	41-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
Rolfe	0-17	Silt loam	OL, CL, ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	17-36	Clay, silty clay, clay loam.	CH	A-7	0	100	95-100	90-100	75-95	50-65	25-35
	36-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-45	10-20
1030*:											
Udorthents.											
Pits.											
1075*:											
Klossner	0-40	Muck	PT	A-8	0	---	---	---	---	---	---
	40-60	Clay loam, loam, mucky silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	90-100	85-100	80-100	60-90	25-55	10-30
Muskego	0-35	Muck	PT	A-8	0	---	---	---	---	---	---
	35-60	Coprogenous earth	OL, ML	A-5	0	95-100	95-100	85-100	75-96	41-50	2-8
1083*:											
Le Sueur	0-15	Clay loam	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
	15-30	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	30-60	Loam, clay loam	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20
Urban land.											
1901B*:											
Le Sueur	0-15	Clay loam	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
	15-37	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	37-60	Loam, clay loam	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1901B*:											
Lester----------	0-8	Loam----------	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	8-25	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	25-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
1917----------	0-35	Silty clay-------	CH, MH	A-7	0	100	100	95-100	90-100	50-65	25-35
Nishna	35-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	60-70	30-40
1931----------	0-12	Sandy loam-------	SM, SC-SM	A-4	0	100	95-100	60-90	35-50	<25	NP-7
Essexville	12-25	Loamy fine sand, fine sand, sand.	SM, SC-SM, SP-SM	A-1-b, A-2-4, A-3, A-4	0	90-100	80-100	40-85	5-45	<25	NP-7
	25-60	Loam, clay loam, silty clay loam.	CL	A-4, A-6	0	95-100	90-100	80-95	55-90	20-38	8-25
1999*:											
Minneiska-------	0-10	Sandy loam-------	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
	10-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	<20	NP-4
Kalmarville-----	0-46	Stratified loam, silt loam, loamy fine sand.	ML, CL, CL-ML, SP-SM	A-4, A-1	0	95-100	90-100	85-100	50-90	15-35	NP-10
	46-60	Coarse sand, sand, loamy fine sand.	SP, SM, SW, SP-SM	A-3, A-2, A-1	0-2	90-100	85-100	40-80	2-30	<25	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
27A	0-19	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.24	4	5	1-2
Dickinson	19-29	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low	0.20			
	29-36	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low	0.20			
	36-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low	0.15			
27B	0-16	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.24	4	5	1-2
Dickinson	16-25	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low	0.20			
	25-33	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low	0.20			
	33-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low	0.15			
35	0-8	18-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Moderate	0.28	5	4L	10-25
Blue Earth	8-60	18-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Low	0.28			
39A	0-11	18-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	4	6	3-6
Wadena	11-36	18-30	1.35-1.50	0.6-2.0	0.14-0.19	5.6-7.3	Low	0.32			
	36-60	1-5	1.55-1.65	>20	0.02-0.04	6.6-8.4	Low	0.10			
39B	0-13	18-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	4	6	3-6
Wadena	13-37	18-30	1.35-1.50	0.6-2.0	0.14-0.19	5.6-7.3	Low	0.32			
	37-60	1-5	1.55-1.65	>20	0.02-0.04	6.6-8.4	Low	0.10			
41B	0-9	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	2-4
Estherville	9-16	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low	0.20			
	16-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			
84	0-20	40-55	1.20-1.30	0.06-0.2	0.13-0.18	7.4-8.4	High	0.28	5	4	4-8
Brownton	20-41	35-60	1.20-1.30	0.06-0.2	0.13-0.16	7.4-8.4	High	0.28			
	41-60	25-35	1.45-1.70	0.2-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
86	0-20	27-35	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.24	5	4L	4-8
Canisteo	20-26	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	26-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
94B	0-26	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	5	6	4-5
Terril	26-34	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low	0.24			
	34-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
94C	0-23	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	5	6	4-5
Terril	23-50	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low	0.24			
	50-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
100B	0-14	14-23	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.28	2	5	2-5
Copaston	14-19	14-20	1.40-1.60	0.6-6.0	0.15-0.17	5.6-7.3	Low	0.28			
	19	---	---	---	---	---	---	---			
102B	0-13	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
Clarion	13-39	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	39-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
106B	0-9	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
Lester	9-40	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	40-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
106C2	0-7	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
Lester	7-24	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	24-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
109	0-14	27-30	1.25-1.45	0.2-0.6	0.18-0.22	6.1-7.3	Moderate	0.28	5	6	4-7
Cordova	14-30	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-6.5	Moderate	0.28			
	30-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
110	0-16	35-40	1.20-1.30	0.06-0.2	0.18-0.22	6.1-7.3	High	0.28	5	4	4-8
Marna	16-25	35-60	1.25-1.40	0.06-0.2	0.13-0.16	6.1-7.3	High	0.28			
	25-60	24-35	1.45-1.70	0.2-2.0	0.14-0.19	6.6-8.4	Moderate	0.28			
112	0-19	27-35	1.35-1.40	0.6-2.0	0.19-0.21	7.9-8.4	Moderate	0.24	5	4L	4-5
Harps	19-31	18-32	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Moderate	0.32			
	31-60	20-30	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			
113	0-19	27-35	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate	0.24	5	6	6-7
Webster	19-26	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate	0.32			
	26-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			
114	0-10	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28	5	7	5-10
Glencoe	10-27	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	27-38	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	0.28			
	38-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low	0.28			
118	0-14	22-27	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	Low	0.28	5	4L	5-6
Crippin	14-31	24-30	1.40-1.55	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.28			
	31-60	22-28	1.55-1.75	0.6-2.0	0.17-0.19	7.9-8.4	Low	0.37			
130	0-17	27-35	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate	0.24	5	6	4-8
Nicollet	17-34	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate	0.32			
	34-60	22-32	1.35-1.55	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.32			
134	0-10	35-42	1.25-1.30	0.2-0.6	0.21-0.23	6.1-7.8	High	0.37	5	4	7-10
Okoboji	10-26	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
	26-50	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High	0.37			
	50-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate	0.28			
196	0-17	27-35	1.10-1.30	0.6-2.0	0.15-0.23	6.1-8.4	Moderate	0.28	2	7	4-5
Joliet	17	---	---	---	---	---	---	---			
206	0-14	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.28	4	6	3-6
Kasota	14-33	35-60	1.30-1.50	0.2-0.6	0.12-0.18	5.6-6.5	High	0.32			
	33-60	1-5	1.50-1.70	6.0-20	0.02-0.06	7.4-8.4	Low	0.15			
221	0-16	27-32	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.24	5	4L	4-8
Canisteo	16-36	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	36-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
239	0-15	28-30	1.50-1.70	0.6-2.0	0.17-0.20	5.6-7.3	Moderate	0.24	5	6	2-4
Le Sueur	15-32	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.32			
	32-60	20-30	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
269	0-31	27-35	1.40-1.60	0.6-2.0	0.17-0.23	7.4-8.4	Moderate	0.28	5	4L	4-6
Millington	31-43	18-35	1.40-1.60	0.6-2.0	0.17-0.20	7.4-8.4	Moderate	0.28			
	43-60	18-35	1.50-1.70	0.6-2.0	0.14-0.20	7.4-8.4	Moderate	0.28			
283A	0-10	3-7	1.50-1.65	6.0-20	0.09-0.12	5.1-7.3	Low	0.17	3	2	.5-2
Plainfield	10-21	3-7	1.50-1.65	6.0-20	0.09-0.11	4.5-6.5	Low	0.17			
	21-60	0-4	1.50-1.70	6.0-20	0.03-0.07	4.5-6.5	Low	0.15			
283B	0-9	3-7	1.50-1.65	6.0-20	0.09-0.12	5.1-7.3	Low	0.17	3	2	.5-2
Plainfield	9-20	3-7	1.50-1.65	6.0-20	0.09-0.11	4.5-6.5	Low	0.17			
	20-60	0-4	1.50-1.70	6.0-20	0.03-0.07	4.5-6.5	Low	0.15			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
283C	0-8	3-7	1.50-1.65	6.0-20	0.09-0.12	5.1-7.3	Low	0.17	3	2	.5-2
Plainfield	8-20	0-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	Low	0.17			
	20-60	0-4	1.50-1.70	6.0-20	0.03-0.07	4.5-6.5	Low	0.15			
317	0-10	28-35	1.15-1.30	0.2-0.6	0.18-0.22	7.4-7.8	Moderate	0.28	5	8	4-10
Oshawa	10-60	18-35	1.30-1.35	0.2-0.6	0.17-0.19	7.4-7.8	Low	0.28			
321	0-10	27-32	1.35-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate	0.28	4	4L	5-6
Tilfer	10-27	18-30	1.40-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.28			
	27	---	---	---	---	---	---	---			
327A	0-9	6-18	1.30-1.40	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.20	3	3	2-4
Dickman	9-18	6-18	1.35-1.50	2.0-6.0	0.12-0.14	5.6-7.3	Low	0.20			
	18-60	1-10	1.50-1.60	6.0-20	0.02-0.07	5.6-7.8	Low	0.15			
327B	0-10	6-18	1.30-1.40	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.20	3	3	2-4
Dickman	10-14	6-18	1.35-1.50	2.0-6.0	0.12-0.14	5.6-7.3	Low	0.20			
	14-60	1-10	1.50-1.60	6.0-20	0.02-0.07	5.6-7.8	Low	0.15			
329	0-9	18-27	1.30-1.60	0.6-2.0	0.20-0.22	6.6-7.8	Low	0.28	5	4L	2-5
Chaska	9-35	18-27	1.40-1.65	0.6-2.0	0.17-0.19	7.4-7.8	Low	0.28			
	35-60	18-35	1.40-1.65	0.2-2.0	0.07-0.16	7.4-8.4	Moderate	0.28			
336	0-20	25-35	1.40-1.65	0.2-0.6	0.18-0.20	5.6-7.8	Moderate	0.24	5	6	4-8
Delft	20-36	18-35	1.40-1.55	0.2-2.0	0.19-0.22	5.6-7.8	Moderate	0.24			
	36-51	18-32	1.30-1.40	0.6-2.0	0.19-0.22	6.6-7.8	Low	0.32			
	51-60	15-32	1.40-1.55	0.2-2.0	0.15-0.19	7.4-8.4	Low	0.32			
386	0-12	20-30	1.20-1.25	0.6-2.0	0.22-0.25	6.1-7.8	Moderate	0.37	5	6	10-18
Okoboji	12-30	35-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
	30-48	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High	0.37			
	48-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate	0.28			
463A	0-9	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-8.4	Low	0.20	5	3	2-5
Minneiska	9-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low	0.28			
463B	0-8	10-27	1.30-1.40	2.0-6.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	2-5
Minneiska	8-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low	0.28			
525	0-8	---	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	---	---	4	2	60-90
Muskego	8-25	---	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	---	---			
	25-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	6.6-8.4	Moderate	0.28			
539	0-26	---	0.25-0.55	0.2-6.0	0.35-0.48	5.6-7.8	---	---	5	2	25-60
Klossner	26-36	22-35	1.10-1.25	0.6-2.0	0.22-0.26	6.1-7.8	Moderate	0.37			
	36-48	22-35	1.30-1.40	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	48-60	15-32	1.35-1.50	0.6-2.0	0.15-0.19	6.1-8.4	Low	0.28			
574	0-10	18-27	1.40-1.60	0.6-2.0	0.22-0.24	6.6-8.4	Moderate	0.28	5	6	3-5
Du Page	10-60	18-27	1.40-1.60	0.6-2.0	0.22-0.24	7.4-8.4	Moderate	0.28			
575	0-20	36-40	1.30-1.35	0.06-0.2	0.12-0.14	7.4-8.4	High	0.37	5	4	4-6
Nishna	20-60	38-46	1.35-1.40	0.06-0.2	0.11-0.13	7.4-8.4	High	0.28			
611F	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low	0.17	3	3	1-4
Hawick	9-19	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low	0.10			
	19-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low	0.10			
851*:											
Chaska	0-7	18-27	1.30-1.60	0.6-2.0	0.20-0.22	6.6-7.8	Low	0.28	5	4L	2-5
	7-60	2-35	1.40-1.65	2.0-6.0	0.07-0.16	7.4-8.4	Low	0.28			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
851*:											
Minneiska	0-10	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-8.4	Low	0.20	5	3	2-5
	10-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low	0.28			
Urban land.											
852*:											
Copaston	0-10	14-23	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.28	2	5	2-5
	10-20	14-20	1.40-1.60	0.6-6.0	0.15-0.17	5.6-7.3	Low	0.28			
	20	---	---	---	---	---	---	---			
Urban land.											
854*:											
Cordova	0-21	27-30	1.25-1.45	0.2-0.6	0.18-0.22	6.1-7.3	Moderate	0.28	5	6	4-7
	21-44	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-6.5	Moderate	0.28			
	44-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
Urban land.											
864B*:											
Plainfield	0-10	3-7	1.50-1.65	6.0-20	0.09-0.12	5.1-7.3	Low	0.17	5	2	.5-2
	10-15	3-7	1.50-1.65	6.0-20	0.09-0.12	4.5-6.5	Low	0.17			
	15-60	0-4	1.50-1.70	6.0-20	0.03-0.07	4.5-6.5	Low	0.15			
Urban land.											
864C*:											
Plainfield	0-8	3-7	1.50-1.65	6.0-20	0.09-0.12	5.1-7.3	Low	0.17	5	2	.5-2
	8-20	3-7	1.50-1.65	6.0-20	0.09-0.12	4.5-6.5	Low	0.17			
	20-60	0-4	1.50-1.70	6.0-20	0.03-0.07	4.5-6.5	Low	0.15			
Urban land.											
920B*:											
Clarion	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	10-29	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	29-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Hawick	0-10	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low	0.17	3	3	1-4
	10-22	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low	0.10			
	22-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low	0.10			
920C2*:											
Clarion	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	8-29	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	29-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-6	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	6-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Hawick	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low	0.17	3	3	1-4
	9-23	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low	0.10			
	23-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low	0.10			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
921B*:											
Clarion	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	10-21	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	21-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
921C2*:											
Clarion	0-7	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	7-23	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	23-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Storden	0-6	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	6-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
923*:											
Copaston	0-6	14-23	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.28	2	5	2-5
	6-9	14-20	1.40-1.60	0.6-6.0	0.15-0.17	5.6-7.3	Low	0.28			
	9	---	---	---	---	---	---	----			
Rock outcrop.											
944F*:											
Lester	0-6	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	6-20	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	20-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Storden	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Estherville	0-7	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	3	3	2-4
	7-13	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low	0.20			
	13-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low	0.10			
945D2*:											
Lester	0-7	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	7-20	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	20-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Storden	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
945F*:											
Lester	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	8-26	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	26-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Storden	0-4	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	4-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
956*:											
Canisteo	0-10	27-35	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.24	5	4L	4-8
	10-22	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	22-30	10-35	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Low	0.32			
	30-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
956*:											
Glencoe	0-10	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28	5	7	5-10
	10-20	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	20-28	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	0.28			
	28-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low	0.28			
960D2*:											
Storden	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Clarion	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	8-25	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	25-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
960F*:											
Storden	0-6	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
	6-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Clarion	0-9	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-5
	9-24	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	24-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
978*:											
Cordova	0-17	27-30	1.25-1.45	0.2-0.6	0.18-0.22	6.1-7.3	Moderate	0.28	5	6	4-7
	17-41	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-6.5	Moderate	0.28			
	41-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
Rolfe	0-17	22-27	1.35-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.28	3	6	3-5
	17-36	38-45	1.40-1.50	0.06-0.2	0.11-0.13	6.1-7.3	High	0.28			
	36-60	24-35	1.50-1.60	0.2-2.0	0.14-0.16	6.1-8.4	Moderate	0.28			
1030*:											
Udorthents.											
Pits.											
1075*:											
Klossner	0-40	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	---	---	5	8	25-60
	40-60	20-35	1.45-1.70	0.2-2.0	0.14-0.22	6.1-8.4	Moderate	0.28			
Muskego	0-35	---	0.10-0.21	0.2-6.0	0.35-0.45	5.6-7.3	---	---	4	8	25-60
	35-60	18-35	0.30-1.10	0.6-2.0	0.18-0.24	6.6-8.4	Moderate	0.28			
1083*:											
Le Sueur	0-15	28-30	1.50-1.70	0.6-2.0	0.17-0.20	5.6-7.3	Moderate	0.24	5	6	2-4
	15-30	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.32			
	30-60	20-30	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
Urban land.											
1901B*:											
Le Sueur	0-15	28-30	1.50-1.70	0.6-2.0	0.17-0.20	5.6-7.3	Moderate	0.24	5	6	2-4
	15-37	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.32			
	37-60	20-30	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
Lester	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	8-25	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	25-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1917	0-35	40-44	1.30-1.35	0.06-0.2	0.12-0.14	7.4-8.4	High	0.37	5	4	6-10
Nishna	35-60	38-40	1.35-1.40	0.06-0.2	0.11-0.13	7.4-8.4	High	0.28			
1931	0-12	12-18	1.30-1.50	2.0-6.0	0.13-0.18	7.4-8.4	Low	0.20	5	3	4-8
Essexville	12-25	2-12	1.40-1.55	6.0-20	0.04-0.12	7.4-8.4	Low	0.17			
	25-60	10-35	1.45-1.70	0.2-0.6	0.12-0.20	7.4-8.4	Moderate	0.32			
1999*:											
Minneiska	0-10	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-8.4	Low	0.20	5	3	2-5
	10-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low	0.28			
Kalmarville	0-46	13-23	1.35-1.45	0.6-2.0	0.20-0.24	6.6-7.8	Low	0.28	5	5	2-4
	46-60	2-5	1.55-1.65	6.0-20	0.06-0.09	6.6-7.8	Low	0.10			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
27A, 27B-------- Dickinson	B	None--------|	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
35-------------- Blue Earth	B/D	None--------|	---	---	+2-1.0	Apparent	Jan-Dec	>60	---	---	High-----	High-----	Low.
39A, 39B-------- Wadena	B	None--------|	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Low.
41B-------------- Estherville	B	None--------|	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Low.
84-------------- Brownton	C/D	None--------|	---	---	1.0-2.5	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Low.
86-------------- Canisteo	B/D	None--------|	---	---	1.0-3.0	Apparent	Oct-Jul	>60	---	---	High-----	High-----	Low.
94B, 94C-------- Terril	B	None--------|	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate	Low.
100B------------ Copaston	D	None--------|	---	---	>6.0	---	---	8-20	Hard	---	Moderate	Low------	Low.
102B------------ Clarion	B	None--------|	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Low.
106B, 106C2----- Lester	B	None--------|	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
109------------- Cordova	C/D	None--------|	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Low.
110------------- Marna	C/D	None--------|	---	---	1.0-2.5	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Low.
112------------- Harps	B/D	None--------|	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
113--Webster	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
114--Glencoe	B/D	None	---	---	+1-1.0	Apparent	Oct-Jul	>60	---	---	High	High	Low.
118--Crippin	B	None	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
130--Nicollet	B	None	---	---	2.5-5.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
134--Okoboji	B/D	None	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
196--Joliet	D	Occasional	Brief	Apr-Jun	0-1.0	Perched	Mar-Jun	10-20	Hard	---	High	High	Low.
206--Kasota	C	None	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate	Low.
221--Canisteo	B/D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High	High	Low.
239--Le Sueur	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	---	High	High	Low.
269--Millington	B/D	Occasional	Brief	Apr-Jun	1.0-2.0	Apparent	Mar-Jul	>60	---	---	High	High	Low.
283A, 283B, 283C--Plainfield	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	High.
317--Oshawa	D	Frequent	Long	Mar-Jul	+1-1.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
321--Tilfer	B/D	Occasional	Brief	Feb-Nov	0-2.0	Apparent	Nov-Jul	20-40	Hard	---	High	High	Low.
327A, 327B--Dickman	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
329--Chaska	B/D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
336--Delft	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
386--Okoboji	B/D	None	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
463A--Minneiska	B	Occasional	Very brief or brief.	Mar-Jul	3.0-6.0	Apparent	Mar-Jun	>60	---	---	Moderate	Low	Low.
463B--Minneiska	B	Rare	---	---	3.0-6.0	Apparent	Mar-Jun	>60	---	---	Moderate	Low	Low.
525--Muskego	A/D	None	---	---	+1-1.0	Apparent	Nov-Aug	>60	---	35-45	High	Moderate	Moderate.
539--Klossner	A/D	None	---	---	+1-1.0	Apparent	Oct-Jul	>60	---	16-32	High	High	Moderate.
574--Du Page	B	Occasional	Brief	Apr-Jun	4.0-6.0	Apparent	Feb-Jun	>60	---	---	Moderate	Low	Low.
575--Nishna	C/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	---	Moderate	High	Low.
611F--Hawick	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Low.
851*:													
Chaska	B/D	Rare	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
Minneiska	B	None or rare	---	---	3.0-6.0	Apparent	Mar-Jun	>60	---	---	Moderate	Low	Low.
Urban land.													
852*:													
Copaston	D	None	---	---	>6.0	---	---	8-20	Hard	---	Moderate	Low	Low.
Urban land.													

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
854*:													
Cordova	C/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
Urban land.													
864B*, 864C*:													
Plainfield	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	High.
Urban land.													
920B*, 920C2*:													
Clarion	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
Storden	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
Hawick	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Low.
921B*, 921C2*:													
Clarion	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
Storden	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
923*:													
Copaston	D	None	---	---	>6.0	---	---	8-20	Hard	---	Moderate	Low	Low.
Rock outcrop.													
944F*:													
Lester	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Moderate.
Storden	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
Estherville	B	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Low.
945D2*, 945F*:													
Lester	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Moderate.
Storden	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
956*:													
Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	>60	---	---	High	High	Low.
Glencoe	B/D	None	---	---	+1-1.0	Apparent	Oct-Jul	>60	---	---	High	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
960D2*, 960F*:													
Storden	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
Clarion	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Low.
978*:													
Cordova	C/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
Rolfe	C	None	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	---	High	High	Moderate.
1030*:													
Udorthents	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	High	Moderate.
Pits.													
1075*:													
Klossner	D	None	---	---	+3-1.0	Apparent	Jan-Dec	>60	---	25-32	High	High	Moderate.
Muskego	D	None	---	---	+3-1.0	Apparent	Jan-Dec	>60	---	30-40	High	Moderate	Moderate.
1083*:													
Le Sueur	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	---	High	High	Low.
Urban land.													
1901B*:													
Le Sueur	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	---	High	High	Low.
Lester	B	None	---	---	>6.0	---	---	>60	---	---	Moderate	Low	Moderate.
1917 Nishna	D	Frequent	Long	Mar-Nov	+1-1.0	Apparent	Jan-Dec	>60	---	---	Moderate	High	Low.
1931 Essexville	A/D	None	---	---	0-1.0	Apparent	Nov-May	>60	---	---	High	High	Low.
1999*:													
Minneiska	B	Frequent	Very brief or brief.	Mar-Jul	3.0-6.0	Apparent	Mar-Jun	>60	---	---	Moderate	Low	Low.
Kalmarville	B/D	Frequent	Brief	Mar-Jun	0-1.0	Apparent	Nov-Aug	>60	---	---	High	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Blue Earth---	Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents
Brownton-----	Fine, montmorillonitic (calcareous), mesic Typic Haplaquolls
Canisteo-----	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Chaska-------	Fine-loamy, mixed (calcareous), mesic Aeric Fluvaquents
Clarion------	Fine-loamy, mixed, mesic Typic Hapludolls
Copaston-----	Loamy, mixed, mesic Lithic Hapludolls
Cordova------	Fine-loamy, mixed, mesic Typic Argiaquolls
Crippin------	Fine-loamy, mixed, mesic Aquic Hapludolls
Delft--------	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Dickinson----	Coarse-loamy, mixed, mesic Typic Hapludolls
Dickman------	Sandy, mixed, mesic Typic Hapludolls
Du Page------	Fine-loamy, mixed, mesic Cumulic Hapludolls
Essexville---	Sandy over loamy, mixed (calcareous), mesic Typic Haplaquolls
Estherville--	Sandy, mixed, mesic Typic Hapludolls
Glencoe------	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Harps--------	Fine-loamy, mesic Typic Calciaquolls
Hawick-------	Sandy, mixed, mesic Entic Hapludolls
*Joliet-------	Loamy, mixed, mesic Lithic Haplaquolls
*Kalmarville--	Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Kasota-------	Clayey over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls
Klossner-----	Loamy, mixed, euic, mesic Terric Medisaprists
Le Sueur-----	Fine-loamy, mixed, mesic Aquic Argiudolls
Lester-------	Fine-loamy, mixed, mesic Mollic Hapludalfs
Marna--------	Fine, montmorillonitic, mesic Typic Haplaquolls
Millington---	Fine-loamy, mixed (calcareous), mesic Cumulic Haplaquolls
Minneiska----	Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents
Muskego------	Coprogenous, euic, mesic Limnic Medisaprists
Nicollet-----	Fine-loamy, mixed, mesic Aquic Hapludolls
Nishna-------	Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls
Okoboji------	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Oshawa-------	Fine-loamy, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Plainfield---	Mixed, mesic Typic Udipsamments
Rolfe--------	Fine, montmorillonitic, mesic Typic Argialbolls
Storden------	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Terril-------	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tilfer-------	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Udorthents---	Udorthents
Wadena-------	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Webster------	Fine-loamy, mixed, mesic Typic Haplaquolls

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