United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Sibley County, Minnesota

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How To Use This Soil Survey

General Soil Map

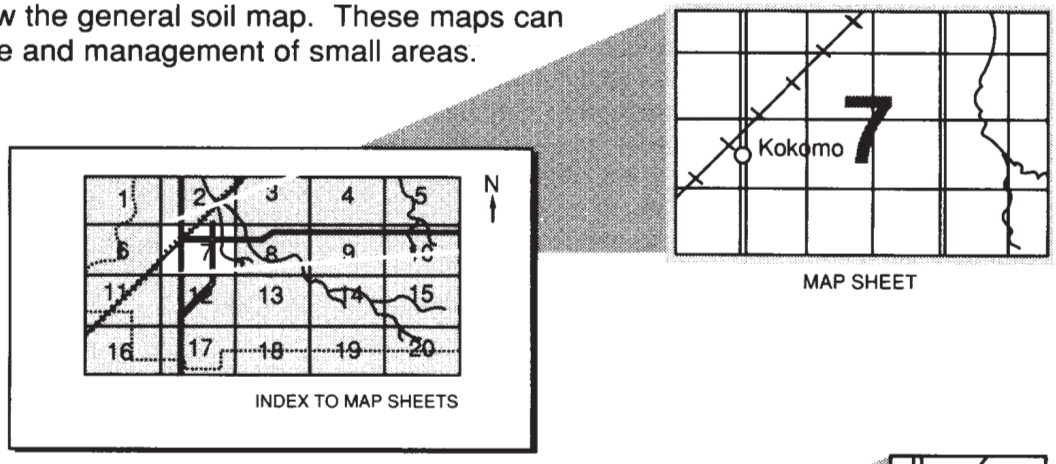
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

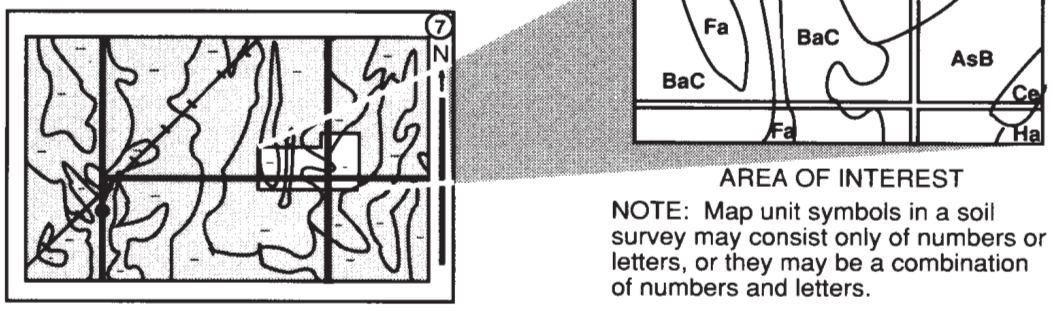
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Sibley County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Sibley County. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources.

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 Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An outwash terrace in an area of the Cordova-Lester-Le Sueur association near the Minnesota River. Glacial till uplands are in the background.

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Issued September 1997

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Summary of Tables

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Foreword

This soil survey contains information that can be used in land-planning programs in Sibley 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, crop consultants, 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 too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of Sibley County, Minnesota

By Michael J. Domeier, Natural Resources Conservation Service

Fieldwork by Michael J. Domeier, Thomas W. Neuenfeldt, and Richard J. Bednarek, Jr., Natural Resources Conservation Service, and Gary S. Elsner and H. Gerald Floren, Jr., Minnesota Agricultural Experiment Station

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

SIBLEY COUNTY is in the central part of Minnesota, along the Minnesota River (fig. 1). It has a total area of 384,000 acres, of which about 4,400 acres is water. Gaylord, the county seat, is about 60 miles southwest of Minneapolis and 80 miles north of the Iowa border. The main highways are Minnesota Highways 5, 19, and 22.

About 80 percent of the land area is farmed. The principal crops are corn and soybeans. Small acreages of oats, wheat, hay, and specialty crops, such as peas, sugar beets, and sweet corn, are also grown. Hogs, dairy cattle, and poultry are the main livestock enterprises, but some beef cattle and sheep are also produced in the county.

The soils are very deep and dark colored. The landscape is generally gently sloping, but slopes range from nearly level to very steep. Most of the soils formed in loamy glacial till. A few formed in loamy and sandy glacial outwash, loamy and sandy alluvial sediments, and clayey glacial lacustrine sediments. The native vegetation was tall and medium prairie grasses in the west and central parts of the county and oak savannah, brush, and forest in the eastern part of the county. The county is part of the transition zone between what was known as the "Big Woods," which extended to the east, and the native grassland prairie to the west.

General Nature of the County

This section provides some general information about Sibley County. It describes geology; history and development; physiography, relief, and drainage; and climate.

Geology

Glacial drift of Wisconsin age forms the uppermost geologic unit in Sibley County. It is generally hundreds of feet thick and covers 95 percent of the county. Cretaceous sedimentary rocks and Precambrian metamorphic and igneous rocks underlie the glacial till.

Four glacial advances and recessions, which can be attributed to the climatic fluctuations of the Wisconsin stage of glaciation, are recorded in the Quaternary deposits in the southern part of Minnesota (Wright and Ruhe, 1965). The last of these glacial advances, called the Des Moines lobe, moved south from the Winnipeg lowland in Canada along the Minnesota River lowland and covered all of the survey area. This advance spread a broad sheet of distinctive shale-rich, calcareous till. The soils of Sibley County formed in this deposit (Wright, 1972).

As the Des Moines lobe melted back into the Red River basin, the water ponded and formed glacial Lake Agassiz. During its early stage, Lake Agassiz had just one outlet, the glacial River Warren. The large volume of water carried by the River Warren entrenched itself into the landscape and formed the wide and deep channel of the present-day Minnesota River. The current river carries only a small fraction of the volume of the glacial River Warren and is a classic example of

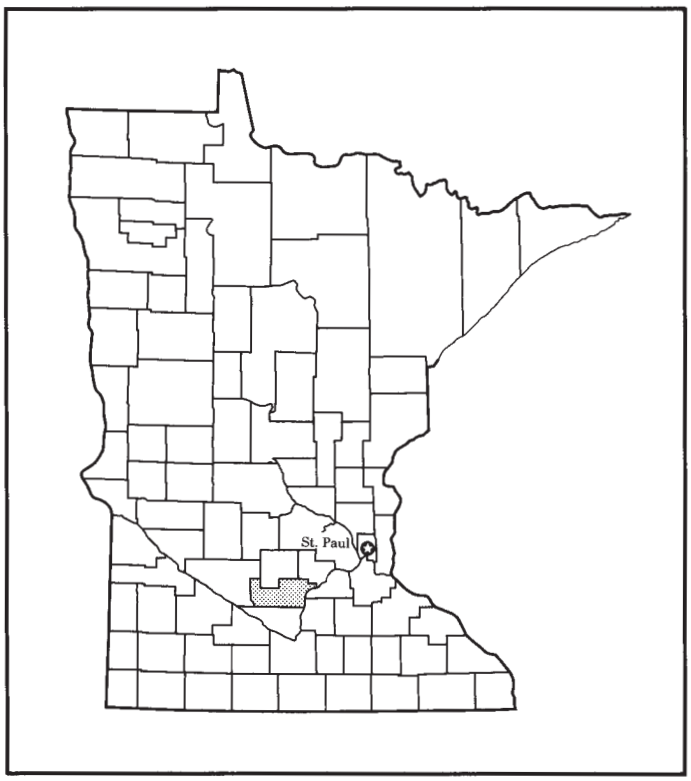

Figure 1.—Location of Sibley County in Minnesota.

an underfit stream (Winchell and Upham, 1884 and 1888).

Other areas of the county are made up of alluvium on flood plains, glacial outwash deposits of sand and gravel, and a small amount of glacial lacustrine sediments. Glacial outwash deposits of sand and gravel are found on high terraces along the Minnesota River valley escarpment. These deposits are remnants of the glacial River Warren. An area of till intermixed with sand and gravel occurs in a belt 1 to 5 miles wide running southeast of Gaylord to an area of lacustrine sediments along the Nicollet County border.

History and Development

Two hundred years ago, the survey area was a mixture of two-thirds tall grass and wet prairie and one-third deciduous forest. The native inhabitants were members of the Dakotah Nation. They lived along lakes, streams, and forest borders.

Many explorers, fur traders, map makers, artists, and missionaries of European descent traveled the various waterways in the 1700's and early 1800's.

In 1851, the Dakotah tribes signed a treaty at Traverse des Sioux, ceding most of the land to the U.S. Government. This treaty stimulated settlement of the area by people of Northern European heritage (Sibley County Centennial Committee, 1949).

The Territorial Legislature established Sibley County in March 1853. The county was named in honor of Minnesota pioneer Henry H. Sibley (Gaylord History Committee, 1982).

The early development of the county was associated with water and overland transportation routes. Because of its location on the banks of the Minnesota River, the village of Henderson became a significant link to westward expansion. Joseph R. Brown surveyed a military supply road in 1852 from Henderson across Sibley County to Fort Ridgely, near Fairfax. The villages of New Rome, Gaylord, Winthrop, and Gibbon developed along this early supply route. In 1867, a railroad was built that passed just east of Henderson. The Minneapolis and St. Louis Railroad Company built a rail line in the 1880's running northeast to southwest through the county. This rail link connected the communities of Green Isle, Arlington, Gaylord, Winthrop, and Gibbon (Sibley County Centennial Committee, 1949; Minnesota Data Book, 1985).

The look and use of the land began to change with settlement. By 1910, 148 miles of county and judicial ditches had spurred agricultural development (Minnesota State Drainage Commission, 1911).

The population of Sibley County was 6,725 in 1870. At the beginning of the 20th century, the population had peaked at 16,862. In 1940, a census reported 16,625 persons living in the county. The population of the county in 1990 was 14,366 (U.S. Department of Commerce, 1952 and 1982; U.S. Department of Commerce and Labor, 1913).

Physiography, Relief, and Drainage

The highest elevation in the survey area, 1,085 feet, is in the northwest corner of Sibley County, in Grafton Township. The lowest elevation, 700 feet, is at the point where the Minnesota River leaves the county along the northern border (U.S. Department of the Interior, 1967).

More than 80 percent of the surface of Sibley County is a nearly level and gently sloping till plain with local relief of 3 to 10 feet. About 6 percent, in the southern and south-central parts of the county, is a gently sloping and sloping till plain with local relief of 10 to 30 feet. In the eastern part of the county, in Henderson and Faxon Townships, two areas making up about 5 percent of the county are on a sloping and moderately steep till plain with local relief of 10 to 50 feet. A nearly level lake plain in the southeastern part of the county joins Lake Prairie Township in Nicollet County. The depth of lacustrine material over till ranges from 0 to 6 feet.

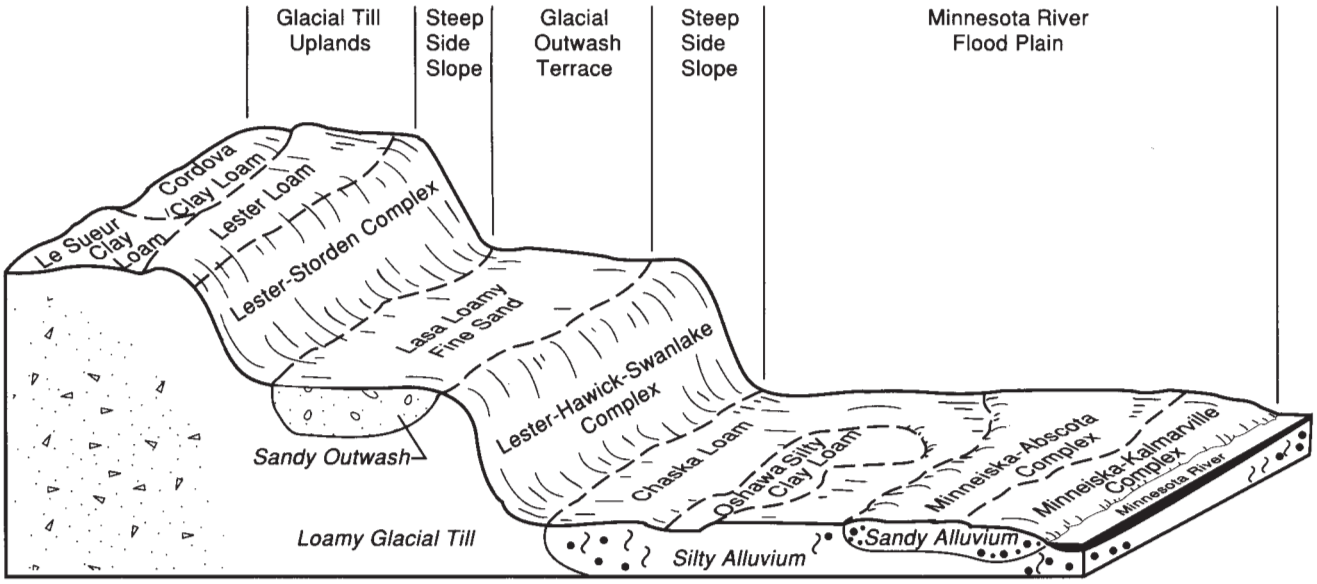

Figure 2.—General relationship of soils along the Minnesota River.

The mostly wooded, steep side slopes and ravines along the Minnesota River provide the most dramatic landscape in Sibley County. This escarpment is the boundary between the till plain on the uplands and the flood plain along the Minnesota River (fig. 2). Slopes range from 35 to 70 percent and are about 250 feet high. Outwash terraces ranging from 200 to 1,000 acres in size are about midway up the steep side slope in four locations. They are remnants of the glacial River Warren.

The nearly level Minnesota River flood plain is in the eastern part of the county. The flood plain is ½ to 1 mile wide and is characterized by large depressions and oxbows.

The drainage pattern in Sibley County is dominated by the Minnesota River, which flows north along the eastern boundary of the county. The main tributaries of the Minnesota River are High Island Creek and the branches of the Rush River. These streams flow from west to east and provide the drainage for most of the county. Bevens Creek and Silver Creek drain small portions of the northeastern part of the county and enter the Minnesota River through Carver County. Buffalo Creek drains a small portion of New Auburn Township and flows to the Crow River, which is a tributary of the Mississippi River (U.S. Department of the Interior, 1967).

The Rush River and High Island Creek are very similar. Each is a low-gradient stream with a drop of 4 feet per mile until the streams are 8 miles from the Minnesota River. At that point, the gradient of the streams increases to 30 feet per mile and a system of deeply dissected valleys and ravines occurs. These streams have not deposited much sediment at their mouths, which indicates that they formed at the same time the erosion of the Minnesota River valley was taking place. The erosional process in the main valley carried away the material coming down the tributary streams. In contrast, the many short ravines along the Minnesota River bluffs formed more recently. The erosional sediments from the ravines are in fan-shaped, gently sloping positions at the mouths of ravines at a height of 5 to 40 feet above the present flood plain.

Artificial drainage using subsurface tile and open ditches has dramatically increased the production of row crops in the county. By removing surface water from depressions and draining the saturated soils, large acreages were made available for row crops. Drainage gives the plants a favorable root environment and allows the soils to warm more quickly in the spring. The loss of habitat resulting from this drainage, however, has had an adverse impact on wildlife.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Gaylord in the period 1957 to 1988. 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 16 degrees F and the average daily minimum temperature is 7

degrees. The lowest temperature on record, which occurred at Gaylord on December 19, 1983, 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 31, 1988, is 105 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 about 30 inches. Of this, 21 inches, or 70 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 5.29 inches at Gaylord on August 14, 1981. Thunderstorms occur on about 38 days each year.

The average seasonal snowfall is 42 inches. The greatest snow depth at any one time during the period of record was 37 inches. On the average, 74 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 50 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; and the kinds of crops and native plants growing on the soils. 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.

Some of the soil names and boundaries in this survey may not fully agree with those of the surveys of adjoining areas that were published at an earlier date. The differences are the result of changes and refinements in series concepts, variations in slope groupings, and improvements in the soil classification system.

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-Okoboji-Nicollet Association

Nearly level and gently sloping, very poorly drained to moderately well drained, loamy and silty soils on till plains

Setting

Landform and position on the landform: Rims of depressions, foot slopes, and summits on till plains (fig. 3)
Slope range: 0 to 3 percent

Composition

Percent of survey area: 46
Extent of components in the association:
Canisteo soils—25 percent
Okoboji soils—20 percent
Nicollet soils—15 percent
Minor soils—40 percent

Soil Properties and Qualities

Canisteo
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Okoboji
Drainage class: Very poorly drained
Parent material: Silty alluvium and glacial till
Surface texture: Silty clay loam

Nicollet
Drainage class: Moderately well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Minor Soils

- The well drained Clarion soils on crests
- The poorly drained Harps soils on the rims of depressions
- The very poorly drained Klossner and Glencoe soils in depressions
- The poorly drained Webster soils on foot slopes

Use and Management

Major use: Cropland; about 85 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Canisteo—high water table, high pH; Okoboji—ponding or high water table; Nicollet—none

2. Clarion-Canisteo-Webster Association

Nearly level to sloping, poorly drained and well drained, loamy soils on till plains

Setting

Landform and position on the landform: Crests, shoulders, rims of depressions, and foot slopes on till plains
Slope range: 0 to 18 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Clarion soils—40 percent
Canisteo soils—20 percent
Webster soils—20 percent

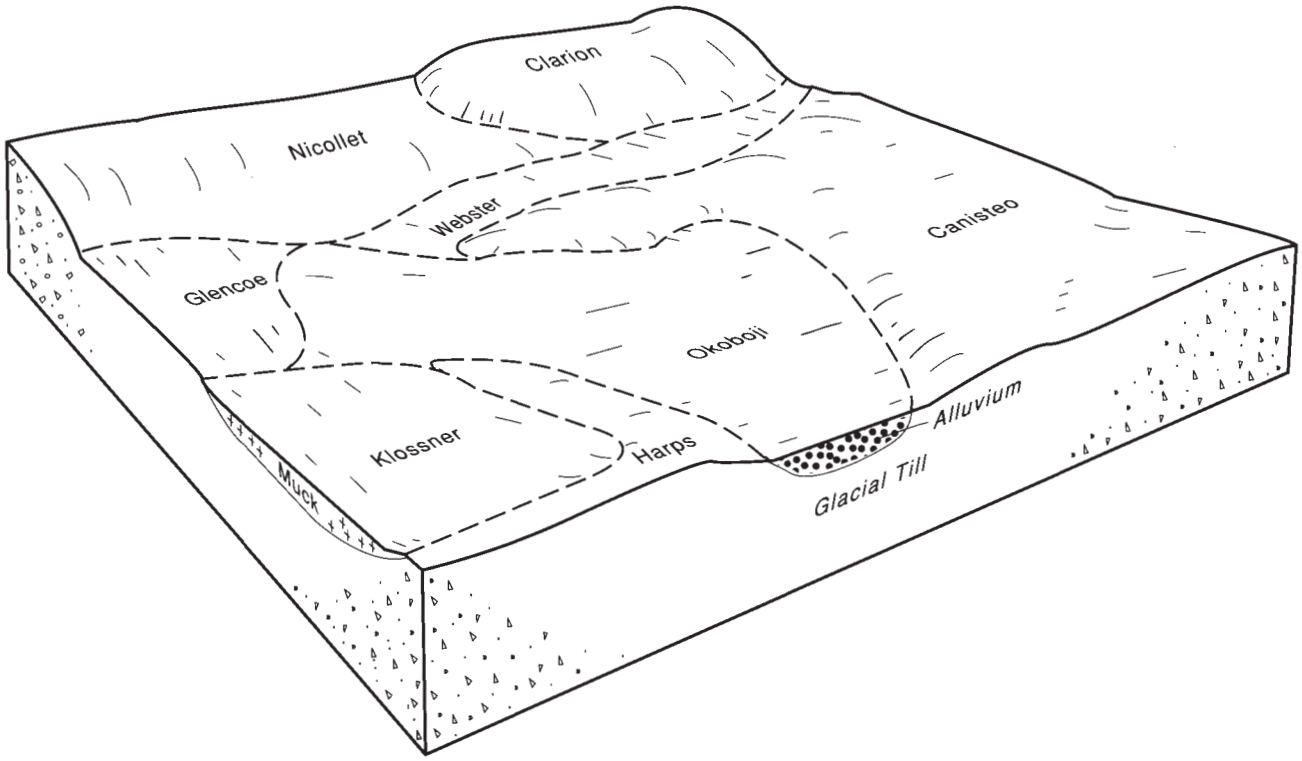

Figure 3.—Typical pattern of soils and parent material in the Canisteo-Okoboji-Nicollet association.

Minor soils—20 percent

Soil Properties and Qualities

Clarion
Drainage class: Well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Canisteo
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Webster
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Minor Soils

- The moderately well drained Nicollet soils on summits
- The very poorly drained Okoboji and Glencoe soils in depressions and sluggish drainageways
- The very poorly drained Klossner and Muskego soils in depressions

Use and Management

Major use: Cropland; about 90 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Clarion—erosion; Canisteo—high water table, high pH; Webster—high water table

3. Canisteo-Nicollet Association

Nearly level and gently sloping, poorly drained and moderately well drained, loamy soils on till plains

Setting

Landform and position on the landform: Rims of depressions, foot slopes, and summits of till plains
Slope range: 0 to 3 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Canisteo soils—50 percent
Nicollet soils—15 percent
Minor soils—35 percent

Soil Properties and Qualities

Canisteo
Drainage class: Poorly drained

Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Nicollet
Drainage class: Moderately well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Minor Soils

- The well drained Clarion soils on crests
- The poorly drained Harps soils on the rims of depressions
- The very poorly drained Klossner soils in depressions
- The poorly drained Webster soils on foot slopes

Use and Management

Major use: Cropland; about 85 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Canisteo—high water table, high pH; Nicollet—none

4. Canisteo-Marna-Nicollet Association

Nearly level and gently sloping, poorly drained and moderately well drained, loamy and clayey soils on till plains and in areas bordering lake plains

Setting

Landform and position on the landform: Foot slopes, rims of depressions, and summits on till plains and in areas bordering lake plains
Slope range: 0 to 3 percent

Composition

Percent of survey area: 1
Extent of components in the association:
Canisteo soils—25 percent
Marna and similar soils—20 percent
Nicollet soils—20 percent
Minor soils—35 percent

Soil Properties and Qualities

Canisteo
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Marna
Drainage class: Poorly drained
Parent material: Silty and clayey lacustrine sediments over calcareous, loamy glacial till
Surface texture: Silty clay loam

Nicollet
Drainage class: Moderately well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Minor Soils

- The well drained Clarion soils on crests and shoulders
- The very poorly drained Okoboji and Glencoe soils in depressions and drainageways
- The very poorly drained Klossner soils in depressions
- The poorly drained Webster soils on foot slopes

Use and Management

Major use: Cropland; about 95 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Canisteo—high water table, high pH; Marna—high water table, clay content; Nicollet—none

5. Cordova-Canisteo-Le Sueur Association

Nearly level and gently sloping, poorly drained and moderately well drained, loamy soils on till plains

Setting

Landform and position on the landform: Foot slopes, rims of depressions, and summits on till plains (fig. 4)
Slope range: 0 to 3 percent

Composition

Percent of survey area: 26
Extent of components in the association:
Cordova soils—20 percent
Canisteo soils—20 percent
Le Sueur soils—20 percent
Minor soils—40 percent

Soil Properties and Qualities

Cordova
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Canisteo
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Le Sueur
Drainage class: Moderately well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Minor Soils

- The well drained Lester soils on crests and shoulders
- The very poorly drained Okoboji and Glencoe soils in depressions and drainageways
- The very poorly drained Klossner soils in depressions

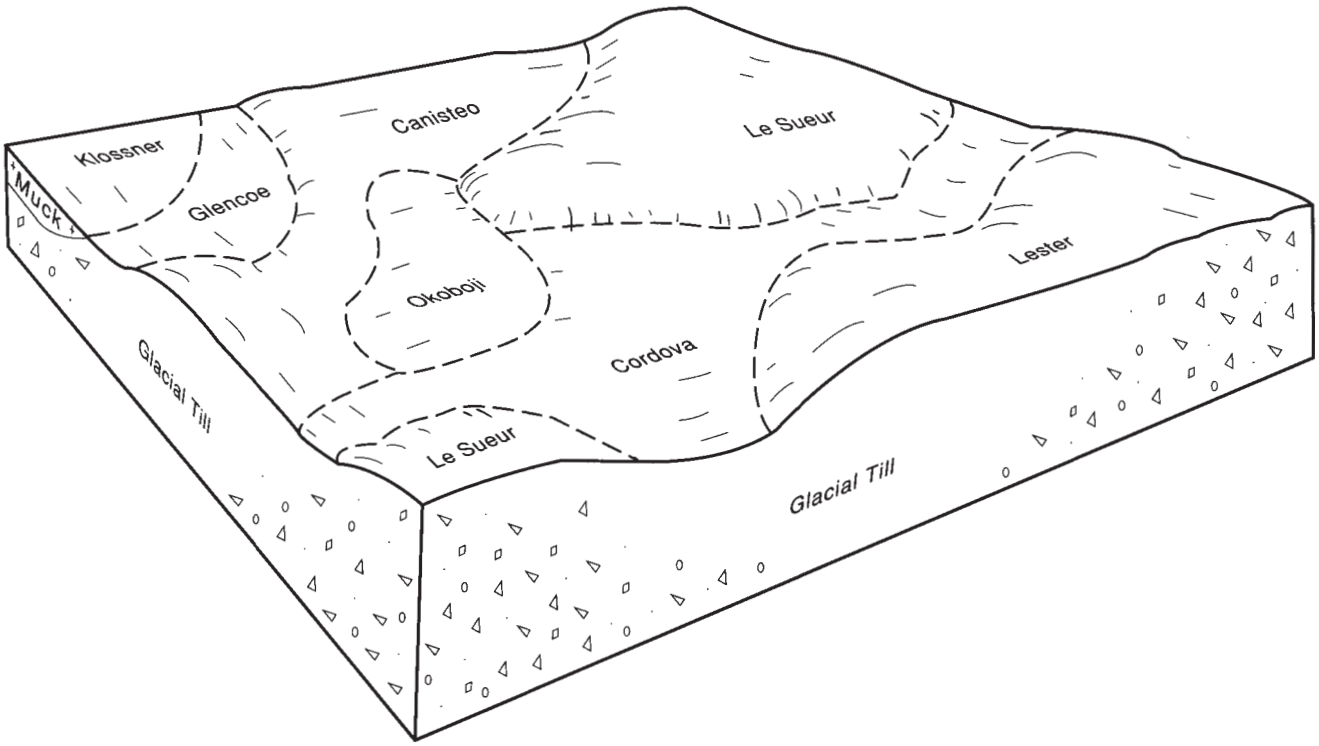

Figure 4.—Typical pattern of soils and parent material in the Cordova-Canisteo-Le Sueur association.

Use and Management

Major use: Cropland; about 80 percent of the association is used for cultivated crops, mostly corn and soybeans.

Major management factors: Cordova—high water table; Canisteo—high water table, high pH; Le Sueur—none

6. Cordova-Lester-Le Sueur Association

Nearly level to sloping, poorly drained to well drained, loamy soils on till plains

Setting

Landform and position on the landform: Foot slopes, crests, shoulders, and summits on till plains

Slope range: 0 to 18 percent

Composition

Percent of survey area: 1

Extent of components in the association:

Cordova and similar soils—25 percent

Lester and similar soils—25 percent

Le Sueur and similar soils—15 percent

Minor soils—35 percent

Soil Properties and Qualities

Cordova

Drainage class: Poorly drained

Parent material: Loamy, calcareous glacial till

Surface texture: Clay loam

Lester

Drainage class: Well drained

Parent material: Loamy, calcareous glacial till

Surface texture: Loam

Le Sueur

Drainage class: Moderately well drained

Parent material: Loamy, calcareous glacial till

Surface texture: Loam

Minor Soils

- The very poorly drained Okoboji and Klossner soils in depressions
- The moderately well drained Nicollet soils on summits
- The poorly drained Delft soils on foot slopes
- The well drained Storden and Swanlake soils on shoulders

Use and Management

Major use: Cropland; about 95 percent of the

association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Cordova—drainage; Lester—erosion; Le Sueur—none

7. Lester-Cordova Association

Nearly level to sloping, poorly drained and well drained, loamy soils on till plains

Setting

Landform and position on the landform: Crests, shoulders, and foot slopes on till plains (fig. 5)
Slope range: 0 to 18 percent

Composition

Percent of survey area: 5
Extent of components in the association:
Lester and similar soils—60 percent
Cordova and similar soils—20 percent
Minor soils—20 percent

Soil Properties and Qualities

Lester
Drainage class: Well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Cordova
Drainage class: Poorly drained
Parent material: Calcareous, loamy glacial till
Surface texture: Clay loam

Minor Soils

- The moderately well drained Le Sueur soils on summits
- The very poorly drained Klossner, Okoboji, and Glencoe soils in depressions
- The poorly drained Webster soils on foot slopes
- The poorly drained Canisteo soils on the rims of depressions

Use and Management

Major use: Cropland; about 75 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Lester—erosion; Cordova—high water table

8. Lester-Storden-Terril Association

Nearly level to very steep, moderately well drained and well drained, loamy soils on till plains

Setting

Landform and position on the landform: Crests, shoulders, back slopes, and the higher foot slopes on till plains
Slope range: 2 to 30 percent; typically 4 to 15 percent

Composition

Percent of survey area: 1
Extent of components in the association:
Lester and similar soils—40 percent
Storden and similar soils—30 percent
Terril and similar soils—20 percent
Minor soils—10 percent

Soil Properties and Qualities

Lester
Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Storden
Drainage class: Well drained
Parent material: Loamy, calcareous glacial till
Surface texture: Loam

Terril
Drainage class: Moderately well drained
Parent material: Loamy colluvium over calcareous glacial till
Surface texture: Loam

Minor Soils

- The moderately well drained Le Sueur soils on summits
- The poorly drained Delft and Cordova soils in drainageways
- The well drained Swanlake soils on shoulders, crests, and ridges

Use and Management

Major uses: Cropland, pasture, woodland wildlife habitat; most areas are used for pasture or are idle land, but about 30 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Lester and Storden—erosion, slope; Terril—slope

9. Lester-Swanlake-Lasa Association

Gently sloping to very steep, well drained, loamy and sandy soils on till plains and terraces

Setting

Landform and position on the landform: Crests and shoulders of till plains; summits and back slopes of outwash plains
Slope range: 2 to 65 percent

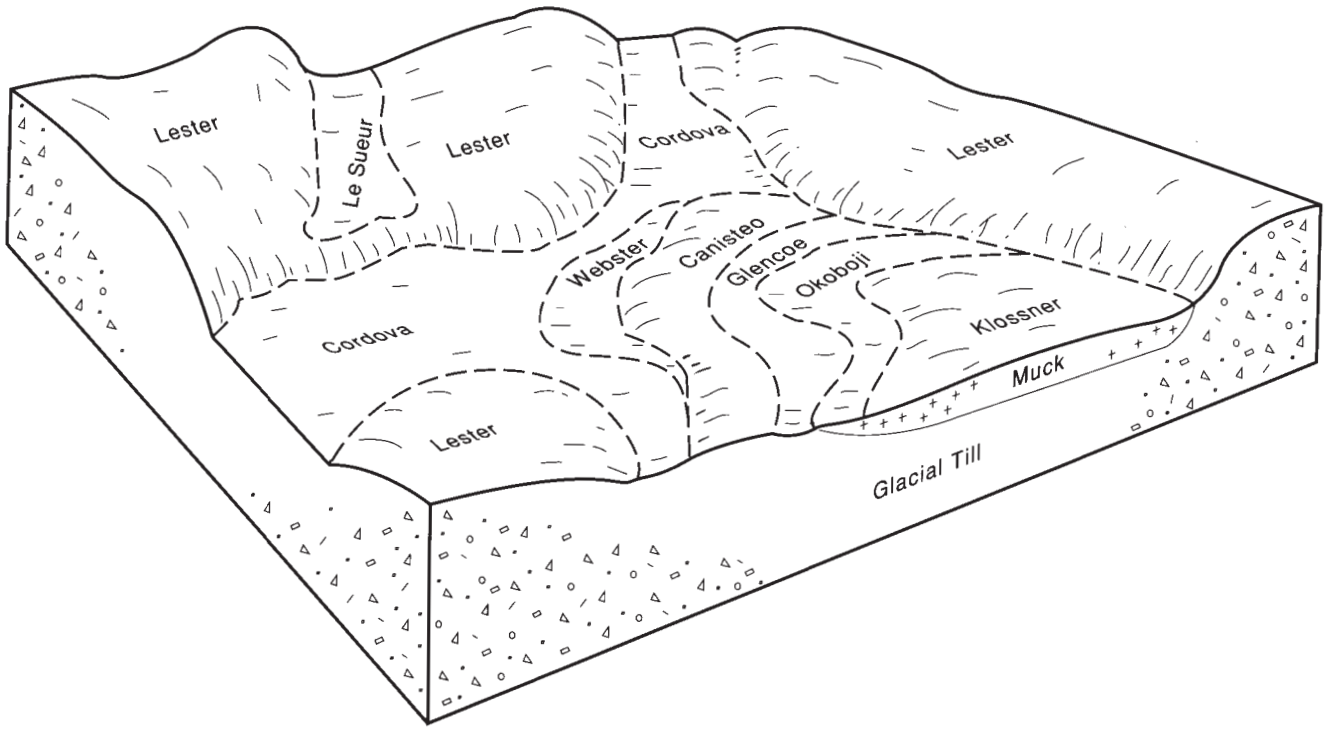

Figure 5.—Typical pattern of soils and parent material in the Lester-Cordova association.

Composition

Percent of survey area: 2
Extent of components in the association:
Lester soils—50 percent
Swanlake soils—25 percent
Lasa soils—15 percent
Minor soils—10 percent

Soil Properties and Qualities

Lester
Drainage class: Well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Swanlake
Drainage class: Well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Lasa
Drainage class: Well drained
Parent material: Sandy glacial outwash
Surface texture: Loamy fine sand

Minor Soils

- The well drained Dakota soils on the summits of terraces
- The excessively drained Hawick soils on shoulders and bluffs along streams
- The moderately well drained Terril soils on foot slopes
- The well drained Dickinson soils on summits and back slopes of outwash plains

Use and Management

Major uses: Woodland, recreation; only about 10 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Lester—erosion; Swanlake—erosion; Lasa—droughtiness, erosion

10. Minneiska-Chaska-Oshawa Association

Nearly level and gently sloping, very poorly drained to moderately well drained, loamy and silty soils on flood plains

Setting

Landform and position on the landform: Microhighs and microlows on flood plains
Slope range: 0 to 3 percent

Composition

Percent of survey area: 3

Extent of components in the association:
Minneiska soils—50 percent
Chaska soils—15 percent
Oshawa soils—15 percent
Minor soils—20 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 Abscota and poorly drained Delft soils on foot slopes

Use and Management

Major use: Cropland, woodland, recreation; about 50 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Seasonal flooding

11. Coland-Clarion-Hawick Association

Nearly level to sloping, poorly drained to excessively drained, loamy and sandy soils on flood plains, till plains, terraces, and bluffs adjacent to stream channels

Setting

Landform and position on the landform: Microlows on flood plains and foot slopes and summits of terraces
Slope range: 0 to 12 percent

Composition

Percent of survey area: 1
Extent of components in the association:
Coland soils—50 percent
Clarion soils—20 percent
Hawick soils—15 percent
Minor soils—15 percent

Soil Properties and Qualities

Coland
Drainage class: Poorly drained
Parent material: Loamy alluvium
Surface texture: Clay loam

Clarion
Drainage class: Well drained
Parent material: Calcareous, loamy glacial till
Surface texture: Loam

Hawick
Drainage class: Excessively drained
Parent material: Calcareous, sandy outwash
Surface texture: Sandy loam and coarse sandy loam

Minor Soils

- The well drained Lester and Storden soils on crests and shoulders
- The moderately well drained Terril soils on the higher foot slopes
- The poorly drained Delft, Cordova, and Webster soils on the lower foot slopes

Use and Management

Major use: Cropland, woodland, recreation; about 65 percent of the association is used for cultivated crops, mostly corn and soybeans.
Major management factors: Coland—seasonal flooding; Clarion—erosion; Hawick—droughtiness

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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, Lester loam, 2 to 6 percent slopes, is a phase of the Lester 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. Other miscellaneous areas have soil material capable of supporting vegetation, but excavation or stockpiling has destroyed the natural soil condition.

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.

This technical publication includes suggested management practices that are intended to increase crop production, to reduce the hazards of soil blowing and water erosion, and to help overcome wetness limitations. Over a period of time, some or all of these conservation practices may or may not be in accordance with Federal, State, or local laws and agency rules and guides.

Soil Descriptions

5B—Dakota loam, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Summits on stream terraces (fig. 6)
Shape of areas: Long and moderately wide with smooth edges
Size of areas: 6 to 160 acres

Typical Profile

0 to 10 inches—very dark gray, friable loam
10 to 14 inches—dark yellowish brown, friable sandy loam
14 to 23 inches—dark yellowish brown, friable sandy clay loam
23 to 35 inches—dark yellowish brown, friable gravelly coarse sandy loam
35 to 60 inches—yellowish brown, loose, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—moderate; next part—moderately rapid; lower part—rapid
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- Lasa soils, which are sandy throughout
- Soils that are not underlain by sand and gravel
- The moderately well drained Terril soils, which are in the higher positions and are loamy throughout
- Poorly drained soils in the lower positions

Similar soils:
- Soils that have a loamy mantle less than 20 inches thick over sand and gravel
- Soils that have more clay in the loamy mantle
- Soils that are underlain by fine sand

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, slope
- Crops may not have sufficient moisture in some years because of the moderate available water capacity.
- Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 6G

27B—Dickinson loam, 2 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Summits on stream terraces
Shape of areas: Long and moderately wide with smooth edges
Size of areas: 4 to 50 acres

Typical Profile

0 to 10 inches—very dark gray, very friable loam
10 to 17 inches—brown or dark brown, very friable fine sandy loam
17 to 40 inches—yellowish brown, very friable fine sandy loam
40 to 51 inches—dark yellowish brown, loose fine sand
51 to 60 inches—brown, loose fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—moderately rapid; lower part—rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet
Special characteristics: In areas on high flood plains, the soil may be subject to rare flooding

Inclusions

Contrasting inclusions:
- Lester soils, which have more clay throughout than the Dickinson soil

Similar soils:
- Soils that have a thinner loamy mantle
- Soils that have more clay in the subsoil
- Soils that are underlain by loamy material

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, slope, organic matter content
- Crops may not have sufficient moisture in some years

Figure 6.—An area of Dakota loam, 1 to 6 percent slopes. The Dakota soil is on summits in the background. Included areas of Terril soils are on the foot slopes in the foreground.

because of the moderate available water capacity.
• Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.

Interpretive Groups

Land capability classification: 3e
Windbreak suitability group: 6G

35—Blue Earth mucky silt loam

Composition

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

Setting

Landform and position on the landform: Closed depressions on till-floored, drained glacial lakebeds
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 10 to 150 acres

Typical Profile

0 to 12 inches—black, very friable, mottled, calcareous mucky silt loam (coprogenous earth)
12 to 30 inches—black, very friable, mottled, calcareous silt loam (coprogenous earth)
30 to 57 inches—black, friable, mottled, calcareous silt loam (coprogenous earth)
57 to 60 inches—very dark gray, friable, mottled, calcareous silt loam (coprogenous earth)

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderate
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 2 feet above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils on the rims of depressions

Similar soils:
• Soils that are underlain by mineral material

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, soil reaction (pH)
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding.
• Choosing plants and varieties that are tolerant of high pH values minimizes the effects of high levels of calcium carbonate.
• The high pH may be a consideration when agricultural chemicals are selected and applied.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2W

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: Low foot slopes and rims of closed depressions on till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or long and narrow with smooth edges
Size of areas: 4 to 300 acres

Typical Profile

0 to 14 inches—black, friable, calcareous clay loam
14 to 18 inches—very dark gray, friable, calcareous clay loam
18 to 26 inches—grayish brown, friable, mottled, calcareous clay loam
26 to 60 inches—grayish brown, 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 the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe, Muskego, Klossner, and Okoboji soils in closed depressions
• Soils that have sand and gravel in the subsoil and underlying material
• The moderately well drained Nicollet and somewhat poorly drained Crippin soils in the higher positions

Similar soils:
• Soils that are leached to a depth of 20 inches or more
• Soils that contain gypsum crystals
• Soils that have a dark surface layer more than 24 inches thick
• Soils that have more clay in the surface layer

Use and Management

Cropland

Major management factors: Seasonal high water table, tilth, soil reaction (pH)
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Working the soil when it is too wet results in surface compaction and cloddiness.
• Choosing plants and varieties that are tolerant of high pH values minimizes the effects of high levels of calcium carbonate.
• The high pH level may be a consideration when agricultural chemicals are selected and applied.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2K

94B—Terril loam, 2 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 till plains and stream terraces

Shape of areas: Long and moderately wide with smooth edges
Size of areas: 4 to 70 acres

Typical Profile

0 to 14 inches—black, friable loam
14 to 25 inches—very dark grayish brown, friable loam
25 to 33 inches—brown or dark brown, friable sandy loam
33 to 47 inches—dark yellowish brown, friable loam
47 to 60 inches—yellowish brown, friable, calcareous fine sandy loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils in the lower positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils in higher positions
• Soils that have a dark surface layer less than 24 inches thick

Use and Management

Cropland

Major management factors: Slope
• Maintaining crop residue on the surface reduces the hazard of erosion.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

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: Crests and linear back slopes on till plains
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—very dark gray, friable loam
10 to 32 inches—dark yellowish brown, friable loam
32 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: Moderate or high
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Nicollet soils in the lower positions
• The poorly drained Webster soils in drainageways
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have more clay in the subsoil
• Soils that have calcium carbonates at or near the surface
• Soils that have a lighter colored surface layer because of erosion

Use and Management

Cropland

Major management factors: Slope
• Maintaining crop residue on the surface reduces the hazard of erosion.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

106B—Lester loam, 2 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Crests and linear back slopes on till plains (fig. 7)
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 60 acres

Typical Profile

0 to 9 inches—very dark gray, friable loam

Figure 7.—A cultivated area of Lester loam, 2 to 6 percent slopes. The Lester soil is on crests and back slopes in the foreground. The included Cordova soils are in the lower positions in the background.

9 to 14 inches—dark yellowish brown, friable clay loam
14 to 30 inches—yellowish brown, friable clay loam
30 to 39 inches—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 the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Le Sueur soils in the lower positions
- Soils that have sand and gravel in the subsoil and underlying material
- The poorly drained Cordova soils in the lower positions

Similar soils:
- Soils that have a dark surface layer less than 7 inches thick and that have calcium carbonates at or near the surface

• Soils that have a lighter colored surface layer because of erosion
• Soils that have less clay in the subsoil

Use and Management

Cropland

Major management factors: Slope
• Maintaining crop residue on the surface reduces the hazard of erosion.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

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

Composition

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

Setting

Landform and position on the landform: Shoulders and summits on till plains
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

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

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova and Delft soils in the lower positions
• The moderately well drained Le Sueur soils in the lower positions
• Soils that have sand and gravel in the subsoil and underlying material
• The moderately well drained Terril soils on foot slopes

Similar soils:
• Soils that have a dark surface layer more than 10 inches thick
• Soils that do not have a dark surface layer
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Eroded surface, slope
• Productivity has been reduced because of erosion. If the soil is not protected, productivity will continue to decline.
• Maintaining crop residue, stripcropping, farming on the contour, or including alfalfa and grasses in the rotation helps to control erosion.
• Terraces, diversions, and grassed waterways reduce the risk of further erosion (fig. 8).

Interpretive Groups

Land capability classification: 3e
Windbreak suitability group: 3

109—Cordova clay loam

Composition

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

Setting

Landform and position on the landform: Foot slopes and drainageways on till plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 4 to 300 acres

Typical Profile

0 to 23 inches—black, friable, clay loam
23 to 47 inches—olive gray, firm, mottled clay loam
47 to 60 inches—light olive gray, firm, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Upper part—moderately slow; lower part—moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils in closed depressions

Figure 8.—Terraces in an area of Lester loam, 6 to 12 percent slopes, eroded.

• The moderately well drained Le Sueur soils in the higher positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have calcium carbonates at or near the surface
• Soils that have less clay in the subsoil

Use and Management

Cropland

Major management factors: Seasonal high water table, tilth
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 2w
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: Foot slopes on till plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—black, firm silty clay loam
10 to 21 inches—black, firm silty clay
21 to 32 inches—olive gray, firm, mottled silty clay
32 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe, Klossner, and Okoboji soils in closed depressions
• Soils that have sand and gravel in the subsoil and underlying material
• The moderately well drained Nicollet soils in the higher positions

Similar soils:
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Seasonal high water table, permeability, tilth
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Because the high clay content restricts water movement within the soil, drainage tiles should be closely spaced.
• Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 2w
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: Rims of depressions on till plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

0 to 19 inches—very dark gray, friable, calcareous clay loam
19 to 23 inches—gray, friable, calcareous clay loam
23 to 31 inches—grayish brown, friable, mottled, calcareous clay loam
31 to 41 inches—grayish brown, friable, mottled, calcareous loam
41 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 the water table: 1 to 3 feet
Special characteristics: Iron chlorosis in soybeans is a particular problem because of the high levels of calcium carbonate.

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe, Muskego, Okoboji, and Klossner soils in closed depressions
• The somewhat poorly drained Crippin soils in the higher positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that contain gypsum crystals
• Soils that are leached to a depth of 20 inches or more
• Soils that have a thicker dark surface layer

Use and Management

Cropland

Major management factors: Seasonal high water table, soil reaction (pH), tilth

• Unless present drainage systems are maintained, wetness can hinder crop production.
• Choosing plants and varieties that are tolerant of high pH values minimizes the effects of high levels of calcium carbonate.
• The high pH level may be a consideration when agricultural chemicals are selected and applied.
• Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 2w
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: Foot slopes and drainageways on till plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 4 to 300 acres

Typical Profile

0 to 17 inches—black, friable clay loam
17 to 21 inches—dark gray, friable, mottled clay loam
21 to 30 inches—grayish brown, friable, mottled clay loam
30 to 35 inches—grayish brown, friable, mottled, calcareous loam
35 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 the water table: 1 to 2 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe and Okoboji soils in closed depressions
• The moderately well drained Nicollet soils in the higher positions
• The well drained Clarion soils in the higher positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have calcium carbonates at or near the surface
• Soils that have more clay in the subsoil
• Soils that have a dark surface layer more than 24 inches thick

Use and Management

Cropland

Major management factors: Seasonal high water table, tilth
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2

114—Glencoe clay loam

Composition

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

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 3 to 10 acres

Typical Profile

0 to 8 inches—black, friable clay loam
8 to 27 inches—black, friable clay loam
27 to 32 inches—very dark gray, friable clay loam
32 to 42 inches—olive gray, friable, mottled clay loam
42 to 50 inches—olive gray, friable, mottled loam
50 to 60 inches—olive gray, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow or moderate; lower part—moderate or moderately rapid
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Harps soils on the rims of depressions
- Klossner soils, which have a layer of muck more than 16 inches thick on the surface

Similar soils:
- Soils that are underlain by sand
- Soils that have more clay in the subsoil
- Soils that have a dark surface layer less than 24 inches thick
- Soils that have a thin layer of muck on the surface

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, tilth
- Unless present drainage systems are maintained, wetness can hinder crop production.
- Surface tile inlets reduce the length of the periods of ponding.
- Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 3w
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: Low summits on till plains
Slope range: 1 to 3 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 30 acres

Typical Profile

0 to 15 inches—black, friable, calcareous loam
15 to 23 inches—dark grayish brown, friable, calcareous loam
23 to 32 inches—dark grayish brown, friable, mottled, calcareous loam
32 to 60 inches—olive 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 the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Harps soils in the lower positions
- The well drained Clarion soils in the higher positions
- Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
- Soils that are leached to a depth of 20 inches or more

Use and Management

Cropland

- Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.

Interpretive Groups

Land capability classification: 1
Windbreak suitability group: 1K

130—Nicollet clay loam

Composition

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

Setting

Landform and position on the landform: Low summits on till plains
Slope range: 1 to 3 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

0 to 9 inches—black, friable clay loam
9 to 15 inches—very dark gray, friable clay loam
15 to 20 inches—brown or dark brown, friable clay loam
20 to 31 inches—grayish brown, friable, mottled clay loam
31 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

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

Depth to the water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Webster soils in the lower positions
- The well drained Clarion soils in the higher positions
- Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
- Soils that have calcium carbonates at or near the surface
- Soils that have more clay in the subsoil
- Soils that have more clay in the surface layer

Use and Management

Cropland

- Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.

Interpretive Groups

Land capability classification: 1
Windbreak suitability group: 1

134—Okoboji silty clay loam

Composition

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

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 4 to 200 acres

Typical Profile

0 to 42 inches—black, friable, mottled silty clay loam
42 to 60 inches—gray, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow; lower part—moderate
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Harps soils on the rims of depressions
- Klossner soils, which have a layer of muck more than 16 inches thick on the surface

Similar soils:
- Soils that have less clay and more sand in the subsoil
- Soils that have a dark surface layer less than 24 inches thick
- Soils that have a thin layer of muck on the surface
- Soils that are underlain by sand

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, permeability, tilth
- Unless present drainage systems are maintained, wetness can hinder crop production.
- Surface tile inlets reduce the length of the periods of ponding.
- Because the high clay content limits water movement within the soil, drainage tiles should be closely spaced.
- Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2W

222B—Lasa loamy fine sand, 2 to 8 percent slopes

Composition

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

Setting

Landform and position on the landform: Summits on stream terraces
Shape of areas: Long and moderately wide with smooth edges
Size of areas: 6 to 200 acres

Typical Profile

0 to 12 inches—very dark grayish brown, loose loamy fine sand
12 to 40 inches—dark brown and dark yellowish brown, loose fine sand that has strata of loamy fine sand
40 to 60 inches—dark yellowish brown, loose, stratified fine sand and loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- Dakota soils, which have a loamy mantle
- Poorly drained soils that have a loamy mantle; in the lower positions

Similar soils:
- Soils that have strata of loam in the subsoil and underlying material
- Soils that are underlain by loam
- Soils that have a higher content of rock fragments

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, slope, organic matter content
- Crops may not have sufficient moisture in some years because of the moderate available water capacity.
- Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing.
- Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.

Interpretive Groups

Land capability classification: 3s
Windbreak suitability group: 7

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: Low summits on till plains
Slope range: 1 to 3 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

0 to 11 inches—black, friable clay loam
11 to 23 inches—dark grayish brown, friable clay loam
23 to 37 inches—dark grayish brown, friable, mottled clay loam
37 to 60 inches—dark grayish brown, friable, mottled, calcareous clay 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 the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Cordova soils in the lower positions
- The well drained Lester soils in the higher positions
- Soils that have sand and gravel in the subsoil and underlying material
- The very poorly drained Rolfe soils in closed depressions

Similar soils:
- Soils that have less clay in the subsoil
- Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

- Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.

Interpretive Groups

Land capability classification: 1
Windbreak suitability group: 1

317—Oshawa silty clay loam, frequently flooded

Composition

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

Setting

Landform and position on the landform: Meanderbelts and oxbows on flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to 300 acres

Typical Profile

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

25 to 40 inches—black, friable, mottled, calcareous silty clay loam
40 to 60 inches—dark grayish brown, 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
Seasonal high water table: 1 foot above to 1 foot below the surface
Frequency of flooding: Frequent
Special characteristics: Springs may be the cause of wetness in some areas. Ponding may occur during spring snowmelt and after periods of heavy or prolonged rainfall.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Chaska soils in the higher positions
• The moderately well drained Minneiska soils, which have more sand than the Oshawa soil; in the higher positions

Similar soils:
• Soils that are underlain by sand
• Soils that have more clay in the subsoil

Use and Management

Pasture and hay

Major management factors: Flooding, seasonal high water table, ponding
• In dry years some areas may be used for pasture and hay.
• Adapted species that tolerate flooding, ponding, and the seasonal high water table should be selected for planting.

Wetland wildlife habitat

Major management factors: None
• Because of open water areas and marsh vegetation, this unit is well suited to wetland wildlife habitat. Adapted species that are useful to wildlife should be planted.

Interpretive Groups

Land capability classification: 6w
Windbreak suitability group: 10

329—Chaska loam, occasionally flooded

Composition

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

Setting

Landform and position on the landform: Splays on flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to 400 acres

Typical Profile

0 to 9 inches—very dark gray, friable, calcareous loam
9 to 30 inches—stratified dark grayish brown and very dark grayish brown, friable, mottled, calcareous very fine sandy loam
30 to 60 inches—stratified, dark grayish brown, friable, mottled, calcareous silt loam and silty clay loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The very poorly drained Oshawa soils in depressions
• The moderately well drained Minneiska soils in the higher positions
• The very poorly drained and poorly drained Kalmarville soils, which have more sand throughout than the Chaska soil

Similar soils:
• Soils that do not have stratified textures
• Soils that are leached to a depth of 20 inches or more

Use and Management

Cropland

Major management factors: Flooding, seasonal high water table
• Seasonal flooding limits the production and harvesting of crops (fig. 9).
• Open ditches allow the return of floodwaters to the river.
• Unless present drainage systems are maintained, wetness can hinder crop production.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 1K

Figure 9.—Hay in an area of Chaska loam, occasionally flooded. Because of the flooding, harvesting of hay or other crops may be difficult in some years.

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: Foot slopes and drainageways on till plains
Slope range: 1 to 3 percent
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

0 to 37 inches—black, friable clay loam
37 to 45 inches—very dark gray, friable, mottled clay loam
45 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Upper part—moderately slow; lower part—moderately slow or moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The well drained Clarion, Lester, and Storden soils in the higher positions
- Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
- Soils that have a thinner layer of topsoil
- Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Seasonal high water table, tilth
- Unless present drainage systems are maintained, wetness can hinder crop production.
- Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2

386—Okoboji mucky silty clay loam

Composition

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

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 5 to 200 acres

Typical Profile

0 to 14 inches—black, friable mucky silty clay loam
14 to 49 inches—black, friable, mottled silty clay loam
49 to 60 inches—dark grayish brown, friable, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderate; next part—moderately slow; lower part—moderate
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
- The poorly drained Canisteo and Harps soils on the rims of depressions

Similar soils:
- Soils that have a surface layer of muck more than 16 inches thick
- Soils that have less clay and more sand in the subsoil
- Soils that have a dark surface layer less than 24 inches thick
- Soils that are underlain by sand

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, permeability, soil blowing, organic matter content
- Unless present drainage systems are maintained, wetness can hinder crop production.
- Surface tile inlets reduce the length of the periods of ponding.
- Because the high clay content limits water movement within the soil, drainage tiles should be closely spaced.
- Planting field windbreaks on adjacent upland soils and keeping the soil surface rough reduce the hazard of soil blowing.
- The effectiveness of herbicides may be reduced because of the very high content of organic matter.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2W

463B—Minneiska loam, 1 to 4 percent slopes

Composition

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

Setting

Landform: Alluvial fans
Shape of areas: Fan shaped
Size of areas: 10 to 40 acres

Typical Profile

0 to 12 inches—very dark grayish brown, friable, calcareous loam
12 to 60 inches—stratified dark grayish brown and grayish brown, friable, mottled, calcareous fine sandy loam and gravelly loamy sand

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Moderately rapid
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to the water table: 3 to 6 feet
Frequency of flooding: Rare
Special characteristics: Stratification of textures and colors varies from place to place.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Chaska soils, which have more clay in the subsoil than the Minneiska soil; in the lower positions
• The moderately well drained Terril soils, which have more clay in the subsoil than the Minneiska soil and are not subject to flooding

Similar soils:
• Soils that are subject to occasional flooding
• Soils that have more sand throughout

Use and Management

Cropland

Major management factors: Slope, soil blowing, flooding
• Maintaining crop residue on the surface reduces the hazard of erosion.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.
• Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing.
• The deposition of sediments from flooding may cause crop damage.
• The high pH levels may be a consideration when agricultural chemicals and crop varieties are selected.

Interpretive Groups

Land capability classification: 2e
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: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 10 to 250 acres

Typical Profile

0 to 40 inches—black, friable muck
40 to 45 inches—black, friable, mottled, calcareous mucky silt loam (coprogenous earth)
45 to 60 inches—olive gray, friable, mottled, calcareous silt loam (coprogenous earth)

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderate or moderately rapid; lower part—slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• Glencoe and Okoboji soils, which formed in mineral materials
• The poorly drained Canisteo and Harps soils on the rims of depressions

Similar soils:
• Soils that are underlain by mineral material
• Soils that have a surface layer of muck less than 16 inches thick
• Soils that have a surface layer of muck more than 51 inches thick

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, soil blowing, organic matter content
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding.
• Planting field windbreaks on adjacent upland soils and keeping the soil surface rough reduce the hazard of soil blowing.
• The effectiveness of herbicides may be reduced because of the very high content of organic matter.

Interpretive Groups

Land capability classification: 4w
Windbreak suitability group: 2(O)

539—Klossner muck

Composition

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

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 5 to 250 acres

Typical Profile

0 to 21 inches—black, friable muck
21 to 32 inches—black, friable, mottled muck
32 to 41 inches—black, friable, mottled mucky silt loam
41 to 60 inches—olive gray, friable, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow to moderately rapid; middle part—moderate; lower part—moderately slow or moderate
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Harps soils on the rims of depressions
• Muskego soils, which are underlain by coprogenous earth
• Glencoe and Okoboji soils, which formed in mineral materials

Similar soils:
• Soils that have a surface layer of muck less than 16 inches thick
• Soils that have a surface layer of muck more than 51 inches thick
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, soil blowing, organic matter content
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding.
• Planting field windbreaks on adjacent upland soils and keeping the soil surface rough reduce the hazard of soil blowing.
• The effectiveness of herbicides may be reduced because of the very high content of organic matter.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2(O)

743—Glencoe clay loam, stratified substratum

Composition

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

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 4 to 60 acres

Typical Profile

0 to 10 inches—black, friable clay loam
10 to 26 inches—black, friable, mottled clay loam
26 to 32 inches—grayish brown, friable, mottled clay loam
32 to 45 inches—olive gray, friable, mottled clay loam
45 to 52 inches—gray, friable, mottled silt loam
52 to 60 inches—dark gray, loose, mottled sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow or moderate; lower part—moderate or moderately rapid
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• The poorly drained Canisteo and Mayer soils in the higher positions
• Glencoe soils that are not underlain by sand and gravel

Similar soils:
• Soils that have a thinner loamy mantle

Use and Management

Cropland

Major management factors: Seasonal high water table, ponding, tilth

• Unless present drainage systems are maintained, wetness may hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding.
• Because of the range of textures in the underlying material, special management may be needed to prevent tile from being filled.
• Caving of cutbanks may occur when tile is installed.
• Working the soil when it is too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2W

772F—Swanlake-Lasa complex, 18 to 65 percent slopes

Composition

Swanlake soil and similar soils: 40 to 60 percent
Lasa soil and similar soils: 35 to 55 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Swanlake—shoulders on till plains; Lasa—side slopes on stream terraces
Slope range: Swanlake—24 to 65 percent; Lasa—18 to 35 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 40 to 400 acres

Typical Profile

Swanlake

0 to 7 inches—very dark brown, friable loam
7 to 32 inches—brown, friable, calcareous loam
32 to 60 inches—brown, firm, mottled, calcareous loam

Lasa

0 to 9 inches—black, very friable loamy fine sand
9 to 27 inches—brown or dark brown, very friable fine sand
27 to 53 inches—brown, loose fine sand that has strata of loamy fine sand
53 to 60 inches—brown, loose, mottled, stratified fine sand and loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Swanlake—moderate; Lasa—moderately rapid in the upper part, rapid in the lower part
Available water capacity: Swanlake—high; Lasa—low
Organic matter content: Moderate
Surface runoff: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft soils in the lower positions
Similar soils:
• Soils that do not have a dark surface layer
• Soils that have a higher content of rock fragments

Use and Management

Wildlife habitat

Major management factors: Slope
• Native trees and plants should be preserved or established.

Interpretive Groups

Land capability classification: 7e
Windbreak suitability group: Swanlake—8; Lasa—7

887B—Clarion-Swanlake complex, 3 to 6 percent slopes

Composition

Clarion soil and similar soils: 45 to 75 percent
Swanlake soil and similar soils: 15 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion—summits and the lower side slopes on till plains; Swanlake—shoulders and the upper side slopes on till plains (fig. 10)
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

Clarion

0 to 12 inches—black, friable loam
12 to 26 inches—dark yellowish brown, friable loam
26 to 44 inches—dark yellowish brown, friable, mottled loam
44 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Swanlake

0 to 8 inches—very dark grayish brown, friable, calcareous loam
8 to 41 inches—yellowish brown, friable, mottled, calcareous loam
41 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained

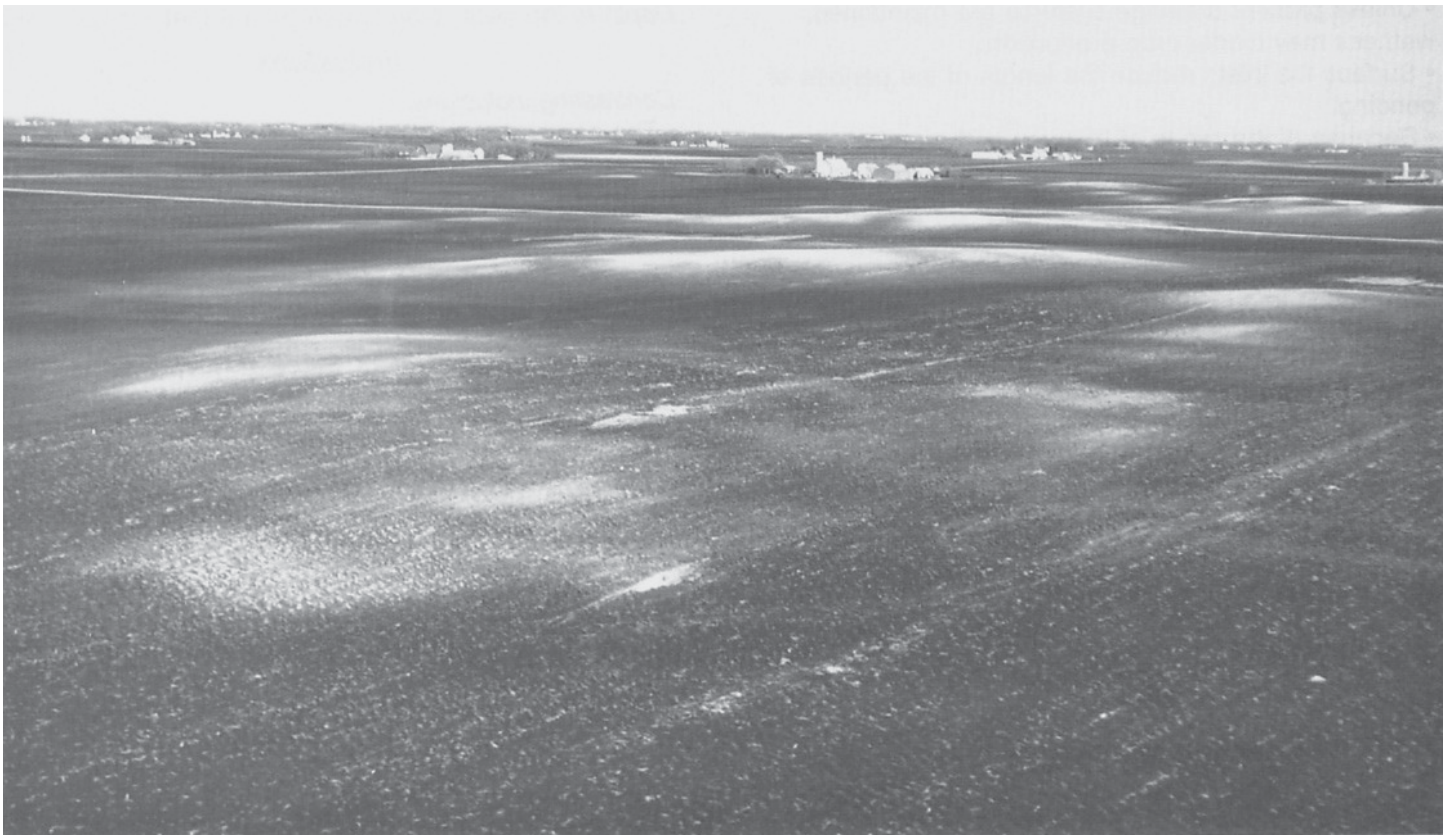

Figure 10.—An area of Clarion-Swanlake complex, 3 to 6 percent slopes. The Clarion soil is in the darker areas, and the Swanlake soil is in the lighter colored areas.

Permeability: Moderate
Available water capacity: High
Organic matter content: Clarion—moderate or high; Swanlake—moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The poorly drained Webster soils in the lower positions
- The moderately well drained Nicollet soils in the lower positions
- Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
- Soils that have a lighter colored surface layer because of erosion

Use and Management

Cropland

Major management factors: Clarion—slope; Swanlake—slope, soil reaction (pH)
- Maintaining crop residue on the surface reduces the hazard of erosion.
- Grassed waterways help to prevent gully erosion in areas of concentrated flow.
- The high pH level in the Swanlake soil should be considered when agricultural chemicals and crop varieties are selected.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: Clarion—3; Swanlake—8

919—Canisteo-Mayer complex

Composition

Canisteo soil and similar soils: 45 to 65 percent
Mayer soil and similar soils: 30 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Low foot slopes and rims of depressions on till plains

Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 4 to 200 acres

Typical Profile

Canisteo

0 to 18 inches—black, friable, calcareous clay loam
18 to 26 inches—dark gray, friable, calcareous clay loam
26 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Mayer

0 to 16 inches—black, friable, calcareous loam
16 to 28 inches—dark grayish brown, friable, mottled, calcareous loam
28 to 35 inches—grayish brown, friable, mottled, calcareous sandy loam
35 to 45 inches—olive gray, loose, calcareous gravelly coarse sand
45 to 60 inches—dark grayish brown, loose, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Canisteo—moderate; Mayer—moderate in the upper part, rapid in the lower part
Available water capacity: Canisteo—high; Mayer—moderate
Organic matter content: High
Surface runoff: Canisteo—slow; Mayer—very slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Glencoe soils in closed depressions
• The moderately well drained Nicollet soils in the higher positions

Similar soils:
• Soils that are leached to a depth of 20 inches or more

Use and Management

Cropland

Major management factors: Canisteo—seasonal high water table, tilth, soil reaction (pH); Mayer—seasonal high water table, available water capacity, tilth, soil reaction (pH)
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Because of the range of textures in the underlying material of the Mayer soil, special management may be needed to prevent tile from being filled.
• Caving of cutbanks may occur when tile is installed in areas of the Mayer soil.
• Working the soils when they are wet results in surface compaction and cloddiness.
• Choosing plants and varieties that are tolerant of the high pH level minimizes the effects of high levels of calcium carbonate.
• The high pH level should be considered when agricultural chemicals are selected and applied.
• Parts of this unit may not have sufficient moisture in some years because of the moderate available water capacity of the Mayer soil.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: Canisteo—2K; Mayer—2K

920B—Clarion-Hawick complex, 3 to 6 percent slopes

Composition

Clarion soil and similar soils: 40 to 60 percent
Hawick soil and similar soils: 30 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion—summits on till plains; Hawick—shoulders on till plains
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 50 acres

Typical Profile

Clarion

0 to 10 inches—black, friable loam
10 to 17 inches—dark brown, firm clay loam
17 to 25 inches—dark yellowish brown, firm clay loam
25 to 29 inches—dark yellowish brown, firm, mottled clay loam
29 to 60 inches—yellowish brown, firm, mottled, calcareous loam

Hawick

0 to 9 inches—very dark grayish brown, friable, calcareous sandy loam
9 to 15 inches—dark brown, loose, calcareous gravelly coarse sand
15 to 43 inches—dark yellowish brown, loose, calcareous gravelly coarse sand
43 to 60 inches—yellowish brown, loose, mottled, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Clarion—well drained; Hawick—excessively drained
Permeability: Clarion—moderate; Hawick—moderately

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

Inclusions

Contrasting inclusions:
• The poorly drained Webster soils in the lower positions
• The moderately well drained Nicollet soils in the lower positions

Similar soils:
• Soils that have a lighter colored surface layer because of erosion
• Soils that have fine sand in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Clarion—slope; Hawick—slope, available water capacity, organic matter content, soil blowing
• Maintaining crop residue on the surface reduces the hazard of soil blowing.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.
• Parts of this unit may not have sufficient moisture because of the low available water capacity of the Hawick soil.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.
• Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing in areas of the Hawick soil.

Interpretive Groups

Land capability classification: Clarion—2e; Hawick—4s
Windbreak suitability group: Clarion—3; Hawick—7

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

Composition

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

Setting

Landform and position on the landform: Clarion—summits and the lower side slopes on till plains; Hawick and Storden—shoulders and the upper side slopes on till plains
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

Clarion

0 to 7 inches—black, friable loam
7 to 25 inches—dark yellowish brown, friable loam
25 to 60 inches—yellowish brown, friable, mottled, calcareous loam

Hawick

0 to 7 inches—very dark brown, very friable, calcareous sandy loam
7 to 14 inches—brown or dark brown, very friable, calcareous loamy coarse sand
14 to 60 inches—dark grayish brown, very friable, calcareous gravelly coarse sand

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 26 inches—brown, friable, calcareous loam
26 to 60 inches—brown, friable, mottled, calcareous loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The poorly drained Webster and Delft soils in the lower positions
• The moderately well drained Nicollet soils in the lower positions
• The moderately well drained Terril soils on foot slopes

Similar soils:
• Soils that have fine sand in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Clarion—eroded surface, slope; Hawick—eroded surface, slope, available water capacity, organic matter content, soil blowing; Storden—eroded surface, slope, soil reaction (pH), organic matter content

- Productivity has been reduced because of erosion. If the soils are not protected, productivity will continue to decline.
- Maintaining crop residue, stripcropping, contour farming, or including alfalfa and grasses in the rotation help to control soil blowing.
- Terraces, diversions, and grassed waterways reduce the hazard of erosion.
- Parts of this unit may not have sufficient moisture because of the low available water capacity of the Hawick soil.
- Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.
- Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing in areas of the Hawick soil.
- The high pH level in the Storden soil should be considered when agricultural chemicals and crop varieties are selected.

Interpretive Groups

Land capability classification: Clarion—3e; Hawick—4s; Storden—3e

Windbreak suitability group: Clarion—3; Hawick—7; Storden—8

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

Composition

Clarion soil and similar soils: 50 to 80 percent
Storden soil and similar soils: 15 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Clarion—summits and the lower side slopes on till plains; Storden—shoulders and the upper side slopes on till plains

Shape of areas: Moderately long and narrow with smooth edges

Size of areas: 4 to 40 acres

Typical Profile

Clarion

0 to 9 inches—black, friable loam
9 to 26 inches—dark yellowish brown, friable loam
26 to 60 inches—light olive brown, friable, calcareous loam

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 20 inches—light yellowish brown, friable, calcareous loam
20 to 47 inches—yellowish brown, friable, calcareous loam
47 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: Clarion—moderate; Storden—moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Delft and Webster soils in drainageways and on foot slopes
- The moderately well drained Nicollet soils in the lower positions
- Soils that have sand and gravel in the subsoil and underlying material
- The moderately well drained Terril soils on foot slopes

Similar soils:

- Soils that have a calcareous, dark surface layer

Use and Management

Cropland

Major management factors: Clarion—eroded surface, slope; Storden—eroded surface, slope, organic matter content, soil reaction (pH)

- Productivity has been reduced because of erosion. If the soils are not protected, productivity will continue to decline.
- Maintaining crop residue, stripcropping, contour farming, or including alfalfa and grasses in the rotation help to control soil blowing.
- Terraces, diversions, and grassed waterways reduce the hazard of erosion.
- Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.
- The high pH level in the Storden soil should be considered when agricultural chemicals and crop varieties are selected.

Interpretive Groups

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

944B—Lester-Hawick complex, 2 to 6 percent slopes

Composition

Lester soil and similar soils: 45 to 80 percent
Hawick soil and similar soils: 15 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lester—summits on till plains; Hawick—shoulders and back slopes on till plains
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

Lester

0 to 10 inches—very dark brown, friable loam
10 to 22 inches—brown or dark brown, friable clay loam
22 to 38 inches—dark yellowish brown, friable clay loam
38 to 52 inches—dark yellowish brown, friable, calcareous loam
52 to 60 inches—dark yellowish brown, friable, mottled, calcareous loam

Hawick

0 to 12 inches—very dark brown, friable sandy loam
12 to 18 inches—dark grayish brown, loose, calcareous fine sand
18 to 48 inches—dark grayish brown, loose, calcareous sand
48 to 60 inches—dark grayish brown, loose, calcareous coarse sand

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils in the lower areas
• The moderately well drained Le Sueur soils in the lower positions

Similar soils:
• Soils that have calcium carbonates at or near the surface
• Soils that have fine sand in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Lester—slope; Hawick—slope, available water capacity, organic matter content, soil blowing
• Maintaining crop residue on the surface helps to control soil blowing.
• Grassed waterways help to prevent gully erosion in areas of concentrated flow.
• Parts of this unit may not have sufficient moisture because of the low available water capacity of the Hawick soil.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.

Interpretive Groups

Land capability classification: Lester—2e; Hawick—4s
Windbreak suitability group: Lester—3; Hawick—7

944C2—Lester-Hawick-Swanlake complex, 6 to 12 percent slopes, eroded

Composition

Lester soil and similar soils: 30 to 50 percent
Hawick soil and similar soils: 30 to 50 percent
Swanlake soil and similar soils: 15 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lester—summits on till plains; Hawick—shoulders and back slopes on till plains; Swanlake—the upper side slopes and shoulders on till plains
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

Lester

0 to 8 inches—black, friable loam
8 to 20 inches—dark yellowish brown, firm clay loam
20 to 34 inches—yellowish brown, firm, mottled loam
34 to 60 inches—light olive brown, firm, mottled, calcareous loam

Hawick

0 to 9 inches—very dark grayish brown, friable, calcareous sandy loam
9 to 16 inches—brown or dark brown, loose, calcareous sand
16 to 42 inches—yellowish brown, loose, calcareous sand
42 to 60 inches—yellowish brown, loose, calcareous gravelly sand

Swanlake

0 to 7 inches—very dark grayish brown, friable, calcareous loam
7 to 29 inches—yellowish brown, firm, calcareous loam
29 to 60 inches—yellowish brown, firm, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Lester—well drained; Hawick—excessively drained; Swanlake—well drained
Permeability: Lester—moderate; Hawick—moderately rapid in the upper part, rapid or very rapid in the next part, very rapid in the lower part; Swanlake—moderate
Available water capacity: Lester—high; Hawick—low; Swanlake—high
Organic matter content: Moderately low or moderate
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cordova and Delft soils in the lower positions
• The moderately well drained Le Sueur soils in the lower positions
• The moderately well drained Terril soils on foot slopes

Similar soils:
• Soils that have fine sand in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Lester—eroded surface, slope; Hawick—eroded surface, slope, available water capacity, organic matter content, soil blowing; Swanlake—eroded surface, slope, organic matter content, soil reaction (pH)
• Productivity has been reduced because of erosion. If the soils are not protected, productivity will continue to decline.
• Maintaining crop residue on the surface, stripcropping, contour farming, and including alfalfa and grasses in the rotation help to control soil blowing.
• Terraces, diversions, and grassed waterways reduce the hazard of erosion.
• Parts of this unit may not have sufficient moisture because of the low available water capacity of the Hawick soil.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.
• The high pH level in the Swanlake soil should be considered when agricultural chemicals and crop varieties are selected.

Interpretive Groups

Land capability classification: Lester—3e; Hawick—4s; Swanlake—3e
Windbreak suitability group: Lester—3; Hawick—7; Swanlake—8

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

Composition

Lester soil and similar soils: 40 to 80 percent
Storden soil and similar soils: 15 to 55 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lester—side slopes and summits on till plains; Storden—shoulders on till plains
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 40 acres

Typical Profile

Lester

0 to 8 inches—very dark grayish brown, friable loam
8 to 22 inches—brown or dark brown, firm clay loam
22 to 34 inches—brown or dark brown, firm, mottled clay loam
34 to 60 inches—brown, firm, mottled, calcareous loam

Storden

0 to 7 inches—brown, friable, calcareous loam
7 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—moderately low or moderate; Storden—moderately low
Surface runoff: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Delft and Webster soils in drainageways and on foot slopes
• The moderately well drained Le Sueur soils in the lower positions
• Soils that have sand and gravel in the subsoil and underlying material
• The moderately well drained Terril soils on foot slopes

Similar soils:
• Soils that have a calcareous, dark surface layer

Use and Management

Cropland

Major management factors: Lester—eroded surface, slope; Storden—eroded surface, slope, organic matter content, soil reaction (pH)
• Productivity has been reduced because of erosion. If the soils are not protected, productivity will continue to decline.
• Maintaining crop residue, stripcropping, contour farming, or including alfalfa and grasses in the rotation helps to control soil blowing.
• Terraces, diversions, and grassed waterways reduce the hazard of erosion.
• Seeding native plants, pasture, or trees is effective in controlling erosion.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.
• The high pH level in the Storden soil should be considered when agricultural chemicals and crop varieties are selected.

Wildlife habitat

Major management factors: Slope
• Native trees and plants should be preserved or established.

Interpretive Groups

Land capability classification: 4e
Windbreak suitability group: Lester—3; Storden—8

945F—Lester-Storden complex, 18 to 65 percent slopes

Composition

Lester soil and similar soils: 65 to 85 percent
Storden soil and similar soils: 10 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lester—side slopes and summits on till plains; Storden—shoulders on till plains
Slope range: Lester—18 to 50 percent; Storden—18 to 65 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 40 to 400 acres

Typical Profile

Lester

0 to 6 inches—very dark brown, friable loam
6 to 9 inches—very dark grayish brown, friable loam
9 to 24 inches—brown or dark brown, friable clay loam
24 to 35 inches—dark yellowish brown, friable clay loam
35 to 60 inches—light olive brown, friable, mottled, calcareous clay loam

Storden

0 to 8 inches—dark grayish brown, friable, calcareous loam
8 to 26 inches—brown, friable, mottled, calcareous loam
26 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: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• Soils that have sand and gravel in the subsoil and underlying material
• The poorly drained Delft soils in the lower positions

Similar soils:
• Soils that have a dark surface layer more than 10 inches thick
• Soils that have a calcareous, dark surface layer

Use and Management

Pasture and hay

Major management factors: Slope, water erosion
• The use of equipment is limited because of the slope.
• Native grasses and shrubs are the major plants grown in areas of these soils.
• Adjusting stocking rates helps to maintain the quality and quantity of forage, especially on the steeper slopes.

Wildlife habitat

Major management factors: Slope
• Native trees and plants should be preserved or established.

• Planting by hand and limiting the amount of soil disturbance help to control erosion.

Interpretive Groups

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

946—Nicollet-Linder complex

Composition

Nicollet soil and similar soils: 35 to 60 percent
Linder soil and similar soils: 35 to 60 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Low summits on till plains
Slope range: Nicollet—1 to 3 percent; Linder—0 to 2 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

Nicollet

0 to 11 inches—black, friable loam
11 to 21 inches—dark grayish brown, friable loam
21 to 60 inches—grayish brown, friable, mottled, calcareous loam

Linder

0 to 12 inches—black, friable loam
12 to 21 inches—dark grayish brown, friable, mottled sandy loam
21 to 26 inches—dark grayish brown, loose, mottled, calcareous gravelly sandy loam
26 to 60 inches—dark grayish brown, loose, mottled, calcareous sand

Soil Properties and Qualities

Drainage class: Nicollet—moderately well drained; Linder—somewhat poorly drained
Permeability: Nicollet—moderate; Linder—moderate in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Nicollet—high; Linder—low
Organic matter content: Nicollet—high; Linder—moderate
Surface runoff: Slow
Depth to the water table: Nicollet—2.5 to 5.0 feet; Linder—2 to 4 feet

Inclusions

Contrasting inclusions:
• The poorly drained Biscay and Webster soils, which are in the lower positions

Similar soils:
• Soils that have calcium carbonates at or near the surface
• Soils that have fine sand in the subsoil and underlying material

Use and Management

Cropland

Major management factors: Linder—available water capacity, soil blowing
• Parts of this unit may not have sufficient moisture because of the low available water capacity of the Linder soil.
• Maintaining crop residue on the surface reduces the hazard of erosion.
• Returning crop residue to the soil, rotating crops, and using minimum tillage help to maintain tilth and fertility.

Interpretive Groups

Land capability classification: Nicollet—1; Linder—2s
Windbreak suitability group: 1

956—Canisteo-Glencoe complex

Composition

Canisteo soil and similar soils: 35 to 70 percent
Glencoe soil and similar soils: 25 to 60 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Canisteo—rims of depressions on till plains; Glencoe—closed depressions on till plains
Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 4 to 400 acres

Typical Profile

Canisteo

0 to 16 inches—black, firm, calcareous clay loam
16 to 23 inches—very dark gray, friable, mottled, calcareous clay loam
23 to 35 inches—olive gray, friable, mottled, calcareous clay loam
35 to 60 inches—olive gray, firm, mottled, calcareous clay loam

Glencoe

0 to 33 inches—black, friable clay loam
33 to 43 inches—very dark gray, friable, mottled clay loam
43 to 60 inches—olive gray, firm, mottled clay 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: High
Organic matter content: Canisteo—high; Glencoe—high or very high
Surface runoff: Canisteo—slow; Glencoe—ponded
Seasonal high water table: Canisteo—at a depth of 1 to 3 feet; Glencoe—1 foot above to 1 foot below the surface
Special characteristics: Ponding in areas of the Glencoe soil during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Crippin soils in the higher positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Canisteo—seasonal high water table, tilth, soil reaction (pH); Glencoe—seasonal high water table, ponding, tilth
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding.
• Working the soils when they are too wet results in surface compaction and cloddiness.
• Selecting plants and varieties that are tolerant of high pH values minimizes the effects of high levels of calcium carbonate in the Canisteo soil.
• The high pH level in the Canisteo soil should be considered when agricultural chemicals are selected and applied.

Interpretive Groups

Land capability classification: Canisteo—2w; Glencoe—3w
Windbreak suitability group: Canisteo—2K; Glencoe—2W

978—Cordova-Rolfe complex

Composition

Cordova soil and similar soils: 55 to 80 percent
Rolfe soil and similar soils: 15 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Cordova—foot slopes on till plains; Rolfe—closed depressions on till plains
Slope range: Cordova—0 to 2 percent; Rolfe—0 to 1 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 5 to 200 acres

Typical Profile

Cordova

0 to 6 inches—black, friable clay loam
6 to 13 inches—black, firm clay loam
13 to 27 inches—gray, firm clay loam
27 to 60 inches—light brownish gray, friable, mottled, calcareous clay loam

Rolfe

0 to 7 inches—black, friable silt loam
7 to 13 inches—dark grayish brown, friable, mottled silt loam
13 to 20 inches—very dark gray, firm silty clay
20 to 37 inches—olive gray, firm, mottled silty clay
37 to 43 inches—olive gray, friable, mottled clay loam
43 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 in the upper part, slow in the next 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
Seasonal high water table: Cordova—at a depth of 1 to 3 feet; Rolfe—1 foot above to 1 foot below the surface
Special characteristics: Ponding in areas of the Rolfe soil during spring snowmelt and after periods of heavy or prolonged rainfall

Inclusions

Contrasting inclusions:
• The moderately well drained Le Sueur soils in the higher positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Cordova—seasonal high water table, tilth; Rolfe—seasonal high water table, ponding, tilth, restricted permeability
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Surface tile inlets reduce the length of the periods of ponding in areas of the Rolfe soil.
• Because the high clay content limits water movement in the Rolfe soil, drainage tiles should be closely spaced.
• Working the soils when they are too wet results in surface compaction and cloddiness.

Interpretive Groups

Land capability classification: Cordova—2w; Rolfe—3w
Windbreak suitability group: 2

1016—Udorthents, loamy

Description of areas: Areas where the natural soil profile has been significantly disturbed or buried, including reclaimed gravel or clay pits, borrow pits, sanitary landfills, and stockpiles of soil material or other materials
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 3 to 100 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 the topsoil is returned to the disturbed site.
• Some reclaimed areas are suitable for commercial or industrial development.
• Wildlife habitat or recreational areas can be developed in areas of these soils.
• Onsite investigation is needed to determine the suitability for specific uses.
Interpretive groups: Not assigned

1030—Udorthents-Pits, gravel, complex

Description of areas: Active or abandoned areas from which gravel or sand has been or is being removed, including excavations, stockpiles of sand and gravel, and some ponds
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 5 to 75 acres
Inclusions: Borrow pits from which loamy materials have been removed; small areas of Biscay, Mayer, Hawick, Linder, Lasa, and Dakota soils, which make up 1 to 5 percent of the map unit and are along the edges of the pits
Use and management:
• If reclaimed, areas of this unit are suited to several uses. Reclamation, however, generally requires extensive filling and grading.
• In some areas, grasses and brush are becoming reestablished.
• Some areas can be reclaimed for agricultural uses if the topsoil is stockpiled.
• Wildlife habitat or recreational areas can be developed by revegetating areas near the ponds.
• Onsite investigation is needed to determine the potentials and limitations for specific uses.
Interpretive groups: Not assigned

1075—Klossner and Muskego soils, ponded

Composition

Klossner soil and similar soils: 40 to 60 percent
Muskego soil and similar soils: 35 to 55 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Closed depressions on till plains
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 5 to 300 acres

Typical Profile

Klossner

0 to 38 inches—black, very friable muck
38 to 42 inches—black, very friable mucky silt loam
42 to 60 inches—olive gray, friable, mottled, calcareous clay loam

Muskego

0 to 39 inches—black, very friable muck
39 to 60 inches—very dark gray, friable, calcareous silt loam (coprogenous earth)

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—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
Seasonal high water table: 3 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained, mineral Canisteo and Harps soils in the higher positions
• Soils that have sand or gravel in the subsoil and underlying material

Similar soils:
• Soils that have mineral materials in the subsoil and underlying material

Use and Management

Pasture and hay

Major management factors: Ponding
• In dry years, some areas may be used for pasture and hay.

Wetland wildlife habitat

Major management factors: Ponding
• Because of open water areas and marsh vegetation, this unit is well suited to wetland wildlife habitat. Adapted species that are useful to wildlife should be planted.

Interpretive Groups

Land capability classification: 8w
Windbreak suitability group: 10

1081—Minneiska-Abscota complex, occasionally flooded

Composition

Minneiska soil and similar soils: 45 to 80 percent
Abscota soil and similar soils: 15 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Splays on flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to 300 acres

Typical Profile

Minneiska

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

Abscota

0 to 8 inches—dark grayish brown, loose, calcareous loamy fine sand
8 to 60 inches—stratified very dark grayish brown and dark grayish brown, loose, calcareous fine sand and loamy fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Minneiska—moderately rapid; Abscota—rapid
Available water capacity: Minneiska—high; Abscota—low
Organic matter content: Minneiska—moderate or high; Abscota—low or moderately low
Surface runoff: Minneiska—slow; Abscota—very slow
Depth to the water table: Minneiska—3 to 6 feet; Abscota—2.5 to 5.0 feet
Frequency of flooding: Occasional
Special characteristics: Stratification of textures and colors varies from place to place in the Minneiska soil.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Chaska soils, which have less sand than the major soils; in the lower positions
• The very poorly drained Oshawa soils in depressions
• The very poorly drained and poorly drained Kalmarville soils, which are in old channels and are subject to frequent flooding

Similar soils:
• Soils that do not have stratified textures
• Soils that are leached to a depth of 20 inches or more

Use and Management

Cropland

Major management factors: Minneiska—flooding, soil blowing, soil reaction (pH); Abscota—flooding, soil blowing, available water capacity, organic matter content
• Seasonal flooding limits the production and harvesting of crops.
• Open ditches allow the return of floodwaters to the river.
• Maintaining crop residue on the surface, planting field windbreaks, or growing cover crops helps to control soil blowing.
• The high pH level in the Minneiska soil should be considered when agricultural chemicals and crop varieties are selected.
• Parts of this unit may not have enough moisture

because of the low available water capacity of the Abscota soil.
• Using a suitable crop rotation and returning crop residue to the soil can maintain or increase the content of organic matter.

Interpretive Groups

Land capability classification: Minneiska—2w; Abscota—4s
Windbreak suitability group: Minneiska—1K; Abscota—1

1093—Webster-Biscay complex

Composition

Webster soil and similar soils: 35 to 65 percent
Biscay soil and similar soils: 30 to 60 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Webster—foot slopes on till plains; Biscay—foot slopes on till plains or stream terraces
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 4 to 200 acres

Typical Profile

Webster

0 to 21 inches—black, friable clay loam
21 to 35 inches—dark grayish brown, friable, mottled clay loam
35 to 60 inches—olive gray, friable, mottled, calcareous loam

Biscay

0 to 16 inches—black, friable clay loam
16 to 21 inches—dark gray, friable clay loam
21 to 35 inches—light olive brown, friable, mottled clay loam
35 to 60 inches—olive gray, very friable, mottled sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Webster—moderate; Biscay—moderate in the upper part, rapid in the lower part
Available water capacity: Webster—high; Biscay—moderate
Organic matter content: High
Surface runoff: Slow
Depth to the water table: Webster—1 to 2 feet; Biscay—1 to 3 feet
Special characteristics: The Webster soil may not occur or may be of limited extent in sec. 27, T. 112 N., R. 27 W., and sec. 35, T. 113 N., R. 26 W.

Inclusions

Contrasting inclusions:
• The moderately well drained Nicollet soils in the higher positions
• The very poorly drained Glencoe soils in closed depressions

Similar soils:
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Webster—seasonal high water table, tilth; Biscay—seasonal high water table, available water capacity, tilth
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Because of the range in textures in the underlying material of the Biscay soil, special management may be needed to prevent tile from being filled.
• Caving of cutbanks may occur when tile is installed in areas of the Biscay soil.
• Working the soils when they are wet results in surface compaction and cloddiness.
• Crops may not have sufficient moisture in some years because of the moderate available water capacity of the Biscay soil.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2

1833—Coland clay loam, occasionally flooded

Composition

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

Setting

Landform and position on the landform: Splays on flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and moderately wide with smooth edges
Size of areas: 30 to 400 acres

Typical Profile

0 to 10 inches—black, friable clay loam
10 to 40 inches—black and very dark grayish brown, friable, mottled clay loam
40 to 60 inches—dark grayish brown, friable, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Upper part—moderate; lower part—moderate or moderately rapid
Available water capacity: High
Organic matter content: High
Surface runoff: Very slow
Depth to the water table: 1 to 3 feet
Frequency of flooding: Occasional
Special characteristics: The need for protection from flooding varies from place to place because of the deepening and straightening of stream channels.

Inclusions

Contrasting inclusions:
• The very poorly drained Oshawa soils in depressions
• The moderately well drained Minneiska soils, which have more sand throughout than the Coland soil

Similar soils:
• Soils that are underlain by sand
• Soils that have calcium carbonates at or near the surface

Use and Management

Cropland

Major management factors: Seasonal high water table, tilth, flooding
• Unless present drainage systems are maintained, wetness can hinder crop production.
• Because of the range of textures in the underlying material, special management may be needed to prevent tile from being filled.
• Caving of cutbanks may occur when tile is installed.
• Working the soil when it is too wet results in surface compaction and cloddiness.
• The occasional flooding may limit the production and harvesting of crops.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2

1834—Coland clay loam, frequently flooded

Composition

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

Setting

Landform and position on the landform: Meanderbelts on flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and moderately wide with smooth edges
Size of areas: 30 to 400 acres

Typical Profile

0 to 10 inches—black, friable clay loam
10 to 36 inches—black, friable silty clay loam
36 to 48 inches—very dark gray, friable, mottled clay loam
48 to 60 inches—dark grayish brown, friable, mottled loam that has thin strata of loamy fine sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Upper part—moderate; lower part—moderate or moderately rapid
Available water capacity: High
Organic matter content: High
Surface runoff: Very slow
Depth to the water table: 1 to 3 feet
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• The very poorly drained Oshawa soils in depressions
• The moderately well drained Minneiska soils, which have more sand throughout than the Coland soil

Similar soils:
• Soils that are underlain by sand
• Soils that have calcium carbonates at or near the surface

Use and Management

Pasture and hay

Major management factors: Flooding
• In dry years, some areas may be used for pasture and hay.

Wetland wildlife habitat

Major management factors: Flooding
• Adapted species that are useful to wildlife should be planted.

Interpretive Groups

Land capability classification: 5w
Windbreak suitability group: 2

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

Composition

Lester soil and similar soils: 35 to 60 percent
Le Sueur soil and similar soils: 35 to 60 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Lester—high

summits and the upper back slopes on till plains; Le Sueur—low summits and the lower back slopes on till plains
Slope range: Lester—3 to 6 percent; Le Sueur—1 to 3 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 4 to 40 acres

Typical Profile

Lester

0 to 9 inches—very dark grayish brown, friable loam
9 to 20 inches—dark yellowish brown, friable loam
20 to 26 inches—dark yellowish brown, friable clay loam
26 to 34 inches—light olive brown, friable, calcareous loam
34 to 60 inches—light olive brown, friable, mottled, calcareous loam

Le Sueur

0 to 10 inches—black, friable clay loam
10 to 18 inches—dark grayish brown, friable clay loam
18 to 24 inches—grayish brown, friable, mottled clay loam
24 to 30 inches—dark grayish brown, friable, mottled clay loam
30 to 60 inches—grayish brown, friable, mottled, calcareous clay loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The poorly drained Cordova soils in the lower positions
• Soils that have sand and gravel in the subsoil and underlying material

Similar soils:
• Soils that have less clay in the subsoil
• Soils that have a lighter colored surface layer because of erosion

Use and Management

Cropland

Major management factors: Lester—slope
• Maintaining crop residue on the surface reduces the hazard of erosion.

Interpretive Groups

Land capability classification: Lester—2e; Le Sueur—1
Windbreak suitability group: Lester—3; Le Sueur—1

1999—Minneiska-Kalmarville complex, frequently flooded

Composition

Minneiska soil and similar soils: 45 to 75 percent
Kalmarville soil and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Minneiska—splays on flood plains; Kalmarville—channels on flood plains
Slope range: Minneiska—0 to 2 percent; Kalmarville—0 to 1 percent
Shape of areas: Long and wide with smooth edges
Size of areas: 10 to 200 acres

Typical Profile

Minneiska

0 to 6 inches—black, friable, calcareous sandy loam
6 to 60 inches—stratified dark grayish brown, dark brown, and grayish brown, very friable, calcareous sand, silt loam, sandy loam, and loamy sand

Kalmarville

0 to 6 inches—very dark grayish brown, friable, mottled, calcareous loam
6 to 54 inches—stratified dark grayish brown and very dark gray, friable and loose, mottled, calcareous silt loam, fine sand, and fine sandy loam
54 to 60 inches—dark grayish brown, loose, calcareous fine sand

Soil Properties and Qualities

Drainage class: Minneiska—moderately well drained; Kalmarville—very poorly drained
Permeability: Minneiska—moderately rapid; Kalmarville—moderate in the upper part, moderately rapid in the next part, rapid in the lower part
Available water capacity: Minneiska—high; Kalmarville—moderate
Organic matter content: Minneiska—moderate or high; Kalmarville—moderate
Surface runoff: Minneiska—slow; Kalmarville—very slow
Seasonal high water table: Minneiska—at a depth of 3 to 6 feet; Kalmarville—at the surface to 1 foot below the surface
Frequency of flooding: Frequent
Special characteristics: Short, steep slopes are common near current and former channels in areas of the

Minneiska soil; stratification of textures and colors varies from place to place.

Inclusions

Contrasting inclusions:

- The very poorly drained Oshawa soils, which have more clay than the major soils; in old channels
- The somewhat poorly drained Chaska soils, which have more clay and less sand throughout than the major soils and are occasionally flooded

Similar soils:

- Soils that have more sand throughout
- Soils that contain gravel at or near the surface

Use and Management

Pasture and hay

Major management factors: Minneiska—flooding, soil blowing, soil reaction (pH); Kalmarville—flooding, soil blowing, seasonal high water table, available water capacity

- The seasonal flooding limits the production of pasture and hay.
- Maintaining a protective cover of vegetation helps to control soil blowing.
- The high pH level should be considered when agricultural chemicals are selected.
- Parts of this unit may not have sufficient moisture in some years because of the moderate available water capacity of the Kalmarville soil.
- The seasonal high water table limits the production of pasture and hay in areas of the Kalmarville soil.

Interpretive Groups

Land capability classification: 5w
Windbreak suitability group: Minneiska—1K; Kalmarville—2

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 Natural Resources Conservation Service.

About 268,000 acres in the survey area, or nearly 71 percent of the total acreage, meets the soil requirements for prime farmland. Areas of this land are scattered throughout the county. Most areas are used for crops. The main crops grown on this land 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 qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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 (Soil Science Society of America and American Society of Agronomy, 1966).

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where 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.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

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 Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants 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 under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

In 1991, about 230,800 acres of cropland was used for corn and soybeans; 23,800 acres for small grain, primarily wheat and oats; and 20,800 acres for hay, primarily alfalfa-grass mixtures (Minnesota Crop and Livestock Reporting Service, 1991). Small acreages of sweet corn and peas are grown in the county for canning. Steeply sloping or excessively wet areas are used for pasture. Soil productivity ranges from marginal to high. Good management can increase yields and conserve the soil.

Most of the cropland in the county is subject to water erosion or soil blowing. The erosion hazard ranges from slight to severe. Sloping soils are the most susceptible to water erosion, and sandy soils are the most susceptible to soil blowing. Erosion is harmful for several reasons. Nutrients and organic matter are lost as the topsoil is removed by erosion. Also, erosion on farmland can result in sedimentation at the base of slopes or in nearby depressions or in pollution of rivers and lakes. Controlling erosion helps to prevent this pollution and maintains the quality of water.

Conservation tillage is one of the most effective

erosion-control methods that can be used in the county. A conservation tillage system leaves part or all of the residue from the previous crop on the surface of the soil. Such systems include full-width tillage, chisel plowing or disc or strip tillage, ridge-till, and no-till farming. Conservation tillage helps to control erosion, reduces fuel consumption, and can result in substantial savings of time. Other conservation practices include grassed waterways, water- and sediment-control basins, diversions, and stripcropping. In areas where slopes are long and uniform, terraces, contour farming, and contour stripcropping can be effective in controlling erosion. Returning crop residue to the soil increases the rate of water infiltration and thus helps to control runoff and erosion.

Soil blowing can be a problem throughout the county, but it is especially serious in areas of the droughty Dickinson, Hawick, and Lasa soils and in areas of mucky soils, such as Klossner and Muskego soils. Most soil blowing occurs in the fall or early spring when the soil is bare. Leaving crop residue on the surface helps to protect the soil. Leaving fields that were plowed in the fall rough and cloddy can be effective in controlling soil blowing. Establishing field windbreaks and stripcropping also reduce the hazard of soil blowing.

Wetness is a limitation in many low-lying and depressional acres. Artificial drainage minimizes ponding and lowers the water table below the root zone in areas of Canisteo, Cordova, Glencoe, Klossner, Okoboji, and Webster soils. Open ditches drain much of the surface water and provide outlets for subsurface tile lines. If outlets are not available, a pumping station may be required. The spacing of subsurface drainage lines depends on the type of soil and the depth at which the drains can be installed. Generally, areas where the soils are finer textured require closer spacing of the lines. Surface inlets remove surface water rapidly from depressional areas. Guidelines for draining wet soils are available in the "Minnesota Drainage Guide" (USDA/SCS, 1984).

Good soil tilth increases the rate of water infiltration and provides a good seedbed. Working the soils when they are wet can result in surface compaction and can damage soil structure (Swan and others, 1987). Moderately fine textured and fine textured soils are frequently tilled in the fall, but the hazard of erosion is high. Ridge planting or chisel plowing reduces the erosion hazard. Freezing and thawing during the winter improve the condition of the surface and make seedbed preparation easier in spring. Returning crop residue to the soil and adding manure improve tilth. A rotation that includes alfalfa-grass mixtures helps to loosen up the soil and improves tilth. Good tilth also helps the soils to warm up faster in the spring and allows for the efficient utilization of nutrients.

On most of the soils in the county, crops respond well to applications of fertilizer. The need for fertilizer depends on the type of soil, past and present management, the degree of erosion, and the kinds of crops to be planted. The kind and amount of fertilizer to be used should be based on the results of soil tests. In areas where there are other limitations, such as droughtiness, excessive wetness, or an imbalance of nutrients caused by high levels of calcium carbonates, applications of fertilizer may not be as effective. A good fertility management program takes into account all aspects of plant growth. Soil texture, organic matter content, and soil reaction affect herbicide application rates and the amount of carryover. Detailed information about these soil properties is provided in the section "Detailed Soil Map Units."

The acreage in the county used for pasture has decreased in recent years. The land used for pastures is generally too wet, too steep, or too droughty for use as cropland. Existing pastures can be improved by applying fertilizer, rotating pastures, deferring grazing during wet periods, and controlling weeds. In places the pasture could be renovated by reseeding to more productive species. Drainage conditions and the type of soil should be considered when species are selected for seeding.

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 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 Natural Resources 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 woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 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, 2e. 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 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 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 the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

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.

At the end of each description under the heading "Detailed Soil Map Units," the soil has been assigned to a windbreak suitability group. The groups for each

map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey. These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service. Specific information also can be obtained from the Sibley County Soil and Water Conservation District or the Sibley County Extension Service.

The soils in Sibley County are assigned to 11 different windbreak suitability groups. The paragraphs that follow describe these groups. In areas where the hazard of water erosion is severe, site preparation 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. Permeability is moderate throughout or is moderate in the upper part of the profile and very rapid in the lower part. The soils do not have free carbonates in the upper part of the profile. This group also includes one moderately well drained soil that is subject to flooding.

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. Permeability is moderate or moderately rapid. The soils generally have free carbonates in the upper part of the profile. This group also includes moderately well drained soils that are subject to flooding.

The trees and shrubs grown as windbreaks and environmental plantings on this soil 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. Permeability ranges from moderately slow to rapid. The soils have been artificially drained and do not have free carbonates in the upper part of the profile. This group also includes poorly drained soils that are subject to flooding.

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. Permeability is moderate throughout or is rapid in the upper part of the profile and moderately slow in the lower part. The upland soils have been artificially drained, but in most cases the alluvial soils have not been artificially drained. The soils in this group generally have free carbonates in the upper part of the profile. This group also includes poorly drained soils that are subject to flooding.

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 wetness, seedling mortality 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 more than 16 inches of organic material. The 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. The 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 and moderately well drained, loamy soils. Permeability is moderate. The soils generally do not have free carbonates in the upper part of the profile.

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 soils that have sand, gravel, or both at a depth of 20 to 40 inches. The soils have a moderate water-holding capacity.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. The moisture stress caused by droughtiness can result in seedling mortality. Cultivation or applications of herbicide help

to remove competing vegetation.

Windbreak suitability group 7.—This group consists dominantly of 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. Seedling mortality 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. Ponding prevents the growth of trees and shrubs. Onsite investigation may identify areas where trees and shrubs can be planted. Special management is needed near the outer edges of the mapped areas.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

A county park along High Island Creek and the Rush River State Park offer hiking, cross-country skiing, and camping facilities. Camping is also available near Henderson, at a county park on the shores of Clear Lake, and in Lake Titlow Park. Boat access ramps are available on Lake Titlow, Clear Lake, and High Island Lake.

The Minnesota River valley provides locations for canoeing, fishing, and hunting. Wildlife management areas and other wetlands provide hunting and trapping opportunities in other parts of the county. A public golf course is south of Winthrop on Highway 15.

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 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 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

Paul Bremer, area wildlife manager, Minnesota Department of Natural Resources, helped prepare this section.

The fertile soils of Sibley County have the potential to support large populations of wildlife. Pheasants, gray partridge, cottontail rabbits, squirrels, furbearers, waterfowl, and white-tailed deer are the primary species of interest to hunters and trappers in the county. In addition, numerous nongame species enrich the ecological diversity. The most common breeding waterfowl are mallards, blue-winged teal, wood ducks, and Canada geese. Waterfowl populations have been steadily declining over the past 50 years, partly because of intensive agriculture and the drainage of wetlands.

White-tailed deer are the only big game species in the county. Approximately 480 deer were harvested in 1988. The 1984 aerial deer census in the county showed a count of 528 wintering deer, but this number does not account for all of the deer in the county. Most of the deer were in the Minnesota River valley, the Rush River valley, and the High Island Creek valley on the eastern end of the county, where the best wintering cover is located. During the summer, the deer spread out into the farmland and scattered woodlots. The deer herd is in excellent condition as a result of the high-quality diet provided by the agricultural areas. The average adult doe bears twins or, occasionally, triplets.

In the late 1950's, Sibley County was one of the primary producers of pheasant and thus one of the major hunting areas. Changing agricultural practices over the past decades have resulted in a drastic decline in the population of this game bird. The change from diversified farming to intensive row cropping has resulted in a reduction of habitat for most species. Row-cropped fields provide little or no breeding habitat. Fall plowing reduces winter food and cover. Landscapes are windswept and hold little snow. The drifting snow piles over the remaining cover and decreases its protective value. The drainage of wetlands also has substantially reduced the amount of winter cover available for pheasants and other upland wildlife. Reserve programs that provide grasslands and woodlots and that restore wetlands can improve the habitat.

Soil-conserving measures that minimize the effects of soil blowing and snow drifting also improve wildlife habitat. The loss of wildlife in winter is less severe in areas where field windbreaks have been established than in the more open areas.

Sibley County has 49 lakes or wetland areas 10 acres or more in size. Although most of these bodies of water are too shallow to support permanent fish populations, they provide fair to excellent habitat for waterfowl. Of these lakes and wetlands, 9 are wholly or partially within the 12 Wildlife Management Areas open to the public for hunting and trapping. One additional wildlife area is a refuge. The 13 wildlife areas make up about 1,081 acres in the county. In some parts of the county, these areas provide the bulk of the wildlife habitat still in existence.

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 (fig. 11).

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

Figure 11.—A wildlife planting in an area of Canisteo and Glencoe soils. Wildlife habitat can be created by planting appropriate vegetation.

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, soybeans, and grain sorghum.

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, birdsfoot trefoil, bromegrass, clover, 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, indiangrass, and switchgrass.

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 blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, crabapple, wild plum, and redosier dogwood.

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 red pine, Scotch pine, spruce, northern whitecedar, 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, salinity, 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 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 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, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Woodlot Management and Productivity

Sibley County is in the northern deciduous forest region. The eastern one-third of the survey area was originally forested. It was covered primarily with oak, maple, basswood, elm, and ash. The river-bottom forests on the flood plains along the Minnesota River consist of ash, cottonwood, elm, hackberry, and willow.

Most of the woodland in the county presently consists of small woodlots on steep slopes adjacent to rivers, on bottom land along rivers, and in areas near lakes. The wooded areas are used mainly for woodland wildlife habitat, homesites, or recreation. A few areas are used for grazing by livestock. The areas support trees similar to those in the original forests, but wood production is limited. Many areas could benefit from improvement of the timber stands. Potential wood products in the county include firewood, lumber, and veneer.

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, 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 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, 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. 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, 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, and flooding affect absorption of the effluent. Large stones 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, 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 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, 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 the water table to permit revegetation. The soil material used as the 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 rock, 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, 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, irrigation, 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. 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 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 large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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, and large stones 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, and slope 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.

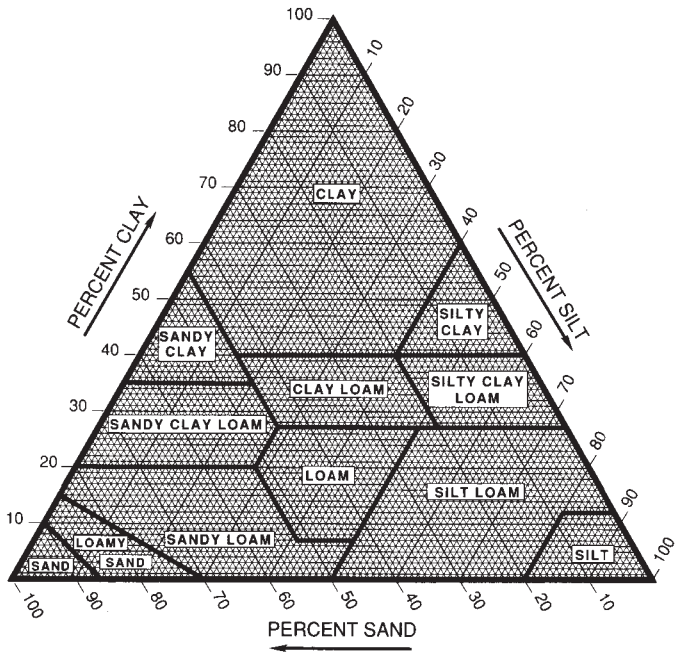

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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. 12). "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 (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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 3 to 10 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 (USDA, 1984).

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 ⅓-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). 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 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.

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 (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. 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" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, matrix 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."

Abscota Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid

Landform: Flood plains
Parent material: Calcareous, sandy alluvium
Slope range: 0 to 2 percent
Taxonomic class: Mixed, mesic Typic Udipsamments

Typical Pedon

Abscota loamy fine sand, in an area of Minneiska-Abscota complex, occasionally flooded, 1,500 feet north and 900 feet west of the southeast corner of sec. 35, T. 114 N., R. 25 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand; single grain; loose; slight effervescence; slightly alkaline; clear smooth boundary.

C1—8 to 18 inches; dark grayish brown (10YR 4/2) fine sand; single grain; loose; slight effervescence; slightly alkaline; clear smooth boundary.

C2—18 to 35 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; single grain; loose; dark grayish brown (10YR 4/2) streaks; slight effervescence; slightly alkaline; gradual smooth boundary.

C3—35 to 60 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; few fine prominent light olive brown (2.5Y 5/6) mottles; single grain; loose; dark grayish brown (10YR 4/2) streaks; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 60 inches

Ap horizon:
Hue—10YR to 5YR
Value—3 to 4
Chroma—1 or 2
Texture—loamy fine sand

C horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—fine sand, loamy fine sand, loamy sand, or fine sandy loam with strata of loam or gravel

Biscay Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Till plains and stream terraces
Parent material: Sandy glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls

Typical Pedon

Biscay clay loam, in an area of Webster-Biscay complex, 1,700 feet north and 2,500 feet west of the southeast corner of sec. 32, T. 112 N., R. 27 W.

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

A—10 to 16 inches; black (10YR 2/1) clay loam, very dark brown (10YR 2/2) dry; weak medium subangular blocky structure; friable; few roots; slightly acid; gradual wavy boundary.

Bg1—16 to 21 inches; dark gray (5Y 4/1) clay loam, dark grayish brown (2.5Y 4/2) dry; weak medium subangular blocky structure; friable; neutral; gradual wavy boundary.

Bg2—21 to 35 inches; light olive brown (2.5Y 5/4) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

2Cg1—35 to 52 inches; olive gray (5Y 5/2) sand; common medium prominent yellowish brown (10YR 5/6) mottles; single grain; very friable; 3 percent gravel; slightly acid; gradual wavy boundary.

2Cg2—52 to 60 inches; olive gray (5Y 4/2) sand; common medium prominent yellowish brown (10YR 5/6) mottles; single grain; very friable; 3 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to 60 inches
Thickness of the mollic epipedon: 16 to 24 inches
Depth to sand or gravel: 20 to 40 inches

Ap horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam
Content of gravel—0 to 5 percent

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam, silty clay loam, or loam
Content of gravel—0 to 5 percent

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 to 3
Texture—loam, clay loam, or sandy clay loam
Content of gravel—0 to 5 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loamy coarse sand, loamy sand, coarse sand, or sand
Content of gravel—3 to 30 percent

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Till-floored, drained glacial lakebeds
Parent material: Calcareous, silty coprogenous earth
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silt loam, 700 feet north and 2,200 feet west of the southeast corner of sec. 19, T. 112 N., R. 30 W.

Ap—0 to 12 inches; black (N 2/0) mucky silt loam (coprogenous earth), dark gray (10YR 4/1) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine granular structure; very friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg1—12 to 30 inches; black (N 2/0) silt loam (coprogenous earth); common fine prominent dark yellowish brown (10YR 4/6) and brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; very friable; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg2—30 to 57 inches; black (N 2/0) silt loam (coprogenous earth); few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg3—57 to 60 inches; very dark gray (N 3/0) silt loam (coprogenous earth); few fine prominent brown (7.5YR 4/4) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 24 to 60 inches
Content of rock fragments: 0 to 25 percent gravel by volume throughout the profile

Ap horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—0 to 2
Texture—silt loam or mucky silt loam

A horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—0 to 2
Texture—silt loam, mucky silty clay loam, or mucky silt loam

Cg horizon:
Hue—neutral, 2.5Y, or 5Y
Value—2 to 4
Chroma—0 to 2
Texture—silt loam, silty clay loam, mucky silt loam, or mucky silty clay loam

Canisteo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls

Typical Pedon

Canisteo clay loam, 2,300 feet north and 1,200 feet east of the southwest corner of sec. 30, T. 113 N., R. 28 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine granular structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

A1—9 to 14 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

A2—14 to 18 inches; very dark gray (N 3/0) clay loam, gray (N 5/0) dry; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

Bg1—18 to 26 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

Bg2—26 to 38 inches; grayish brown (2.5Y 5/2) loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

Cg—38 to 60 inches; grayish brown (2.5Y 5/2) loam;

many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 14 to 24 inches
Content of rock fragments: 1 to 8 percent gravel by volume throughout the profile

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

A horizon:
Hue—neutral or 10YR
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, loam, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 3
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 rapid in the lower part
Landform: Flood plains
Parent material: Calcareous, loamy and silty alluvium
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Aeric Fluvaquents

Typical Pedon

Chaska loam, occasionally flooded, 2,300 feet north and 100 feet west of the southeast corner of sec. 34, T. 112 N., R. 26 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 0 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

C1—9 to 30 inches; stratified dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), and grayish brown (2.5Y 5/2) very fine sandy loam; few fine prominent light olive brown (2.5Y 5/6) mottles; weak thin platy and weak fine subangular blocky structure; friable; 0 percent gravel; slight effervescence; slightly alkaline; abrupt wavy boundary.

C2—30 to 60 inches; stratified dark grayish brown (2.5Y 4/2) and very dark gray (10YR 3/1) silt loam and silty clay loam; common fine distinct light olive brown (2.5Y 5/6) and common light brownish gray (2.5Y 6/2) mottles; massive; friable; 0 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 0 to 9 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 to 3
Texture—silt loam, very fine sandy loam, silty clay loam, fine sand, loamy fine sand, or fine sandy loam

Clarion Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 2 to 12 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Clarion loam, 2 to 6 percent slopes (fig. 13), 100 feet south and 1,200 feet west of the northeast corner of sec. 20, T. 112 N., R. 28 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark brown (10YR 3/3) dry; moderate fine subangular blocky structure; friable; few fine roots; 3 percent gravel; moderately acid; clear smooth boundary.

Bw—10 to 32 inches; dark yellowish brown (10YR 4/4) loam; moderate very fine subangular blocky structure; friable; 3 percent gravel; moderately acid; abrupt wavy boundary.

C1—32 to 41 inches; yellowish brown (10YR 5/4) loam; few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; friable; common light gray (10YR 7/1), soft accumulations; 5 percent gravel; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—41 to 60 inches; yellowish brown (10YR 5/4) loam; common medium prominent grayish brown (2.5Y 5/2) and common dark yellowish brown (10YR 4/6) mottles; massive; friable; common light gray (10YR 7/1), soft accumulations; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Thickness of the mollic epipedon: 7 to 22 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

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

Coland Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderate or moderately rapid in the lower part
Landform: Flood plains
Parent material: Loamy and sandy alluvium
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Coland clay loam, frequently flooded, 1,000 feet north and 2,300 feet west of the southeast corner of sec. 6, T. 113 N., R. 27 W.

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

A2—10 to 36 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few roots; neutral; gradual wavy boundary.

ACg—36 to 48 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine prominent olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; few black (10YR 2/1) streaks; neutral; gradual wavy boundary.

Cg—48 to 60 inches; dark grayish brown (2.5Y 4/2), stratified loam and loamy fine sand; common fine distinct olive brown (2.5Y 4/4) mottles; massive; friable; common grayish brown (10YR 5/2) streaks; slightly alkaline.

Range in Characteristics

Depth to carbonates: 32 to 60 inches
Thickness of the mollic epipedon: 36 to 55 inches

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, clay loam, or loam

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—2 to 5
Chroma—0 to 2
Texture—clay loam, loam, or sandy loam with strata ranging from silty clay to loamy sand
Content of gravel—1 to 10 percent

Cordova Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow in the upper part, moderate in the lower part
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Cordova clay loam, in an area of Cordova-Rolfe complex, 1,100 feet south and 1,100 feet east of the northwest corner of sec. 21, T. 112 N., R. 26 W.

Ap—0 to 6 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A—6 to 13 inches; black (N 2/0) clay loam, very dark

gray (10YR 3/1) dry; moderate fine subangular blocky structure; firm; few very dark gray (N 3/0) clay films on faces of peds and in pores; moderately acid; gradual smooth boundary.

Btg—13 to 27 inches; gray (5Y 5/1) clay loam; moderate fine subangular blocky structure; firm; few dark grayish brown (2.5Y 4/2) clay films on faces of peds and in pores; slightly acid; clear wavy boundary.

Cg—27 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common white (2.5Y 8/2), soft accumulations; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of rock fragments: 2 to 6 percent gravel by volume throughout the profile

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam, clay loam, or silty clay loam

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 or 3
Texture—loam or clay loam

Crippin Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Crippin loam, 1,400 feet north and 1,450 feet west of the southeast corner of sec. 29, T. 112 N., R. 29 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; neutral; abrupt smooth boundary.

A—9 to 15 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

Bw1—15 to 23 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; 5 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

Bw2—23 to 32 inches; dark grayish brown (2.5Y 4/2) loam; common fine distinct grayish brown (2.5Y 5/2) and common dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; friable; common white (N 8/0), soft accumulations; 5 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

C—32 to 60 inches; olive brown (2.5Y 4/4) loam; common fine distinct grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/6) mottles; massive; friable; common white (N 8/0), soft accumulations; 8 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 10 to 20 inches
Content of rock fragments: 1 to 8 percent gravel by volume throughout the profile

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

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

Chroma—2 to 4
Texture—loam or clay loam

Dakota Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the upper part, moderately rapid in the next part, rapid in the lower part
Landform: Stream terraces
Parent material: Sandy glacial outwash (fig. 14)
Slope range: 1 to 6 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls

Typical Pedon

Dakota loam, 1 to 6 percent slopes, 900 feet north and 25 feet west of the southeast corner of sec. 32, T. 114 N., R. 25 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark brown (10YR 3/3) dry; moderate fine subangular blocky structure; friable; common roots; 2 percent gravel; slightly acid; clear wavy boundary.
Bt1—10 to 14 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; few roots; few brown (10YR 4/3) clay films on faces of peds; 2 percent gravel; slightly acid; gradual wavy boundary.
Bt2—14 to 23 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium angular blocky structure; friable; few roots; common brown (10YR 4/3) clay films on faces of peds; 2 percent gravel; strongly acid; clear smooth boundary.
2Bt3—23 to 35 inches; dark yellowish brown (10YR 4/4) gravelly coarse sandy loam; moderate fine angular blocky structure; friable; common roots; few dark yellowish brown (10YR 4/4) clay films between sand grains; 25 percent gravel; 2 percent cobbles; slightly acid; gradual wavy boundary.
2C—35 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; few roots; 25 percent gravel; 2 percent cobbles; slight effervescence; neutral.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 10 to 18 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam
Content of gravel—0 to 2 percent

Bt horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 5
Texture—loam, sandy clay loam, or clay loam with subhorizons of sandy loam or silt loam
Content of gravel—0 to 2 percent

2Bt horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 5
Texture—sandy loam, loamy sand, gravelly coarse sandy loam, gravelly loamy sand, or gravelly sandy loam
Content of gravel—0 to 25 percent

2C horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 6
Texture—sand, coarse sand, gravelly sand, or gravelly coarse sand
Content of gravel—0 to 25 percent

Delft Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow in the upper part, moderately slow or moderate in the lower part
Landform: Till plains
Parent material: Loamy local alluvium and calcareous, loamy glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Delft clay loam, 1,500 feet south and 2,600 feet east of the northwest corner of sec. 8, T. 112 N., R. 31 W.

Ap—0 to 10 inches; black (N 2/0) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; common roots; 1 percent gravel; moderately acid; clear smooth boundary.
A1—10 to 28 inches; black (N 2/0) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; few roots; 2 percent gravel; slightly acid; gradual smooth boundary.
A2—28 to 37 inches; black (N 2/0) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; 2 percent gravel; neutral; gradual smooth boundary.
A3—37 to 45 inches; very dark gray (5Y 3/1) clay loam,

gray (10YR 5/1) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 2 percent gravel; neutral; gradual smooth boundary.

Cg—45 to 60 inches; olive gray (5Y 4/2) clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 2 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 60 inches
Thickness of the mollic epipedon: 24 to 50 inches

Ap horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—0 or 1
Texture—clay loam
Content of gravel—1 to 5 percent

A horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—0 or 1
Texture—loam, clay loam, or silty clay loam
Content of gravel—1 to 5 percent

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, or sandy loam
Content of gravel—1 to 10 percent

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: Sandy glacial outwash
Slope range: 2 to 6 percent
Taxonomic class: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickinson loam, 2 to 6 percent slopes, 200 feet north and 2,100 feet east of the southwest corner of sec. 23, T. 112 N., R. 26 W.

A—0 to 10 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; moderately acid; gradual wavy boundary.

Bw—10 to 17 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

Bt—17 to 40 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine subangular blocky structure; very friable; few dark yellowish brown (10YR 4/4) clay films on faces of peds; slightly acid; clear wavy boundary.

C1—40 to 51 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; strongly acid; gradual wavy boundary.

C2—51 to 60 inches; brown (10YR 5/3) fine sand; single grain; loose; moderately acid.

Range in Characteristics

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

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam

Bw horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—sandy loam or fine sandy loam

Bt horizon:
Hue—10YR
Value—3 or 5
Chroma—2 to 4
Texture—sandy loam or fine sandy loam

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy fine sand, loamy sand, fine sand, or sand
Content of gravel—0 to 20 percent

Glencoe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow or moderate in the upper part, moderate or moderately rapid in the lower part
Landform: Till plains
Parent material: Loamy local alluvium and calcareous, loamy glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Haplaquolls

Typical Pedon

Glencoe clay loam, 1,600 feet south and 2,500 feet east

of the northwest corner of sec. 17, T. 113 N., R. 28 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A1—8 to 27 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

A2—27 to 32 inches; very dark gray (5Y 3/1) clay loam, dark gray (5Y 4/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; neutral; gradual wavy boundary.

Bg1—32 to 42 inches; olive gray (5Y 5/2) clay loam; common fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 4 percent gravel; slightly alkaline; gradual wavy boundary.

Bg2—42 to 50 inches; olive gray (5Y 5/2) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; 4 percent gravel; slightly alkaline; clear wavy boundary.

Cg—50 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 4 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
Content of rock fragments: 2 to 5 percent gravel by volume throughout the profile

Ap horizon:
Hue—10YR to 5Y or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

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

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam, silty clay loam, loam, sand, sandy loam, loamy sand, or silt loam

Harps Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mesic Typic Calciaquolls

Typical Pedon

Harps clay loam, 1,700 feet south and 1,800 feet west of the northeast corner of sec. 2, T. 114 N., R. 31 W.

Akp—0 to 9 inches; very dark gray (N 3/0) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; disseminated calcium carbonates; violent effervescence; moderately alkaline; abrupt smooth boundary.

Ak—9 to 19 inches; very dark gray (N 3/0) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; disseminated calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

Bg1—19 to 23 inches; gray (5Y 5/1) clay loam; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Bg2—23 to 31 inches; grayish brown (2.5Y 5/2) clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg1—31 to 41 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/6) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—41 to 60 inches; olive gray (5Y 5/2) loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 2 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 12 to 21 inches
Content of rock fragments: 1 to 5 percent gravel by volume throughout the profile

Akp horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

Ak horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam

Bg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam or clay loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam, clay 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 next part, very rapid in the lower part
Landform: Till plains
Parent material: Calcareous, sandy glacial outwash
Slope range: 2 to 12 percent
Taxonomic class: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Hawick sandy loam, in an area of Clarion-Hawick complex, 3 to 6 percent slopes, 300 feet south and 2,200 feet east of the northwest corner of sec. 13, T. 112 N., R. 30 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; weak fine granular structure; friable; common roots; 3 percent gravel; strong effervescence; abrupt smooth boundary.

Bw—9 to 15 inches; dark brown (10YR 3/3) gravelly coarse sand; weak fine subangular blocky structure; very friable; few roots; 25 percent gravel; strong effervescence; gradual wavy boundary.

C1—15 to 43 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grain; loose; 35 percent gravel; strong effervescence; gradual wavy boundary.

C2—43 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 25 percent gravel; strong effervescence.

Range in Characteristics

Depth to carbonates: 0 to 30 inches
Thickness of the mollic epipedon: 7 to 15 inches
Content of rock fragments: 5 to 35 percent gravel by volume throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loamy sand, loamy coarse sand, coarse sandy loam, or fine sandy loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 6
Texture—loamy sand, coarse sand, fine sand, or the gravelly analogs of those textures

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—coarse sand, sand, fine sand, or the gravelly analogs of those textures

Kalmarville Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate in the upper part, moderately rapid in the next part, rapid in the lower part
Landform: Flood plains
Parent material: Calcareous, loamy and sandy alluvium
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Taxadjunct features: The Kalmarville soils in this survey area are calcareous throughout the 10- to 20-inch layer. They are classified as coarse-loamy, mixed (calcareous), mesic Mollic Fluvaquents.

Typical Pedon

Kalmarville loam, in an area of Minneiska-Kalmarville complex, frequently flooded, 1,800 feet south and 700 feet east of the northwest corner of sec. 35, T. 112 N., R. 26 W.

A—0 to 54 inches; very dark grayish brown (10YR 3/2) loam that has strata of dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) fine sand, silt loam, and fine sandy loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; weak thin platy structure; friable; slight effervescence; slightly alkaline; clear smooth boundary.

2C—54 to 60 inches; dark grayish brown (10YR 4/2) fine sand; single grain; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 20 inches
Thickness of the mollic epipedon: 6 to 10 inches

A horizon:
- Hue—10YR or 2.5Y
- Value—2 to 5
- Chroma—1 to 3
- Texture—loam that has strata of silt loam, sandy loam, or fine sandy loam
- Content of gravel—0 to 5 percent

2C horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5
- Chroma—1 or 2
- Texture—coarse sand, sand, fine sand, loamy coarse sand, or loamy fine sand
- Content of gravel—0 to 10 percent

Klossner Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderate in the next part, moderately slow or moderate in the lower part
Landform: Till plains
Parent material: Mucky organic material and calcareous, loamy glacial till
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic, mesic Terric Medisaprists

Typical Pedon

Klossner muck, 400 feet south and 2,300 feet west of the northeast corner of sec. 5, T. 113 N., R. 28 W.

Oap—0 to 9 inches; black (10YR 2/1) muck, dark gray (10YR 4/1) dry; weak fine granular structure; friable; 0 percent gravel; neutral; abrupt smooth boundary.

Oa1—9 to 21 inches; black (10YR 2/1) muck, dark gray (10YR 4/1) dry; weak medium platy structure; friable; 0 percent gravel; neutral; gradual smooth boundary.

Oa2—21 to 32 inches; black (10YR 2/1) muck, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; few dark yellowish brown (10YR 3/6) iron stains in channels; 0 percent gravel; neutral; gradual smooth boundary.

2A—32 to 41 inches; black (N 2/0) mucky silt loam, very dark gray (10YR 3/1) dry; common fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common dark yellowish brown (10YR 3/6) iron stains in channels; 0 percent gravel; neutral; clear smooth boundary.

2Cg—41 to 60 inches; olive gray (5Y 5/2) silty clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 0 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches
Depth to carbonates: 16 inches or more

Oa horizon:
- Hue—neutral or 10YR
- Value—2 or 3
- Chroma—0 or 1
- Texture—muck

2A horizon:
- Hue—neutral, 10YR, 2.5Y, or 5Y
- Value—2 or 3
- Chroma—0 to 2
- Texture—mucky silt loam, silty clay loam, clay loam, mucky silty clay loam, or silt loam
- Content of gravel—0 to 5 percent

2Cg horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—3 to 6
- Chroma—0 to 2
- Texture—silty clay loam, loam, clay loam, or sandy clay loam; sandy strata in some pedons
- Content of gravel—0 to 8 percent

Lasa 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: Sandy glacial outwash
Slope range: 2 to 35 percent
Taxonomic class: Sandy, mixed, mesic Entic Hapludolls
Taxadjunct features: The Lasa soils in this survey area have less very fine sand than is defined as the range for the series. Also, they have argillic horizons. They are classified as coarse-loamy, mixed, mesic Psammentic Argiudolls.

Typical Pedon

Lasa loamy fine sand, 2 to 8 percent slopes, 1,200 feet south and 1,500 feet east of the northwest corner of sec. 26, T. 112 N., R. 26 W.

A—0 to 12 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; moderately acid; gradual smooth boundary.

Bw—12 to 18 inches; dark brown (10YR 3/3) fine sand, grayish brown (10YR 5/2) dry; single grain; loose; slightly acid; gradual smooth boundary.
Bt—18 to 40 inches; dark yellowish brown (10YR 4/4) fine sand that has thin strata of loamy fine sand; single grain; loose; clay bridges in the upper part; slightly acid; gradual smooth boundary.
BC—40 to 60 inches; dark yellowish brown (10YR 4/4), stratified loamy fine sand and fine sand; single grain; loose; slightly acid.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

Bw horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 or 4
Texture—loamy fine sand or fine sand with stratification

Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 to 5
Texture—loamy fine sand or fine sand with stratification

BC horizon:
Hue—10YR or 7.5YR
Value—4 or 5
Chroma—4 or 5
Texture—fine sand or loamy fine sand with stratification

Lester Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 2 to 50 percent
Taxonomic class: Fine-loamy, mixed, mesic Mollic Hapludalfs
Taxadjunct features: Lester loam, 6 to 12 percent slopes, eroded, has a mollic epipedon that is more than one-third of the thickness from the surface to the accumulation of secondary carbonates. This soil is classified as fine-loamy, mixed, mesic Typic Argiudolls.

Typical Pedon

Lester loam, 2 to 6 percent slopes (fig. 15), 150 feet north and 2,200 feet west of the southeast corner of sec. 11, T. 112 N., R. 26 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; 3 percent gravel; slightly acid; abrupt smooth boundary.
Bt1—9 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine prismatic structure; friable; common brown (10YR 4/3) clay films on faces of peds; 3 percent gravel; neutral; clear smooth boundary.
Bt2—14 to 30 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure; friable; common brown (10YR 4/3) clay films on faces of peds; 3 percent gravel; neutral; clear smooth boundary.
Bt3—30 to 39 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) clay films on faces of peds; 3 percent gravel; neutral; clear wavy boundary.
C1—39 to 49 inches; light olive brown (2.5Y 5/4) loam; few fine distinct grayish brown (2.5Y 5/2) mottles; massive; friable; 4 percent gravel; slight effervescence; slightly alkaline; gradual smooth boundary.
C2—49 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct grayish brown (2.5Y 5/2) and few dark yellowish brown (10YR 4/6) mottles; massive; friable; 4 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches
Thickness of the mollic epipedon: 6 to 10 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—loam or clay loam

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

Le Sueur Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Le Sueur clay loam, 2,100 feet south and 1,400 feet west of the northeast corner of sec. 8, T. 113 N., R. 26 W.

A—0 to 11 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

Bt1—11 to 17 inches; dark grayish brown (10YR 4/2) clay loam; weak medium subangular blocky structure; friable; few very dark gray (10YR 3/1) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Bt2—17 to 23 inches; dark grayish brown (10YR 4/2) clay loam; weak medium subangular blocky structure; friable; common dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Bt3—23 to 28 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; friable; common very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Bt4—28 to 37 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; few dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

Cg—37 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common light gray (2.5Y 7/2), soft accumulations; 2 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 22 to 55 inches
Thickness of the mollic epipedon: 10 to 18 inches
Content of rock fragments: 1 to 8 percent gravel by volume throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay loam or loam

Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam or loam

Linder Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part, moderately rapid in the next part, very rapid in the lower part
Landform: Till plains
Parent material: Calcareous, sandy glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Linder loam, in an area of Nicollet-Linder complex, 600 feet north and 2,300 feet east of the southwest corner of sec. 17, T. 113 N., R. 28 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; 3 percent gravel; slightly acid; clear smooth boundary.

Bw—12 to 21 inches; dark grayish brown (10YR 4/2) sandy loam; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; 8 percent gravel; slightly acid; clear smooth boundary.

BC—21 to 26 inches; dark grayish brown (2.5Y 4/2) sandy loam; common fine distinct olive brown (2.5Y 4/4) mottles; single grain; loose; common light gray (2.5Y 7/2), soft accumulations; 14 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

2C1—26 to 52 inches; dark grayish brown (2.5Y 4/2) sand; common medium prominent dark yellowish brown (10YR 4/6) mottles; single grain; loose; 5 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

2C2—52 to 60 inches; dark grayish brown (2.5Y 4/2)

sand; few fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; 10 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches
Thickness of the mollic epipedon: 10 to 18 inches
Depth to sand or gravel: 24 to 40 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of gravel—2 to 10 percent

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—sandy loam
Content of gravel—2 to 20 percent

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 6
Texture—sand, coarse sand, gravelly sand, or gravelly coarse sand
Content of gravel—2 to 45 percent

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: Till plains
Parent material: Clayey and silty lacustrine sediments and the underlying calcareous, loamy glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, mesic Typic Haplaquolls

Typical Pedon

Marna silty clay loam (fig. 16), 900 feet south and 2,500 feet east of the northwest corner of sec. 35, T. 112 N., R. 27 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; firm; common roots; 2 percent gravel; neutral; abrupt smooth boundary.

A—10 to 21 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; firm; few roots; 2 percent gravel; neutral; gradual wavy boundary.

Bg—21 to 32 inches; olive gray (5Y 4/2) silty clay; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; firm; few very dark gray (5Y 3/1) streaks on faces of peds; 2 percent gravel; neutral; gradual wavy boundary.

2Cg—32 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and few medium prominent olive brown (2.5Y 4/4) mottles; massive; friable; 3 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 26 to 45 inches
Thickness of the mollic epipedon: 16 to 24 inches

Ap horizon:
Hue—neutral, 10YR, or 5Y
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam
Content of gravel—0 to 2 percent

A horizon:
Hue—neutral, 10YR, or 5Y
Value—2 or 3
Chroma—0 or 1
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 loam or silty clay
Content of gravel—0 to 2 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of gravel—2 to 10 percent

Mayer Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Till plains
Parent material: Calcareous, sandy glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls

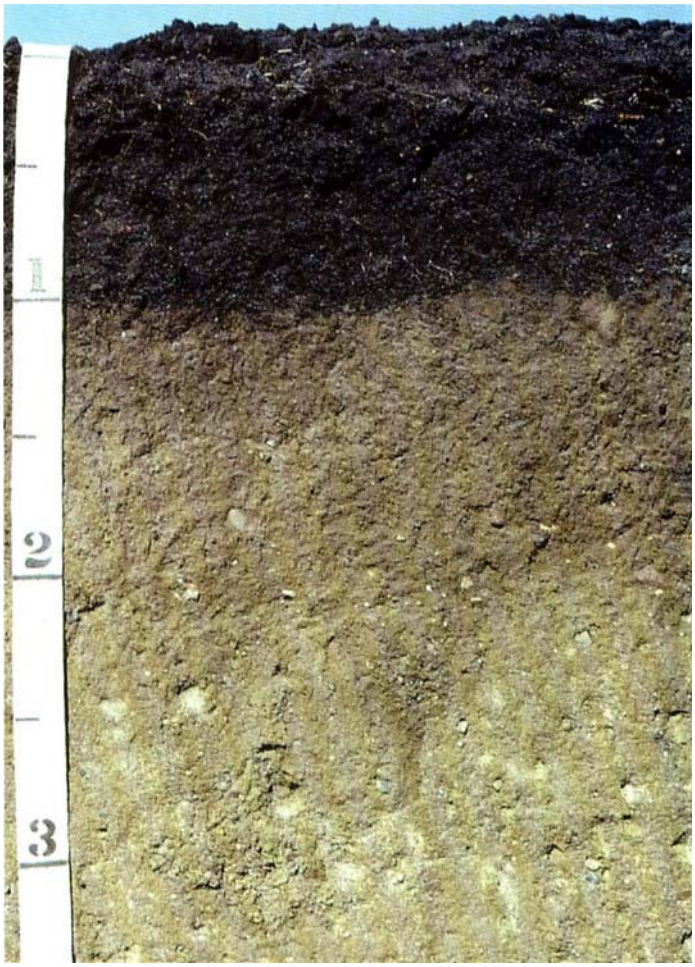

Figure 13.—A profile of Clarion loam, 2 to 6 percent slopes. This soil has a dark surface layer, a dark yellowish brown subsoil, and an accumulation of calcium carbonates in the lower part of the subsoil. Depth is marked in feet.

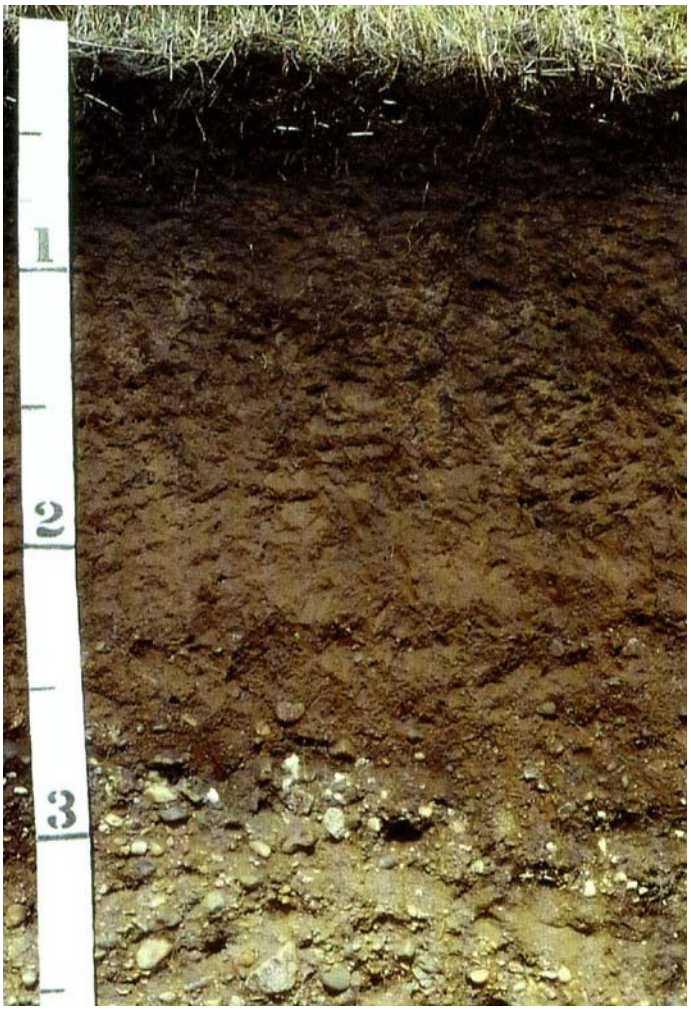

Figure 14.—A profile of Dakota loam, 1 to 6 percent slopes. The underlying material, from a depth of 35 to 60 inches, is gravelly glacial outwash. Depth is marked in feet.

Figure 15.—A profile of Lester loam, 2 to 6 percent slopes. The subsoil is yellowish brown and has an accumulation of clay. Depth is marked in feet.

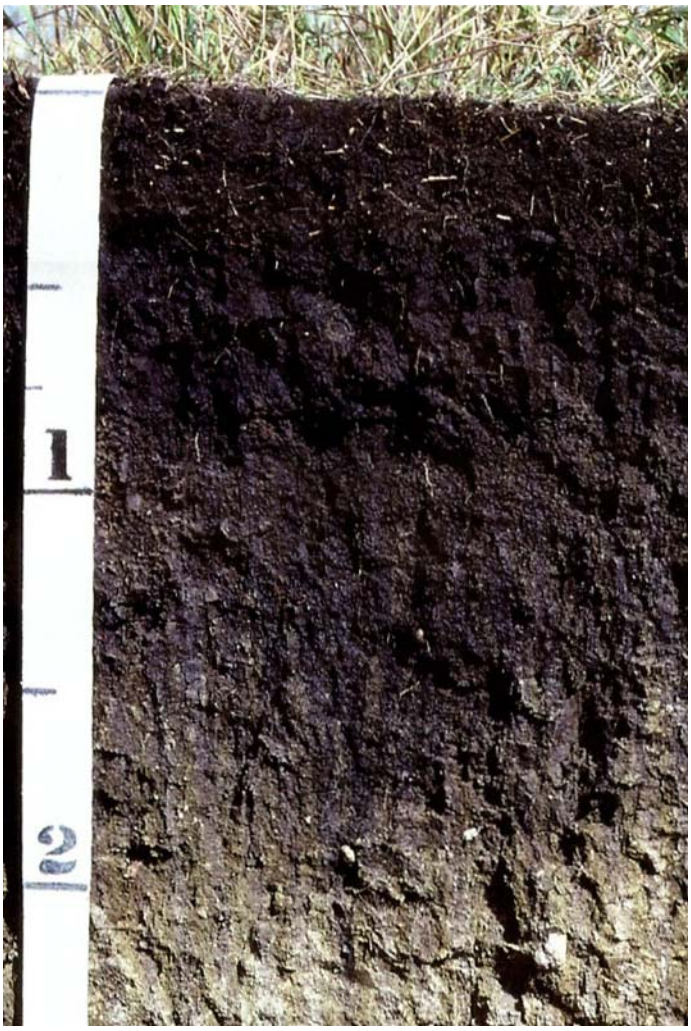

Figure 16.—A profile of Marna silty clay loam. This soil has a thick, dark surface layer and an accumulation of calcium carbonates in the lower part of the subsoil. The olive gray subsoil is indicative of wetness. Depth is marked in feet.

Figure 17.—A profile of a Minneiska fine sandy loam. This soil formed in stratified loamy and sandy alluvium. Depth is marked in feet.

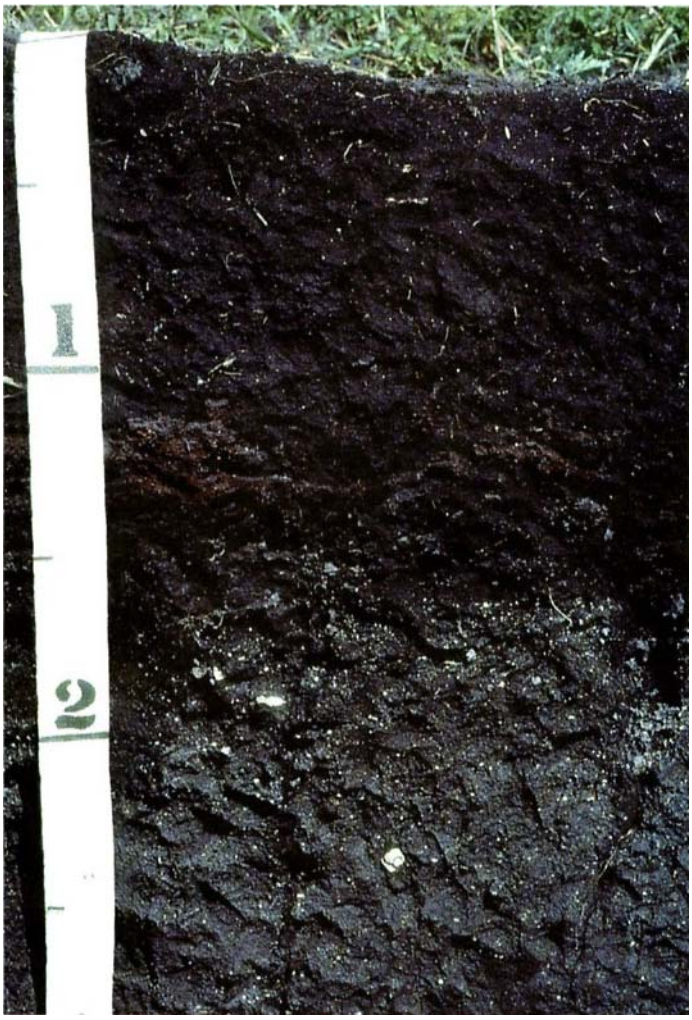

Figure 18.—A profile of Muskego muck. Note the snail-shell fragments in the substratum. Depth is marked in feet.

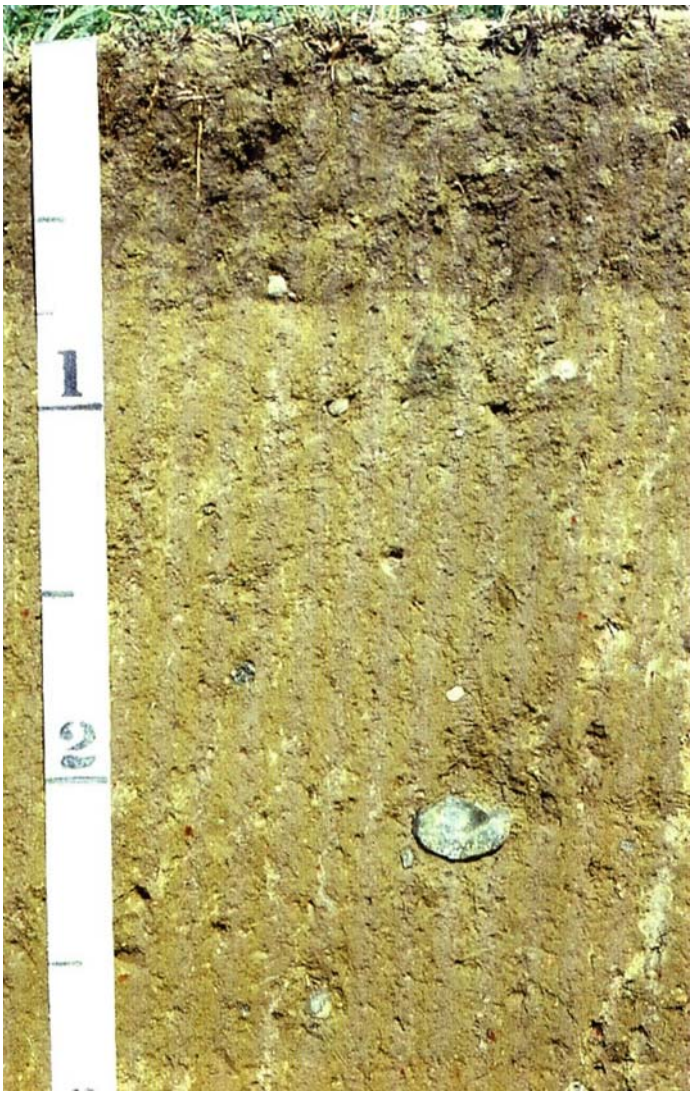

Figure 19.—A profile of a Storden loam. This soil has a light colored surface layer. The profile is rich in calcium carbonates. Depth is marked in feet.

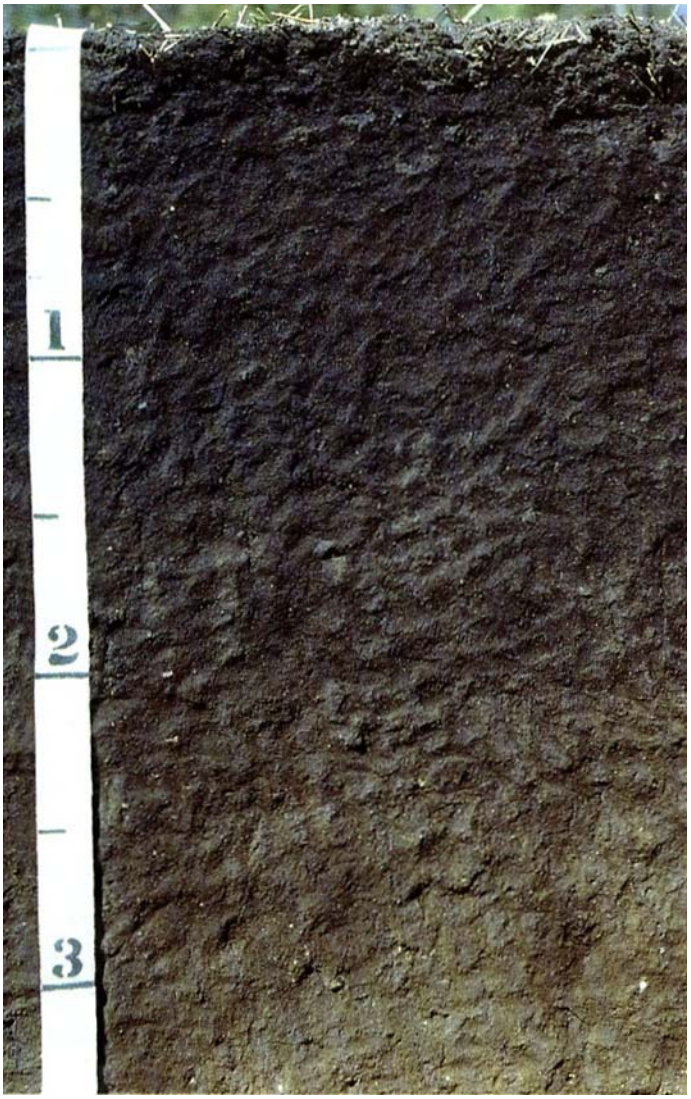

Figure 20.—A profile of Terril loam, 2 to 6 percent slopes. This soil has a thick, dark surface layer. Depth is marked in feet.

Typical Pedon

Mayer loam, in an area of Canisteo-Mayer complex, 2,000 feet north and 300 feet east of the southwest corner of sec. 11, T. 112 N., R. 28 W.

Ap—0 to 10 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; slight effervescence; moderately alkaline; clear smooth boundary.

A—10 to 16 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; slight effervescence; moderately alkaline; clear smooth boundary.

Bg—16 to 28 inches; dark grayish brown (2.5Y 4/2) loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; 5 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

2BC—28 to 35 inches; grayish brown (2.5Y 5/2) sandy loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure parting to single grain; friable; 10 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

2Cg1—35 to 45 inches; olive gray (5Y 5/2) gravelly coarse sand; single grain; loose; 15 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—45 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly sand; single grain; loose; 20 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 14 to 24 inches
Depth to sand or gravel: 20 to 40 inches

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam
Content of gravel—0 to 5 percent

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam
Content of gravel—0 to 5 percent

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, or sandy clay loam
Content of gravel—0 to 10 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 to 3
Texture—sand, coarse sand, gravelly coarse sand, or gravelly sand
Content of gravel—10 to 30 percent

Minneiska Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Flood plains and alluvial fans
Parent material: Calcareous, loamy and sandy alluvium (fig. 17)
Slope range: 0 to 4 percent
Taxonomic class: Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents

Typical Pedon

Minneiska fine sandy loam, in an area of Minneiska-Abscota complex, occasionally flooded, 1,800 feet north and 600 feet east of the southwest corner of sec. 35, T. 112 N., R. 26 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; 0 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

C—9 to 60 inches; stratified brown (10YR 5/3), dark brown (10YR 4/3), and very dark grayish brown (2.5Y 3/2) loamy fine sand, fine sandy loam, and silt loam; common medium distinct grayish brown (2.5Y 5/2) mottles; massive; friable; 0 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 7 to 10 inches
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—fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 or 3
Texture—fine sandy loam, sand, silt loam, loam,

loamy fine sand, sandy loam, or loamy sand

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: Till plains
Parent material: Mucky organic material and calcareous, silty coprogenous earth
Slope range: 0 to 1 percent
Taxonomic class: Coprogenous, euic, mesic Limnic Medisaprists

Typical Pedon

Muskego muck (fig. 18), 1,600 feet north and 1,700 feet west of the southeast corner of sec. 8, T. 113 N., R. 26 W.

Oap—0 to 9 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; 0 percent gravel; moderately acid; abrupt smooth boundary.

Oa1—9 to 24 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; weak thin platy structure parting to weak fine granular; friable; 0 percent gravel; moderately acid; gradual smooth boundary.

Oa2—24 to 40 inches; black (10YR 2/1) muck, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; 0 percent gravel; moderately acid; clear smooth boundary.

C1—40 to 45 inches; black (5Y 2.5/1) mucky silt loam (coprogenous earth); common fine prominent dark yellowish brown (10YR 4/6) and common olive gray (5Y 5/2) mottles; massive; friable; 0 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

C2—45 to 60 inches; olive gray (5Y 5/2) silt loam (coprogenous earth); common fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 0 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 51 inches
Thickness of the organic material: 16 to 51 inches

Oa horizons:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 to 2
Texture—muck

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 5
Chroma—1 or 2
Texture—mucky silt loam (coprogenous earth)

Nicollet Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 800 feet south and 2,300 feet east of the northwest corner of sec. 34, T. 114 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

A—9 to 15 inches; very dark gray (10YR 3/1) clay loam, dark brown (10YR 3/3) dry; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

Bw—15 to 20 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; gradual smooth boundary.

Bg—20 to 31 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; clear wavy boundary.

Cg—31 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common light gray (2.5Y 7/2), soft accumulations; 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 10 to 18 inches
Content of rock fragments: 1 to 8 percent gravel by volume throughout the profile

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, or silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—2 to 4
Texture—clay loam or loam

Bg horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay loam or loam

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

Okoboji Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate in the upper part, moderately slow in the next part, moderate in the lower part
Landform: Till plains
Parent material: Silty local alluvium and calcareous, loamy glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, mesic Cumulic Haplaquolls

Typical Pedon

Okoboji silty clay loam, 1,000 feet south and 100 feet east of the northwest corner of sec. 25, T. 112 N., R. 30 W.

Ap—0 to 12 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; friable; 0 percent gravel; slightly alkaline; clear smooth boundary.

A—12 to 42 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; friable; 0 percent gravel; slightly alkaline; gradual wavy boundary.

Cg1—42 to 52 inches; gray (5Y 5/1) silty clay loam; common medium prominent olive brown (2.5Y 4/4) and few dark yellowish brown (10YR 4/6) mottles; massive; friable; few white (5Y 8/1), soft accumulations; 0 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—52 to 60 inches; gray (5Y 5/1) silty clay loam; common medium prominent olive brown (2.5Y 4/4) and few medium prominent black (10YR 2/1) mottles; massive; friable; 0 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 24 to 48 inches

Ap horizon:
Hue—neutral, 10YR, or 5Y
Value—2
Chroma—0 or 1
Texture—silty clay loam
Content of gravel—0 to 2 percent

A horizon:
Hue—neutral, 10YR, or 5Y
Value—2
Chroma—0 or 1
Texture—silty clay loam, silt loam, mucky silty clay loam, or mucky silt loam
Content of gravel—0 to 2 percent

Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam
Content of gravel—0 to 5 percent

Oshawa Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Calcareous, silty alluvium
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Fluvaquentic Haplaquolls

Typical Pedon

Oshawa silty clay loam, frequently flooded, 1,100 feet south and 100 feet east of the northwest corner of sec. 25, T. 113 N., R. 26 W.

A—0 to 16 inches; black (10YR 2/1) silty clay loam, grayish brown (10YR 5/2) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; violent effervescence; slightly alkaline; gradual wavy boundary.

Cg1—16 to 25 inches; dark grayish brown (2.5Y 4/2)

silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common black (10YR 2/1) streaks; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg2—25 to 40 inches; black (10YR 2/1) silty clay loam, grayish brown (10YR 5/2) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg3—40 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; common black (10YR 2/1) streaks; slight effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR or 5Y
Value—2 or 3
Chroma—1 or 2
Texture—silty clay loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 5
Chroma—1 or 2
Texture—silty clay loam, silt loam, or clay loam

Rolfe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate in the upper part, slow in the next part, moderately slow or moderate in the lower part
Landform: Till plains
Parent material: Silty and clayey local alluvium and calcareous, loamy 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, 2,500 feet north and 200 feet west of the southeast corner of sec. 7, T. 114 N., R. 26 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; 0 percent gravel; neutral; abrupt smooth boundary.

E—7 to 13 inches; gray (10YR 5/1) silt loam, light gray (5Y 7/1) dry; common fine distinct light olive brown (2.5Y 5/6) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; 0 percent gravel; neutral; clear smooth boundary.

Btg1—13 to 20 inches; very dark gray (5Y 3/1) silty clay, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; many black (N 2/0) clay films on faces of peds; 2 percent gravel; slightly acid; gradual smooth boundary.

Btg2—20 to 27 inches; olive gray (5Y 4/2) silty clay; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; many black (N 2/0) clay films on faces of peds; 2 percent gravel; slightly acid; gradual smooth boundary.

Btg3—27 to 37 inches; olive gray (5Y 4/2) silty clay; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; common very dark gray (5Y 3/1) clay films on faces of peds; 2 percent gravel; neutral; gradual smooth boundary.

2Btg4—37 to 43 inches; olive gray (5Y 5/2) clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; common very dark gray (5Y 3/1) clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

2Cg—43 to 60 inches; olive gray (5Y 5/2) loam; many medium prominent light olive brown (2.5Y 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 42 to 60 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of rock fragments: 1 to 5 percent gravel by volume throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

E horizon:
Hue—10YR
Value—3 to 6
Chroma—1
Texture—silt loam or loam

Btg and 2Btg horizons:
Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—silty clay or clay

2Cg horizon:
Hue—5Y
Value—4 to 6
Chroma—2
Texture—loam or clay loam

Storden Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 6 to 65 percent
Taxonomic class: Fine-loamy, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Storden loam (fig. 19), in an area of Clarion-Storden complex, 6 to 12 percent slopes, eroded, 1,900 feet north and 2,600 feet east of the southwest corner of sec. 4, T. 112 N., R. 30 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; 5 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

C1—8 to 20 inches; light yellowish brown (10YR 6/4) loam; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

C2—20 to 47 inches; yellowish brown (10YR 5/4) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—47 to 60 inches; yellowish brown (10YR 5/4) loam; few medium distinct dark yellowish brown (10YR 4/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Content of rock fragments: 2 to 8 percent gravel by volume throughout the profile

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

Swanlake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 3 to 65 percent
Taxonomic class: Fine-loamy, mixed, mesic Entic Hapludolls

Typical Pedon

Swanlake loam, in an area of Clarion-Swanlake complex, 3 to 6 percent slopes, 400 feet south and 2,500 feet east of the northwest corner of sec. 20, T. 112 N., R. 30 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; 1 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

C1—8 to 34 inches; yellowish brown (10YR 5/4) loam; few fine prominent strong brown (7.5YR 4/6) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; common white (10YR 8/1), soft accumulations; 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—34 to 41 inches; yellowish brown (10YR 5/4) loam; few fine distinct dark yellowish brown (10YR 4/6) and strong brown (7.5YR 4/6) mottles; massive; friable; few white (10YR 8/1), soft accumulations; 5 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

C3—41 to 60 inches; yellowish brown (10YR 5/4) loam; few fine distinct gray (10YR 5/1) and strong brown (7.5YR 4/6) mottles; massive; friable; few white (10YR 8/1), soft accumulations; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Carbonates: Throughout the profile
Thickness of the mollic epipedon: 7 to 12 inches
Content of rock fragments: 1 to 10 percent gravel by volume throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 5
Texture—loam

Terril Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till plains and stream terraces
Parent material: Loamy local alluvium
Slope range: 2 to 6 percent
Taxonomic class: Fine-loamy, mixed, mesic Cumulic Hapludolls

Typical Pedon

Terril loam, 2 to 6 percent slopes (fig. 20), 1,400 feet south and 1,800 feet west of the northeast corner of sec. 23, T. 113 N., R. 26 W.

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

A1—8 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

A2—14 to 25 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; gradual smooth boundary.

Bw1—25 to 33 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; 4 percent gravel; neutral; gradual smooth boundary.

Bw2—33 to 47 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; 4 percent gravel; neutral; clear wavy boundary.

2C—47 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam; massive; friable; 6 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Thickness of the mollic epipedon: 24 to 60 inches
Content of rock fragments: 2 to 10 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, silt loam, or clay loam

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

C horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—loam, clay loam, or fine sandy loam

Webster Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Calcareous, loamy glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, mesic Typic Haplaquolls

Typical Pedon

Webster clay loam, 1,900 feet south and 2,100 feet east of the northwest corner of sec. 17, T. 113 N., R. 28 W.

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

A—8 to 17 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

Bg1—17 to 21 inches; dark gray (5Y 4/1) clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; neutral; clear smooth boundary.

Bg2—21 to 30 inches; grayish brown (2.5Y 5/2) clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; 2 percent gravel; slightly alkaline; clear wavy boundary.

Cg1—30 to 35 inches; grayish brown (2.5Y 5/2) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 2 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—35 to 60 inches; light brownish gray (2.5Y 6/2)

loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Thickness of the mollic epipedon: 14 to 24 inches
Content of rock fragments: 1 to 8 percent gravel by volume throughout the profile

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam

A horizon:
Hue—neutral or 10YR
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, loam, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—clay loam or loam

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Formation of the Soils

Soil forms through the action of soil-forming processes on material deposited or accumulated by geologic forces. The characteristics of the soil at any given point are determined by the interaction of five factors—the composition of the parent material; the climate under which the soil material has accumulated; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material (Jenny, 1941).

Climate and plant and animal life, chiefly plants, are the most active factors of soil formation. The type of parent material and its resistance to weathering determines the kind and degree of soil development. Relief modifies the effect of climate, which in turn influences the kinds of plants that grow in an area. Time is needed for changes to occur in the parent material. Much or little time may be needed, depending on the intensity of soil development.

All five factors of soil formation are interrelated. A change in one factor results in changes in the other four factors. The following paragraphs relate the factors of soil formation to the soils in the survey area.

Parent Material

The soils in Sibley County formed in glacial till, in material sorted out by glacial meltwaters, or in organic material. The most common parent material in the survey area is glacial till. It was deposited by ice as an unsorted mixture of clay, silt, sand, pebbles, and rocks. The glacial till in this survey area was deposited about 14,000 years ago (Matsch, 1972). Soils that formed in glacial till include those of the Clarion, Nicollet, Webster, Lester, Le Sueur, and Cordova series.

During the period when the glacial ice was melting, glacial meltwater flowed through the survey area. This meltwater carried huge volumes of soil material. As the volume of water decreased, the coarser material settled out first. This material, mainly sand and gravel, is called glacial outwash. Soils that formed in outwash are Dakota, Dickinson, Hawick, and Lasa soils. Some of these soils are relatively distant from present-day watercourses.

After the coarser sand and gravel had settled out and as the water volume and speed decreased further, fine textured glacial lacustrine material settled out. Marna and Okoboji soils formed in this material.

The present-day rivers in the county still carry material as they constantly cut and dig at streambanks. This parent material, called alluvium, is deposited on flood plains as the water volume decreases. Alluvium is generally finer textured than outwash and in most cases is much younger. Chaska, Coland, Minneiska, and Oshawa soils formed in alluvium.

Climate

The climate of the survey area has been relatively constant for the past few thousand years. It is a continental climate characterized by long, cold winters and hot summers.

Climate is essentially uniform throughout the survey area, but local variations in climate are caused by differences in relief and aspect. South- and west-facing slopes tend to be slightly drier and warmer than north- and east-facing slopes.

Climatic changes have been responsible for the formation and melting of glacial ice, the deposition of glacial sediments, the evolution of topography, and the growth cycles of plants and animals. Climate also influenced the types of vegetation under which the soils formed.

Freezing of the soil during the winter slows the soil-forming processes. Alternate freezing and thawing also help to disintegrate parent materials, and frost heaving helps to mix soil material. Rainfall influences the leaching of carbonates and the translocation of clays in the soil.

Climate and fires determined the growth of prairie or forest vegetation. In Sibley County the line between forests to the east and prairie to the west has moved back and forth with fluctuations in the climate over the past 13,000 years. As a result of grass cover, most soils in the survey area have a dark surface layer. Prairie vegetation and cool average annual temperatures promote the accumulation of organic matter. The western two-thirds of Sibley County was

characterized primarily by prairie vegetation. The eastern one-third was influenced by both forest and prairie vegetation.

Plants and Animals

All forms of life, both in and on the soil, influence the chemical and biological processes of soil formation. Bacteria, earthworms, and other forms of animal life aid in the weathering of materials and the decomposition of organic matter. Plants, including fungi, influence soil formation by returning decaying plant residue to the soil and aiding in decomposition. Plant roots loosen the soil and bring minerals up from the parent material. The vegetation influences the soil structure and the movement of nutrients upward and downward through the soil.

Earthworms have perhaps the greatest effect on soil formation of any animals. Earthworms and small burrowing animals help to mix the soil material in the surface layer and the subsoil. Generally, plants have a greater influence than animals on soil formation.

The soil-formation process begins as plants begin to grow on the freshly deposited parent material. Plant roots loosen soil and release minerals in the underlying material. As the plants decay, organic matter and plant nutrients are returned to the soil.

The soils in the western two-thirds of Sibley County formed under prairie vegetation. These soils have a thick, dark surface layer and are neutral to moderately alkaline in reaction. The soils in the eastern one-third of the county formed under both prairie and forest vegetation. Soils that formed under forested vegetation, such as Lester, Le Sueur, and Cordova soils, have a surface layer that is somewhat lighter in color and are slightly acid or moderately acid.

Forest vegetation promotes leaching in the soils. Soils that formed under forest vegetation are generally more acid than soils that formed under prairie vegetation. The lower pH increases the dispersion of clays. This dispersion and percolating rainfall result in the downward movement of clay particles in the soil profile. A clay-rich horizon in the subsoil is a characteristic of soils that formed under forest vegetation.

Human activities also influence soil formation. Farming has increased the action of some soil-forming processes. In fields where the soil is exposed to the air and wind, the oxidation of organic matter is accelerated. Erosion of the surface layer has been accelerated on the steeper slopes, and areas below these slopes have received deposits of eroded material. Artificial drainage that lowers the water table in wet soils, management decisions that change soil fertility, and changes in the types of vegetation planted also affect soil formation. Tillage can increase bulk density and surface compaction.

Relief

Relief affects soil formation through its influence on drainage, aeration, and erosion. Differences in relief can account for differences in soils that formed in the same kind of parent material. Different positions on the landform, such as crests, side slopes, foot slopes, toe slopes, or drainageways, have different effects on the kind of soil that forms.

In areas with more pronounced relief, much of the rainfall runs off the hillsides and plant growth is less than in areas where the rain infiltrates into the ground. The lack of water movement through the soil limits the leaching of carbonates and the translocation of clay particles.

Soils in sloping areas have less horizon development than soils in the more level areas. Storden soils, for example, are weakly developed. Runoff does infiltrate at the base of sloping soils, and in those areas the soils have developed more distinct horizons.

In steeply sloping areas, erosional sediments are carried downslope by runoff. These sediments not only affect the soils from which they have been removed, but they also affect the areas where they are deposited. Delft soils, which formed in colluvial sediments, have a thicker dark surface layer and are more fertile than the soils in upslope areas.

Topographic position affects soil drainage. Cordova and Webster soils, which are in swales, are poorly drained and have a seasonal high water table at a depth of 1 to 3 feet. In contrast, Clarion and Lester soils are on convex side slopes. They are well drained and have a water table at a much greater depth.

Soils on the slight rises on the rims of depressions have high levels of calcium carbonates and have a high pH. The fluctuating water level in the depressions precipitates dissolved calcium carbonates from the subsoil at or near the surface of the soil in these areas.

Time

The soils in Sibley County are geologically young. The last glaciation in Sibley County was between 12,000 and 15,000 years ago. Most of the soils of Sibley County formed in these glacial deposits.

Time is required for climate and biological activity to affect parent materials. In positions where conditions are favorable for soil development, mature profiles have developed. Mature soils, such as Clarion and Lester soils, have a well developed surface layer and subsoil.

In contrast, Storden soils are weakly developed and have only a thin surface layer over the parent material. The difference in development of these soils, which took place over the same period of time, is a result of differences in landscape position.

Soils that formed in alluvium along streams are also weakly developed because the parent material has been recently deposited. Fresh deposits of alluvium are added almost annually. This recurring deposition prevents the formation of distinct horizons and mature profiles. Minneiska soils are examples of soils that formed in alluvium.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

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

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

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

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

Basal till. Compact glacial till deposited beneath the ice.

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

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

Better drained spot. A spot symbol used on the soil maps to indicate an area of moderately well drained or better drained soil in a poorly drained or very poorly drained map unit.

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.

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

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

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

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 textura 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 2 millimeters to 38 centimeters (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.

Compaction. The packing effect of a mechanical force on the soil. The packing effect decreases the volume occupied by pores and increases the density and strength of the soil mass.

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.

Congeliturbate. Soil material disturbed by frost action.

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.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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

Crest. The highest part of the landform.

Curvilinear. A term used to describe the shape of map units. A curvilinear map unit is bounded by a curved line where the ratio of the length of the chord to the length of the arc is 0.6 to 1 or more but less than 0.9 to 1. The radius of the curve is intermediate in size between the radius of the curve of a lobate map unit and the radius of the curve of a smooth map unit.

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

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

Des Moines lobe. One of four major ice lobes of the Wisconsin Glaciation. It is characterized by gray, calcareous till containing fragments of shale.

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.

Drainageway. An open and broad water channel on a till plain.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

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.

Epipedon. The soil horizon or layer that formed at the surface of the soil.

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.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment (other than bedrock). A spot symbol used on the soil maps to indicate a spot with a drop in elevation of at least 10 feet in an area too narrow to delineate. Such areas are not suitable for agriculture. The slope ranges to more than 18 percent, and the areas above and below the spot are at least two slope classes less sloping. This spot symbol is commonly used along streams and lakes.

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.

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

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 drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial Lake Agassiz. A glacial lake that formed about 12,000 years ago behind the Big Stone Moraine as the Des Moines lobe retreated to the northwest. The lake extended into northwestern Minnesota, eastern North Dakota, and Manitoba.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial River Warren. The outlet stream for glacial Lake Agassiz, which cut a deep outlet gorge through glacial deposits to the Mississippi River. The Minnesota River now flows in this channel.

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.

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

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 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Gravelly spot. A spot symbol used on the soil maps to indicate an area that has 15 percent or more coarse fragments (by volume) at the soil surface.

Gravel/sand pit. A spot symbol used on the soil maps to indicate an open pit left after sand and gravel were removed as borrow material. Also includes small areas of water.

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

Ground water (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.

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

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.

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

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

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

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

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

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

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

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

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

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

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

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

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

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

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

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

Levee. A spot symbol used on the soil maps to indicate a manmade, built-up area, generally more than 6 feet high, that protects bottom-land soils from flooding.

Limnic. Refers to organic and inorganic materials deposited in water. These materials may be deposited by precipitation or through the action of aquatic organisms, such as algae or diatoms. They may also be formed from underwater or floating aquatic plants that are later modified by aquatic animals.

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

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

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low 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.

Organic spot. A spot symbol used on the soil maps to indicate a depressional area that has an organic matter content of more than 20 percent in the surface layer.

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, such as slope, stoniness, and thickness.

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

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

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

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

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.

Precambrian. The geologic time during which the earliest forms of life have been documented. The time frame ranges from more than 4 billion years ago to 600 million years ago.

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.

Quaternary. The most recent period in geologic time. It extends back to about 1 million years ago and includes the Pleistocene epoch (ice age) and the Holocene epoch (recent).

Ravine. A small stream valley with narrow, steep sides; commonly v-shaped in cross section. It is larger than a gully.

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
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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.

Sandy spot. A spot symbol used on the soil maps to indicate an area that has a surface layer of loamy fine sand or coarser sand.

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.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short steep slopes. A spot symbol used on the soil maps to indicate an area at least two slope classes more sloping than the map unit. Such areas are generally suited to agriculture. Slopes are less than 18 percent.

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.

Side slope. The upper slope bounding a drainageway.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

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.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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. The slope classes used in this survey are as follows:

Nearly level	0 to 2 percent
Gently sloping	2 to 6 percent
Sloping	6 to 12 percent
Moderately steep	12 to 18 percent
Steep	18 to 25 percent
Very steep	25 to 45 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

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.

Smooth. A term used to describe the shape of map units. A smooth map unit is bounded by a curved line where the ratio of the length of the chord to the length of the arc is more than 0.9 to 1. The radius of the curve is relatively larger than the radius of the curve on a curvilinear map unit or a lobate map unit.

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.

Stony spot. A spot symbol used on the soil maps to indicate an area that has enough cobbles, stones, or boulders at the surface to prevent or seriously inhibit tillage (more than about 1 to 5 percent, by volume).

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

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.

Swale. A shallow depression on a till plain.

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). A layer of 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.

Translocation. The downward movement of clays in the soil profile. The movement is caused by percolating water.

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.

Variegation. Refers to patterns of contrasting colors

assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

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.

Wet spot. A spot symbol used on the soil maps to indicate an area of poorly drained or very poorly drained soil in a better drained map unit.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Winnipeg lowland. The source of the gray, calcareous till that characterizes the Des Moines lobe of the Wisconsin Glaciation.

Wisconsin Glaciation. The latest ice advances over Minnesota. Only minimal geologic changes in the landscape of Minnesota have occurred since this glaciation.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1957-88 at Gaylord, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--		Average		2 years in 10 will have--		Average	
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	number of growing degree days*	Average	Less than--	More than--	number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	21.5	2.3	11.9	45	-30	0	0.73	0.22	1.15	2	8.4
February----	27.9	8.7	18.3	51	-25	0	.71	.20	1.12	2	7.7
March-------	40.2	21.4	30.8	71	-14	24	1.68	.65	2.53	4	9.7
April-------	58.1	35.7	46.9	86	15	80	2.74	1.16	4.07	6	2.5
May---------	72.1	47.7	59.9	93	30	323	3.52	2.11	4.77	7	.0
June--------	81.0	56.9	69.0	97	41	570	4.23	2.49	5.78	7	.0
July--------	85.4	61.7	73.6	99	48	732	3.65	1.81	5.24	6	.0
August------	82.2	58.9	70.6	96	44	639	4.17	2.04	6.01	7	.0
September---	72.7	49.5	61.1	91	31	333	3.03	1.53	4.33	6	.0
October-----	61.2	38.7	50.0	85	20	124	2.25	.67	3.53	5	.5
November----	41.8	24.8	33.3	66	-4	0	1.44	.39	2.29	3	4.9
December----	27.5	10.5	19.0	50	-23	0	.94	.28	1.47	2	8.7
Yearly:											
Average---	56.0	34.7	45.4	---	---	---	---	---	---	---	---
Extreme---	---	---	---	100	-32	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,825	29.09	22.89	34.99	57	42.4

* 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 1957-88 at Gaylord, 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--	May 21	June 2	June 15
2 years in 10 later than--	May 2	May 13	May 24
5 years in 10 later than--	Mar. 27	Apr. 4	Apr. 13
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 8	Aug. 26	Aug. 15
2 years in 10 earlier than--	Sept. 29	Sept. 18	Sept. 7
5 years in 10 earlier than--	Nov. 9	Oct. 31	Oct. 22

TABLE 3.--GROWING SEASON

(Recorded in the period 1957-88 at Gaylord, 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	182	159	141
8 years in 10	188	167	148
5 years in 10	200	181	162
2 years in 10	215	198	178
1 year in 10	232	216	198

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
5B	Dakota loam, 1 to 6 percent slopes	1,095	0.3
27B	Dickinson loam, 2 to 6 percent slopes	915	0.2
35	Blue Earth mucky silt loam	455	0.1
86	Canisteo clay loam	24,980	6.4
94B	Terril loam, 2 to 6 percent slopes	1,175	0.3
102B	Clarion loam, 2 to 6 percent slopes	13,392	3.5
106B	Lester loam, 2 to 6 percent slopes	10,788	2.8
106C2	Lester loam, 6 to 12 percent slopes, eroded	11,136	2.9
109	Cordova clay loam	12,920	3.4
110	Marna silty clay loam	535	0.1
112	Harps clay loam	13,364	3.5
113	Webster clay loam	15,585	4.1
114	Glencoe clay loam	7,895	2.1
118	Crippin loam	11,880	3.1
130	Nicollet clay loam	14,128	3.7
134	Okoboji silty clay loam	17,396	4.5
222B	Lasa loamy fine sand, 2 to 8 percent slopes	1,045	0.3
239	Le Sueur clay loam	8,775	2.3
317	Oshawa silty clay loam, frequently flooded	975	0.3
329	Chaska loam, occasionally flooded	1,975	0.5
336	Delft clay loam	10,444	2.7
386	Okoboji mucky silty clay loam	14,620	3.8
463B	Minneiska loam, 1 to 4 percent slopes	775	0.2
525	Muskego muck	9,152	2.4
539	Klossner muck	12,984	3.4
743	Glencoe clay loam, stratified substratum	815	0.2
772F	Swanlake-Lasa complex, 18 to 65 percent slopes	2,375	0.6
887B	Clarion-Swanlake complex, 3 to 6 percent slopes	14,780	3.8
919	Canisteo-Mayer complex	9,380	2.4
920B	Clarion-Hawick complex, 3 to 6 percent slopes	12,336	3.2
920C2	Clarion-Hawick-Storden complex, 6 to 12 percent slopes, eroded	1,035	0.3
921C2	Clarion-Storden complex, 6 to 12 percent slopes, eroded	14,428	3.8
944B	Lester-Hawick complex, 2 to 6 percent slopes	8,244	2.1
944C2	Lester-Hawick-Swanlake complex, 6 to 12 percent slopes, eroded	1,356	0.4
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded	811	0.2
945F	Lester-Storden complex, 18 to 65 percent slopes	13,436	3.5
946	Nicollet-Linder complex	1,475	0.4
956	Canisteo-Glencoe complex	18,668	4.9
978	Cordova-Rolfe complex	10,875	2.8
1016	Udorthents, loamy	530	0.1
1030	Udorthents-Pits, gravel, complex	275	0.1
1075	Klossner and Muskego soils, ponded	17,032	4.4
1081	Minneiska-Abscota complex, occasionally flooded	15,200	4.0
1093	Webster-Biscay complex	585	0.2
1833	Coland clay loam, occasionally flooded	8,045	2.1
1834	Coland clay loam, frequently flooded	4,055	1.1
1901B	Lester-Le Sueur complex, 1 to 6 percent slopes	4,555	1.2
1999	Minneiska-Kalmarville complex, frequently flooded	925	0.2
	Water	4,400	1.1
	Total	384,000	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
5B	Dakota loam, 1 to 6 percent slopes
27B	Dickinson loam, 2 to 6 percent slopes
86	Canisteo clay loam (where drained)
94B	Terril loam, 2 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 clay loam (where drained)
118	Crippin loam
130	Nicollet clay loam
134	Okoboji silty clay loam (where drained)
239	Le Sueur clay loam
329	Chaska loam, occasionally flooded (where drained)
336	Delft clay loam (where drained)
386	Okoboji mucky silty clay loam (where drained)
463B	Minneiska loam, 1 to 4 percent slopes
743	Glencoe clay loam, stratified substratum (where drained)
887B	Clarion-Swanlake complex, 3 to 6 percent slopes
919	Canisteo-Mayer complex (where drained)
946	Nicollet-Linder complex
956	Canisteo-Glencoe complex (where drained)
978	Cordova-Rolfe complex (where drained)
1081	Minneiska-Abscota complex, occasionally flooded
1093	Webster-Biscay complex (where drained)
1833	Coland clay loam, occasionally flooded (where drained)
1901B	Lester-Le Sueur complex, 1 to 6 percent slopes

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	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
5B---------- Dakota	2e	112	35	65	3.7	5.7
27B---------- Dickinson	3e	113	37	65	3.7	7.7
35---------- Blue Earth	3w	124	40	72	4.0	5.0
86---------- Canisteo	2w	140	43	75	4.6	6.2
94B---------- Terril	2e	143	44	92	4.7	7.8
102B---------- Clarion	2e	140	42	88	4.6	7.5
106B---------- Lester	2e	137	40	80	4.5	6.5
106C2---------- Lester	3e	101	31	65	3.3	6.3
109---------- Cordova	2w	143	44	75	4.7	6.0
110---------- Marna	2w	140	42	75	4.5	6.0
112---------- Harps	2w	134	35	88	4.4	6.3
113---------- Webster	2w	145	46	92	4.8	7.3
114---------- Glencoe	3w	130	39	75	4.2	5.1
118---------- Crippin	1	150	45	90	4.9	7.5
130---------- Nicollet	1	150	45	92	5.0	7.7
134---------- Okoboji	3w	130	37	81	4.3	5.8
222B---------- Lasa	3s	75	23	42	2.6	3.6
239---------- Le Sueur	1	147	45	90	4.9	7.5
317---------- Oshawa	6w	---	---	---	---	---

See footnote 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	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
329 Chaska	2w	85	34	55	3.1	5.3
336 Delft	2w	146	45	90	4.7	7.2
386 Okoboji	3w	128	38	83	4.2	6.0
463B Minneiska	2e	112	33	80	3.7	5.7
525 Muskego	4w	117	35	70	3.9	6.0
539 Klossner	3w	124	38	75	4.0	6.2
743 Glencoe	3w	128	39	75	4.0	5.0
772F Swanlake-Lasa	7e	---	---	---	---	---
887B Clarion-Swanlake	2e	138	40	86	4.5	7.4
919 Canisteo-Mayer	2w	134	40	75	4.4	6.8
920B		116	36	70	3.8	5.8
Clarion	2e					
Hawick	4s					
920C2		79	25	60	3.0	5.0
Clarion	3e					
Hawick	4s					
Storden	3e					
921C2 Clarion-Storden	3e	95	30	68	3.5	5.5
944B		115	35	65	3.8	5.2
Lester	2e					
Hawick	4s					
944C2		79	24	54	3.2	4.6
Lester	3e					
Hawick	4s					
Swanlake	3e					
945D2 Lester-Storden	4e	80	25	48	2.6	4.0
945F Lester-Storden	7e	---	---	---	---	---
946		132	40	76	4.5	6.6
Nicollet	1					
Linder	2s					

See footnote 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	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
956		136	42	75	4.4	6.5
Canisteo	2w					
Glencoe	3w					
978		138	43	76	4.6	6.9
Cordova	2w					
Rolfe	3w					
1016. Udorthents						
1030. Udorthents-Pits						
1075 Klossner and Muskego	8w	---	---	---	---	---
1081		65	20	50	2.5	3.2
Minneiska	2w					
Abscota	4s					
1093 Webster-Biscay	2w	138	40	90	4.5	7.1
1833 Coland	2w	116	36	70	3.8	5.8
1834 Coland	5w	---	---	---	3.2	5.0
1901B		141	44	80	4.7	7.2
Lester	2e					
Le Sueur	1					
1999 Minneiska-Kalmarville	5w	---	---	---	---	---

* 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.

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)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
5B---------- Dakota	Manyflower cotoneaster.	Silky dogwood, Siberian peashrub, eastern redcedar, American cranberrybush, Amur maple, lilac, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
27B---------- Dickinson	Lilac----------	Eastern redcedar, Russian-olive, Siberian peashrub.	Eastern white pine, green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	Jack pine---------	---
35---------- Blue Earth	---	Redosier dogwood	Black ash, tall purple willow.	Black ash, golden willow, white willow.	---
86---------- Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar, redosier dogwood, honeysuckle, American plum.	Hackberry, bur oak, white spruce, eastern redcedar, quaking aspen.	Golden willow, honeylocust, green ash, Norway poplar, linden.	Eastern cottonwood.
94B---------- Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern whitecedar, eastern redcedar, sugar maple.	Eastern white pine, green ash, linden.	---
102B---------- Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub, honeysuckle.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, bur oak, hackberry, white oak, sugar maple.	Green ash, eastern white pine, black walnut, silver maple, Norway spruce, butternut, Norway poplar, linden.	---
106B, 106C2------- Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood, honeysuckle.	Hackberry, eastern redcedar, bur oak, northern whitecedar, Amur maple, Russian-olive, blue spruce, pin oak, sugar maple.	Eastern white pine, green ash, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---

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, honeysuckle, nannyberry viburnum.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple, Black Hills spruce.	Green ash, golden willow, linden.	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, honeysuckle.	Hackberry, white spruce, eastern redcedar, bur oak, quaking aspen.	Golden willow, honeylocust, green ash, Norway poplar, linden.	Eastern cottonwood.
113--Webster	---	Redosier dogwood, American plum, cotoneaster, lilac, honeysuckle.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce, quaking aspen.	Golden willow, green ash, linden.	Eastern cottonwood, silver maple.
114--Glencoe	---	Redosier dogwood, gray dogwood, honeysuckle, juneberry.	Black ash, tall purple willow, northern whitecedar, green ash.	Black willow, golden willow, white willow.	---
118--Crippin	Nanking cherry----	Northern whitecedar, cotoneaster, Siberian peashrub, lilac, honeysuckle.	Hackberry, white spruce, eastern redcedar, bur oak, red oak, pin oak, Norway spruce.	Golden willow, green ash, honeylocust.	Eastern cottonwood, silver maple, Norway poplar.
130--Nicollet	Nanking cherry----	Redosier dogwood, lilac, honeysuckle, American plum.	Northern whitecedar, white spruce, blue spruce, Amur maple, red oak, pin oak, Norway spruce.	Austrian pine, eastern white pine, green ash, hackberry, white ash.	Silver maple, Norway poplar, eastern cottonwood.
134--Okoboji	---	Redosier dogwood, gray dogwood, honeysuckle, juneberry.	Black ash, tall purple willow, northern whitecedar, green ash.	Black willow, white willow, golden willow.	---
222B--Lasa	Siberian peashrub	Eastern redcedar, lilac.	Red pine, jack pine, Austrian pine, green ash, honeylocust, Russian-olive.	Eastern white pine, Siberian elm.	---

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	Nanking cherry----	Redosier dogwood, lilac, American plum, honeysuckle.	Northern whitecedar, white spruce, blue spruce, Amur maple, red oak, pin oak, Norway spruce.	Austrian pine, eastern white pine, green ash, hackberry, white ash.	Silver maple, Norway poplar, eastern cottonwood.
317. Oshawa					
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, lilac, honeysuckle.	Hackberry, Amur maple, white spruce, northern whitecedar, tall purple willow, quaking aspen.	Green ash, golden willow, linden.	Silver maple, eastern cottonwood.
386---------- Okoboji	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
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, green ash.	Siberian crabapple, black willow, white willow, golden willow.	Imperial Carolina poplar.
539---------- Klossner	---	Nannyberry viburnum, silky dogwood, juneberry, redosier dogwood.	White spruce------	Green ash, Norway spruce, white willow.	Imperial Carolina poplar.
743---------- Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
772F: Swanlake---------	American plum-----	Eastern redcedar, Siberian peashrub, hackberry.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---

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
772F:					
Lasa	Siberian peashrub	Eastern redcedar, lilac.	Red pine, jack pine, Austrian pine, green ash, honeylocust, Russian-olive.	Eastern white pine, Siberian elm.	---
887B:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub, honeysuckle.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, bur oak, hackberry, red oak, sugar maple.	Green ash, eastern white pine, Norway spruce, black walnut, butternut, Norway poplar, linden.	---
Swanlake	American plum	Eastern redcedar, Siberian peashrub, hackberry.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
919:					
Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar, American plum, redosier dogwood.	Hackberry, bur oak, white spruce, eastern redcedar, quaking aspen.	Golden willow, honeylocust, green ash, Norway poplar, linden.	Eastern cottonwood.
Mayer	---	Lilac, northern whitecedar, Siberian peashrub.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
920B:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub, honeysuckle.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, red oak, hackberry, bur oak, sugar maple.	Green ash, eastern white pine, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
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.	---

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
920C2:					
Clarion----------	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub, honeysuckle.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, bur oak, hackberry, red oak, sugar maple.	Green ash, eastern white pine, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
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.	---
Storden----------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
921C2:					
Clarion----------	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub, honeysuckle.	Northern whitecedar, blue spruce, Amur maple, Russian-olive, eastern redcedar, red oak, hackberry, bur oak, sugar maple.	Green ash, eastern white pine, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
Storden----------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---
944B:					
Lester----------	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood, honeysuckle.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce, red oak, Black Hills spruce.	Eastern white pine, green ash, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---

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
944B:					
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.	---
944C2:					
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood, honeysuckle.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce, red oak, Black Hills spruce.	Eastern white pine, green ash, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
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.	---
Swanlake	American plum	Eastern redcedar, Siberian peashrub, hackberry.	Honeylocust, green ash, Russian-olive.	Siberian elm	---
945D2, 945F:					
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood, honeysuckle.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce, red oak, Black Hills spruce.	Eastern white pine, green ash, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm	---

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
946:					
Nicollet	Nanking cherry	Redosier dogwood, lilac, honeysuckle, American plum.	Northern whitecedar, white spruce, blue spruce, Amur maple, red oak, pin oak, Norway spruce.	Austrian pine, eastern white pine, green ash, hackberry, white ash.	Silver maple, Norway poplar, eastern cottonwood.
Linder	---	Redosier dogwood, lilac.	Northern whitecedar, blue spruce, Amur maple, white spruce.	Eastern white pine, Austrian pine, green ash, hackberry.	Silver maple.
956:					
Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar, redosier dogwood, honeysuckle, American plum.	Hackberry, bur oak, white spruce, eastern redcedar, quaking aspen.	Golden willow, honeylocust, green ash, Norway poplar, linden.	Eastern cottonwood.
Glencoe	---	Redosier dogwood, gray dogwood, honeysuckle, juneberry.	Black ash, tall purple willow, northern whitecedar, green ash.	Black willow, golden willow, white willow.	---
978:					
Cordova	---	Redosier dogwood, American plum, honeysuckle, nannyberry viburnum.	Northern whitecedar, white spruce, hackberry, tall purple willow, Amur maple, Black Hills spruce.	Green ash, golden willow, linden.	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.
1016.					
Udorthents					
1030:					
Udorthents.					
Pits.					
1075:					
Klossner.					
Muskego.					

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
1081:					
Minneiska	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
Abscota	---	Silky dogwood, Amur privet, nannyberry viburnum, American cranberrybush, common ninebark.	White spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
1093:					
Webster	---	Redosier dogwood, American plum, cotoneaster.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Biscay	---	Redosier dogwood, American plum, cotoneaster.	Northern whitecedar, Amur maple, white spruce, hackberry, tall purple willow.	Green ash, golden willow.	Eastern cottonwood, silver maple.
1833, 1834 Coland	---	Redosier dogwood, cotoneaster, American plum.	White spruce, hackberry, northern whitecedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
1901B:					
Lester	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood, honeysuckle.	Hackberry, eastern redcedar, northern whitecedar, Amur maple, Russian-olive, blue spruce, pin oak, sugar maple.	Eastern white pine, green ash, Norway spruce, silver maple, black walnut, butternut, Norway poplar, linden.	---
Le Sueur	Nanking cherry	Redosier dogwood, lilac, honeysuckle, American plum.	Northern whitecedar, white spruce, blue spruce, Amur maple, red oak, pin oak, Norway spruce.	Austrian pine, eastern white pine, green ash, hackberry, white ash.	Silver maple, Norway poplar, eastern cottonwood.
1999:					
Minneiska	---	Northern whitecedar, lilac, Siberian peashrub.	Hackberry, white spruce, eastern redcedar, bur oak.	Honeylocust, golden willow, green ash.	Eastern cottonwood.

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
1999: Kalmarville------	---	American plum, redosier dogwood.	Tall purple willow, hackberry, northern whitecedar, white spruce, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.

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
5B Dakota	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
35 Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
86 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
94B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
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.	Moderate: wetness.
112 Harps	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
113 Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
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.
222B Lasa	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
239 Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
317--Oshawa	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
329--Chaska	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
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.
463B--Minneiska	Severe: flooding.	Slight	Moderate: slope.	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.
743--Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
772F:					
Swanlake	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lasa	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy.	Severe: slope.
887B:					
Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Swanlake	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
919:					
Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Mayer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
920B:					
Clarion	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.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
920C2:					
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
921C2:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
944B:					
Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
Hawick	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
944C2:					
Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Swanlake	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
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.
946:					
Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
Linder	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
956:					
Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
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.
1016. Udorthents					
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.
1081: Minneiska	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Abscota	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: droughty, flooding.
1093: Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Biscay	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1833 Coland	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
1834 Coland	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
1901B: Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
1999: Minneiska	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1999: Kalmarville----------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.

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
5B---------- Dakota	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
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.
86---------- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
94B---------- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	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.
134---------- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
222B---------- Lasa	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
239---------- Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
317---------- Oshawa	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

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
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.
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.
743---------- Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
772F:										
Swanlake----------	Very poor.	Very poor.	Poor	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.
Lasa----------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
887B:										
Clarion----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Swanlake----------	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
919:										
Canisteo----------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
Mayer----------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
920B:										
Clarion----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	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.
Hawick----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Storden----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
921C2:										
Clarion----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	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
921C2:										
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
944B:										
Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
944C2:										
Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Swanlake	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	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.
946:										
Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Linder	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	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.
978:										
Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Rolfe	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1016. Udorthents										
1030: Udorthents.										
Pits.										

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	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
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.
1081:										
Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Abscota	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
1093:										
Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Biscay	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good.
1833--- Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
1834--- Coland	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
1901B:										
Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1999:										
Minneiska	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Kalmarville	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

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
5B---------- Dakota	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, 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.
86---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
94B---------- Terril	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.
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: low strength, frost action.	Moderate: wetness.
110---------- Marna	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	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: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
118---------- Crippin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Slight.

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
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.
222B---------- Lasa	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
239---------- Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
317---------- Oshawa	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
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, excess humus.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
463B---------- Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	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.
743---------- Glencoe	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
772F:						
Swanlake---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lasa----------	Severe: cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

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
887B:						
Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Swanlake	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
919:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Mayer	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
920B:						
Clarion	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.
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
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.
944B:						
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
944C2:						
Lester	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

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
944C2:						
Swanlake	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: 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.
946:						
Nicollet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Linder	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
956:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Glencoe	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
978:						
Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Rolfe	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1016. Udorthents						
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.

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
1081:						
Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Abscota	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
1093:						
Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Biscay	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
1833--- Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
1834--- Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
1901B:						
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
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.

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
5B---------- Dakota	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
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.
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.
102B---------- Clarion	Slight----------	Moderate: seepage, slope.	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.	Moderate: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
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: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
118---------- Crippin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, 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
130---------- Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
134---------- Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
222B---------- Lasa	Slight----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
239---------- Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
317---------- Oshawa	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
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, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
463B---------- Minneiska	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: 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.
743---------- Glencoe	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
772F: Swanlake----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

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
772F:					
Lasa	Severe: slope, seepage, poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
887B:					
Clarion	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Swanlake	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
919:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Mayer	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
920B:					
Clarion	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.
Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Storden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
921C2:					
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
944B:					
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.

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
944B:					
Hawick	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
944C2:					
Lester	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Swanlake	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
945D2, 945F:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
946:					
Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Linder	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
956:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Glencoe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
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.
1016. Udorthents					
1030: Udorthents.					
Pits.					

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
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.
1081:					
Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy.
Abscota	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
1093:					
Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Biscay	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
1833, 1834 Coland	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
1901B:					
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, 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.

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
5B Dakota	Good	Probable	Probable	Poor: small stones, area reclaim.
27B Dickinson	Good	Probable	Improbable: too sandy.	Fair: thin layer.
35 Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
86 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
94B Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
102B Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
106B Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
106C2 Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
109 Cordova	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
110 Marna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
112 Harps	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
113 Webster	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
114 Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
118 Crippin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
130 Nicollet	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
134 Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
222B Lasa	Good	Probable	Improbable: too sandy.	Poor: too sandy.
239 Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
317 Oshawa	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
329 Chaska	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
336 Delft	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
386 Okoboji	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
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.
743 Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
772F: Swanlake	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Lasa	Good	Probable	Improbable: too sandy.	Poor: too sandy.
887B: Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Swanlake	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
919: Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
919:				
Mayer	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
920B:				
Clarion	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: too clayey, small stones, slope.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
921C2:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
944B:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
944C2:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
944C2:				
Swanlake	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
945D2:				
Lester	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
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.
946:				
Nicollet	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Linder	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, area reclaim.
956:				
Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
978:				
Cordova	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1016.				
Udorthents				
1030:				
Udorthents.				
Pits.				
1075:				
Klossner	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1075:				
Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
1081:				
Minneiska	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Abscota	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
1093:				
Webster	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Biscay	Fair: wetness.	Probable	Probable	Poor: area reclaim.
1833, 1834 Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1901B:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
1999:				
Minneiska	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Kalmarville	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.

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	Irrigation	Terraces and diversions	Grassed waterways
5B---------- Dakota	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Too sandy------	Favorable.
27B---------- Dickinson	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Too sandy------	Favorable.
35---------- Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
86---------- Canisteo	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
94B---------- Terril	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
102B---------- Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
106B---------- Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
106C2---------- Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
109---------- Cordova	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
110---------- Marna	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness--------	Wetness, percs slowly.
112---------- Harps	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
113---------- Webster	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
114---------- Glencoe	Moderate: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
118---------- Crippin	Moderate: seepage.	Moderate: piping, wetness.	Frost action---	Wetness, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
130---------- Nicollet	Moderate: seepage.	Moderate: wetness.	Frost action---	Wetness--------	Wetness--------	Favorable.
134---------- Okoboji	Moderate: seepage.	Severe: ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
222B---------- Lasa	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
239---------- Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action---	Wetness--------	Wetness--------	Favorable.
317---------- Oshawa	Slight---------	Severe: ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding--------	Wetness.
329---------- Chaska	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness--------	Wetness.
336---------- Delft	Moderate: seepage.	Severe: thin layer, wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
386---------- Okoboji	Moderate: seepage.	Severe: ponding, excess humus.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
463B---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Favorable------	Too sandy------	Favorable.
525---------- Muskego	Severe: seepage.	Severe: excess humus, ponding.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
539---------- Klossner	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
743---------- Glencoe	Severe: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
772F:						
Swanlake---------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Lasa----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
887B:						
Clarion----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Swanlake---------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
919:						
Canisteo---------	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
Mayer----------	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
920B:						
Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Hawick	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
920C2:						
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
Storden	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
921C2:						
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
944B:						
Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
Hawick	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
944C2:						
Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
Swanlake	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
945D2, 945F:						
Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Storden	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
946:						
Nicollet	Moderate: seepage.	Moderate: wetness.	Frost action	Wetness	Wetness	Favorable.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
946:						
Linder	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Rooting depth.
956:						
Canisteo	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
Glencoe	Moderate: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
978:						
Cordova	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
Rolfe	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
1016. Udorthents						
1030: Udorthents.						
Pits.						
1075:						
Klossner	Severe: seepage.	Severe: piping, ponding, excess humus.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
Muskego	Severe: seepage.	Severe: piping, excess humus, ponding.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
1081:						
Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
Abscota	Severe: seepage.	Severe: seepage, piping.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
1093:						
Webster	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
Biscay	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
1833, 1834 Coland	Severe: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1901B:						
Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action	Wetness	Wetness	Favorable.
1999:						
Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
Kalmarville	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.

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	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
5B---------- Dakota	0-10	Loam----------	CL	A-4, A-6	0	95-100	85-100	75-95	50-75	25-35	7-15
	10-23	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	95-100	85-100	70-100	35-80	25-40	9-20
	23-35	Sandy loam, loamy sand, gravelly loamy coarse sand.	SM, SP, GM, GP	A-2, A-4, A-1, A-3	0-5	55-100	45-100	20-75	2-40	<21	NP-4
	35-60	Sand, gravelly coarse sand, loamy sand.	SP, GP, GM, SM	A-1, A-3, A-2	0-5	50-100	45-100	20-75	2-30	---	NP
27B---------- Dickinson	0-10	Loam----------	ML, CL-ML, CL	A-4	0	100	100	85-95	50-60	15-30	NP-10
	10-40	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-4	0	100	100	85-95	35-50	15-30	NP-10
	40-51	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
	51-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
35---------- Blue Earth	0-60	Mucky silt loam, silt loam.	OL, ML	A-5	0	95-100	95-100	85-95	80-95	41-50	2-8
86---------- Canisteo	0-18	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	18-26	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	26-38	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
	38-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
94B---------- Terril	0-25	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	25-47	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	47-60	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
102B---------- 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
	10-32	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	32-60	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
	9-39	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	39-60	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
	7-20	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
109---------- Cordova	0-23	Clay loam--------	CL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	23-47	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	47-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
110----------	0-10	Silty clay loam	MH, ML	A-7	0	95-100	90-100	90-100	85-95	45-65	15-30
Marna	10-32	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	95-100	90-100	90-100	85-95	50-80	20-45
	32-60	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	60-80	35-50	15-25
112----------	0-19	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	35-55	15-35
Harps	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----------	0-17	Clay loam--------	CL, CH	A-7, A-6	0-5	95-100	95-100	85-95	70-90	35-60	15-30
Webster	17-30	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
	30-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
114----------	0-8	Clay loam--------	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
Glencoe	8-32	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
	32-50	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
	50-60	Loam, clay loam	CL, ML	A-6	0	90-100	85-100	60-95	55-75	30-40	10-20
118----------	0-15	Loam----------	CL	A-6, A-7	0	95-100	95-100	80-90	60-80	30-45	10-20
Crippin	15-32	Loam, clay loam	CL	A-6	0-5	95-100	90-100	80-90	60-80	30-40	10-20
	32-60	Loam, clay loam	CL	A-6	2-5	90-100	85-100	75-90	55-80	30-40	10-20
130----------	0-15	Clay loam--------	ML, CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	35-50	10-25
Nicollet	15-31	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
	31-60	Loam, clay loam	CL	A-6	0-5	95-100	90-100	75-90	50-75	30-40	15-25
134----------	0-12	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
Okoboji	12-42	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	42-52	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	52-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	45-55	20-30
222B----------	0-12	Loamy fine sand	SM	A-2	0	100	100	80-95	15-30	---	NP
Lasa	12-40	Fine sand, loamy fine sand.	SM	A-2	0	100	100	80-95	15-30	---	NP
	40-60	Fine sand, loamy fine sand.	SP, SP-SM, SM	A-3, A-2	0	100	100	75-90	0-35	---	NP
239----------	0-11	Clay loam--------	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
Le Sueur	11-37	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
317----------	0-16	Silty clay loam	MH, CH	A-7	0	95-100	95-100	95-100	90-100	50-70	20-40
Oshawa	16-60	Loam, silt loam, silty clay loam.	CL	A-6	0	95-100	95-100	90-100	85-95	30-40	10-15

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
329----------	0-9	Loam----------	OL, CL, ML	A-4, A-6	0	100	100	90-100	70-80	30-40	5-15
Chaska	9-30	Stratified silt loam to loamy fine sand.	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	20-40	5-15
	30-60	Stratified silty clay loam to fine sand.	SM, ML	A-4	0	100	100	85-95	35-75	<35	NP-7
336----------	0-10	Clay loam--------	CL, ML	A-6, A-7	0	95-100	90-100	75-90	60-80	30-45	10-20
Delft	10-37	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
	37-45	Loam, clay loam, silt loam.	CL, ML	A-6, A-4	0	95-100	90-100	70-90	50-75	25-40	7-15
	45-60	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
386----------	0-14	Mucky silty clay loam.	MH	A-7	0	100	100	95-100	90-95	60-90	10-30
Okoboji	14-37	Silty clay loam, silty clay.	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	37-49	Silty clay loam, silty clay.	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
	49-60	Stratified loam to silty clay loam.	CL, CH	A-7	0-5	95-100	90-100	90-100	75-90	45-55	20-30
463B----------	0-12	Loam----------	ML, CL, CL-ML	A-4	0	100	95-100	70-90	50-75	20-35	3-10
Minneiska	12-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	<20	NP-4
525----------	0-40	Muck----------	PT	A-8	0	---	---	---	---	---	---
Muskego	40-60	Coprogenous earth	OL	A-5	0	95-100	95-100	85-100	75-96	40-50	2-8
539----------	0-32	Muck----------	PT	A-8	0	---	---	---	---	---	---
Klossner	32-41	Mucky silt loam, mucky silty clay loam.	MH	A-7	0	100	95-100	90-100	85-95	60-90	10-30
	41-60	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
743----------	0-10	Clay loam--------	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
Glencoe	10-26	Clay loam, loam	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	26-45	Clay loam, loam	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-45	10-20
	45-60	Stratified silt loam to sand.	SM, SC-SM, CL-ML	A-2-4, A-4, A-6	0	95-100	85-100	55-85	30-60	<30	NP-10
772F:											
Swanlake--------	0-7	Loam----------	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	75-90	50-70	20-35	5-15
	7-32	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	70-90	50-70	20-35	5-15
	32-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	20-35	5-15
Lasa----------	0-9	Loamy fine sand	SM	A-2	0	100	100	80-95	15-30	---	NP
	9-27	Fine sand, loamy fine sand.	SM	A-2	0	100	100	80-95	15-30	---	NP
	27-60	Fine sand, loamy fine sand.	SP, SP-SM, SM	A-3, A-2	0	100	100	75-90	0-35	---	NP

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
887B:											
Clarion---------	0-12	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	12-44	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	44-60	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
Swanlake--------	0-8	Loam----------	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	75-90	50-70	20-35	5-15
	8-41	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	70-90	50-70	20-35	5-15
	41-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	20-35	5-15
919:											
Canisteo--------	0-18	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	18-26	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	26-36	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
	36-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
Mayer-----------	0-16	Loam----------	CL, ML	A-6, A-4	0-2	95-100	85-100	70-90	50-85	30-40	5-20
	16-35	Sandy clay loam, silt loam, clay loam.	CL, SC, ML, SM	A-6, A-4	0-10	65-95	45-85	20-45	2-10	30-40	5-15
	35-60	Gravelly coarse sand, sand, coarse sand.	SP, SW, SP-SM	A-1	0-10	65-95	45-85	20-45	2-10	15-20	0-0
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
Hawick----------	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	9-15	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
	15-60	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---------	0-7	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	7-25	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
Hawick----------	0-7	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	7-14	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
	14-60	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

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
920C2:											
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---------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	9-26	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	26-60	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
944B:											
Lester----------	0-10	Loam----------	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	10-38	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	38-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
Hawick----------	0-12	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	12-48	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
	48-60	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
944C2:											
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
	8-34	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	34-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20
Hawick----------	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	9-42	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
	42-60	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
Swanlake---------	0-7	Loam----------	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	75-90	50-70	20-35	5-15
	7-29	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-98	70-90	50-70	20-35	5-15
	29-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	20-35	5-15
945D2:											
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
	8-34	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	34-60	Loam, clay loam	CL, CL-ML, ML	A-6	0-5	95-100	90-100	75-90	50-70	30-40	10-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
945D2:											
Storden---------	0-7	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	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----------	0-9	Loam----------	ML, CL, CL-ML	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	9-35	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	35-60	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
946:											
Nicollet---------	0-11	Loam----------	ML, CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	30-45	10-25
	11-21	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
	21-60	Loam, clay loam	CL	A-6	0-5	95-100	90-100	75-90	50-75	30-40	15-25
Linder----------	0-12	Loam----------	CL	A-4, A-6	0	100	95-100	80-95	50-80	25-40	8-15
	12-26	Sandy loam--------	SC, SC-SM	A-2, A-4	0	95-100	80-100	45-75	30-45	20-30	5-10
	26-60	Gravelly sand, gravelly loamy sand, loamy coarse sand.	SP, SP-SM	A-1	0-5	75-95	30-95	25-50	2-12	---	NP
956:											
Canisteo---------	0-16	Clay loam---------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
	16-23	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	23-35	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
	35-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
Glencoe---------	0-12	Clay loam---------	OL, ML, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	35-45	15-20
	12-33	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
	33-43	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
	43-60	Loam, clay loam	CL, ML	A-6	0	90-100	85-100	60-95	55-75	30-40	10-20
978:											
Cordova---------	0-13	Clay loam---------	CL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	13-27	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	27-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
Rolfe-----------	0-13	Silt loam---------	OL, CL, ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	13-43	Clay, silty clay, clay loam.	CH	A-7	0	100	95-100	90-100	75-95	50-65	25-35
	43-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-45	10-20
1016------------- Udorthents	0-60	Variable---------	---	---	---	---	---	---	---	---	---
1030:											
Udorthents------	0-60	Variable---------	---	---	---	---	---	---	---	---	---

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
1030:											
Pits	0-60	Variable	---	---	---	---	---	---	---	---	---
1075:											
Klossner	0-38	Muck	PT	A-8	---	---	---	---	---	---	---
	38-60	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	0-39	Muck	PT	A-8	0	---	---	---	---	---	---
	39-60	Coprogenous earth	OL, ML	A-5	0	95-100	95-100	85-100	75-96	41-50	2-8
1081:											
Minneiska	0-9	Fine 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
Abscota	0-8	Loamy fine sand	SM	A-2-4	0	95-100	95-100	50-75	15-30	---	NP
	8-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2-4, A-1, A-3	0	95-100	85-100	45-65	5-30	---	NP
1093:											
Webster	0-21	Clay loam	CL, CH	A-7, A-6	0-5	95-100	95-100	85-95	70-90	35-60	15-30
	21-35	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
	35-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
Biscay	0-16	Clay loam	CL, ML	A-7, A-6	0	95-100	95-100	70-95	50-80	35-50	10-25
	16-35	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	70-90	50-75	30-50	10-20
	35-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	45-95	35-95	20-45	2-10	---	NP
1833	0-10	Clay loam	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
Coland	10-40	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	40-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
1834	0-10	Clay loam	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
Coland	10-48	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	48-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
1901B:											
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
	9-26	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
Le Sueur	0-10	Clay loam	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
	10-30	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

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
1999:											
Minneiska-------	0-6	Sandy loam-------	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
	6-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	<20	NP-4
Kalmarville-----	0-6	Loam-------------	ML, CL, CL-ML	A-4	0	95-100	90-100	85-100	50-90	15-35	NP-10
	6-54	Fine sandy loam, sandy loam, silt loam.	ML, SM, SC-SM, CL-ML	A-4, A-2	0	95-100	90-100	60-85	30-60	15-25	NP-5
	54-60	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

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
5B	0-10	14-27	1.40-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.24	4	5	2-5
Dakota	10-23	18-32	1.30-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Low	0.32			
	23-35	4-11	1.55-1.65	2.0-6.0	0.02-0.14	5.1-7.3	Low	0.24			
	35-60	1-4	1.55-1.65	6.0-20	0.02-0.10	5.1-7.8	Low	0.15			
27B	0-10	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.28	4	5	1-2
Dickinson	10-40	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low	0.17			
	40-51	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low	0.20			
	51-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low	0.15			
35	0-60	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											
86	0-18	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	18-26	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	26-38	10-35	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Low	0.32			
	38-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low	0.32			
94B	0-25	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	5	6	3-5
Terril	25-47	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low	0.28			
	47-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low	0.32			
102B	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.24	5	6	3-5
Clarion	10-32	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	32-60	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	2-5
Lester	9-39	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.28			
	39-60	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	1-3
Lester	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			
109	0-23	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	23-47	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-6.5	Moderate	0.28			
	47-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
110	0-10	30-40	1.20-1.30	0.06-0.2	0.18-0.22	6.1-7.3	High	0.28	5	4	4-8
Marna	10-32	35-60	1.25-1.40	0.06-0.2	0.13-0.16	6.1-7.3	High	0.28			
	32-60	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	0-17	27-35	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate	0.24	5	6	6-8
Webster	17-30	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate	0.32			
	30-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			
114	0-8	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28	5	6	5-10
Glencoe	8-32	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	32-50	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	0.28			
	50-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low	0.28			
118	0-15	22-27	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	Low	0.24	5	4L	5-6
Crippin	15-32	24-30	1.40-1.55	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.28			
	32-60	22-28	1.55-1.75	0.6-2.0	0.17-0.19	7.9-8.4	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
130----------	0-15	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	15-31	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	31-60	22-32	1.35-1.55	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
134----------	0-12	35-42	1.30-1.40	0.2-0.6	0.21-0.23	6.1-7.8	High---------	0.32	5	4	7-10
Okoboji	12-42	35-42	1.30-1.40	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.32			
	42-52	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High---------	0.32			
	52-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
222B----------	0-12	2-10	1.45-1.55	2.0-6.0	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	2-4
Lasa	12-40	2-10	1.55-1.70	2.0-6.0	0.07-0.09	6.1-7.3	Low----------	0.17			
	40-60	2-10	1.55-1.70	6.0-20	0.06-0.08	6.1-7.3	Low----------	0.17			
239----------	0-11	28-30	1.50-1.70	0.6-2.0	0.17-0.20	5.6-7.3	Moderate-----	0.24	5	6	3-6
Le Sueur	11-37	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			
317----------	0-16	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	16-60	18-35	1.30-1.35	0.2-0.6	0.17-0.19	7.4-7.8	Low----------	0.28			
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	9-30	18-27	1.40-1.65	0.6-2.0	0.17-0.19	7.4-7.8	Low----------	0.28			
	30-60	2-27	1.40-1.65	2.0-6.0	0.07-0.16	7.4-8.4	Low----------	0.28			
336----------	0-10	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	10-37	18-35	1.40-1.55	0.2-2.0	0.19-0.22	5.6-7.8	Moderate-----	0.24			
	37-45	18-32	1.30-1.40	0.6-2.0	0.19-0.22	6.6-7.8	Low----------	0.32			
	45-60	15-32	1.40-1.55	0.2-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
386----------	0-14	20-30	1.20-1.25	0.6-2.0	0.22-0.25	6.1-7.8	Moderate-----	0.32	5	6	10-18
Okoboji	14-37	35-42	1.30-1.40	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.32			
	37-49	35-45	1.35-1.40	0.2-0.6	0.18-0.20	6.6-8.4	High---------	0.32			
	49-60	20-30	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
463B----------	0-12	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	12-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.28			
525----------	0-40	---	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	----------	----	4	2	25-90
Muskego	40-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	6.6-8.4	Moderate-----	0.28			
539----------	0-32	---	0.25-0.55	0.2-6.0	0.35-0.48	5.6-7.8	----------	----	5	2	25-60
Klossner	32-41	22-35	1.10-1.25	0.6-2.0	0.22-0.26	6.1-7.8	Moderate-----	0.37			
	41-60	22-35	1.30-1.40	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
743----------	0-10	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	6	5-10
Glencoe	10-26	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
	26-45	25-35	1.35-1.50	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
	45-60	5-30	1.40-1.60	0.6-6.0	0.07-0.17	6.1-7.8	Low----------	0.20			
772F:											
Swanlake--------	0-7	18-27	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Low----------	0.28	5	4L	2-4
	7-32	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
	32-60	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Lasa----------	0-9	2-10	1.45-1.55	2.0-6.0	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	2-4
	9-27	2-10	1.55-1.70	2.0-6.0	0.07-0.09	6.1-7.3	Low----------	0.17			
	27-60	2-10	1.55-1.70	6.0-20	0.06-0.08	6.1-7.3	Low----------	0.17			

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
887B:											
Clarion---------	0-12	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	5	6	3-5
	12-44	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	44-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Swanlake--------	0-8	18-27	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Low----------	0.28	5	4L	2-4
	8-41	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
	41-60	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
919:											
Canisteo--------	0-18	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
	18-26	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
	26-36	10-35	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Low----------	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			
Mayer-----------	0-16	18-30	1.25-1.35	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.24	4	4L	4-8
	16-35	18-30	1.25-1.35	0.6-2.0	0.16-0.19	7.4-8.4	Low----------	0.28			
	35-60	1-5	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.15			
920B:											
Clarion---------	0-10	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	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			
Hawick----------	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	5	3	1-4
	9-15	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low----------	0.10			
	15-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
920C2:											
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	2-3
	7-25	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			
Hawick----------	0-7	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	5	3	1-3
	7-14	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low----------	0.10			
	14-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
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---------	0-9	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-3
	9-26	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	26-60	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			
944B:											
Lester----------	0-10	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
	10-38	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	38-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
Hawick----------	0-12	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	5	3	1-4
	12-48	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low----------	0.10			
	48-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
944C2:											
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	1-3
	8-34	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	34-60	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
944C2:											
Hawick----------	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	5	3	1-3
	9-42	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low----------	0.10			
	42-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
Swanlake--------	0-7	18-27	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Low----------	0.28	5	4L	1-3
	7-29	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
	29-60	18-30	1.30-1.50	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
945D2:											
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	1-3
	8-34	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	34-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
Storden---------	0-7	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
	7-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
945F:											
Lester----------	0-9	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
	9-35	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	35-60	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			
946:											
Nicollet--------	0-11	24-27	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.24	5	6	4-8
	11-21	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	21-60	22-32	1.35-1.55	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
Linder----------	0-12	14-18	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.8	Low----------	0.24	4	5	3-4
	12-26	10-18	1.45-1.55	2.0-6.0	0.15-0.17	6.1-7.8	Low----------	0.24			
	26-60	2-8	1.55-1.75	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
956:											
Canisteo--------	0-16	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
	16-23	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
	23-35	10-35	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Low----------	0.32			
	35-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low----------	0.32			
Glencoe---------	0-12	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	6	5-10
	12-33	25-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
	33-43	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate-----	0.28			
	43-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low----------	0.28			
978:											
Cordova---------	0-13	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
	13-27	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	27-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate-----	0.28			
Rolfe-----------	0-13	22-27	1.35-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	3	6	3-5
	13-43	38-45	1.40-1.50	0.06-0.2	0.11-0.13	6.1-7.3	High---------	0.28			
	43-60	24-35	1.50-1.60	0.2-2.0	0.14-0.16	6.1-8.4	Moderate-----	0.28			
1016------------ Udorthents	0-60	18-35	1.45-1.65	0.06-2.0	0.12-0.18	6.6-9.0	Moderate-----	0.32	5	6	<1
1030: Udorthents.											
Pits.											

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
1075:											
Klossner---------	0-38	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	5	8	25-60
	38-60	20-35	1.45-1.70	0.2-2.0	0.14-0.22	6.1-8.4	Moderate-----	0.28			
Muskego----------	0-39	---	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	----------	----	4	8	25-60
	39-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	6.6-8.4	Moderate-----	0.28			
1081:											
Minneiska--------	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
	9-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.28			
Abscota----------	0-8	2-15	1.30-1.60	6.0-20	0.10-0.12	6.1-7.3	Low----------	0.17	5	2	.5-2
	8-60	0-10	1.35-1.60	6.0-20	0.05-0.11	6.1-7.8	Low----------	0.17			
1093:											
Webster----------	0-21	27-35	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate-----	0.24	5	6	6-8
	21-35	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.32			
	35-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
Biscay-----------	0-16	18-30	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	Moderate-----	0.28	4	6	4-8
	16-35	18-30	1.25-1.35	0.6-2.0	0.17-0.19	6.6-7.8	Moderate-----	0.28			
	35-60	1-6	1.55-1.65	6.0-20	0.02-0.04	6.6-8.4	Low----------	0.10			
1833-------------	0-10	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6	5-7
Coland	10-40	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24			
	40-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
1834-------------	0-10	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6	5-7
Coland	10-48	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24			
	48-60	12-26	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28			
1901B:											
Lester-----------	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	2-5
	9-26	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			
Le Sueur---------	0-10	28-30	1.50-1.70	0.6-2.0	0.17-0.20	5.6-7.3	Moderate-----	0.24	5	6	3-6
	10-30	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			
1999:											
Minneiska--------	0-6	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
	6-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.28			
Kalmarville------	0-6	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
	6-54	8-18	1.40-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low----------	0.20			
	54-60	2-5	1.55-1.65	6.0-20	0.06-0.09	6.6-7.8	Low----------	0.10			

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," and "apparent" 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			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
5B---------- Dakota	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Moderate.
27B---------- Dickinson	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Moderate.
35---------- Blue Earth	B/D	None--------	---	---	+2-1.0	Apparent	Jan-Dec	High--------	High-----	Low.
86---------- Canisteo	B/D	None--------	---	---	1.0-3.0	Apparent	Oct-Jul	High--------	High-----	Low.
94B---------- Terril	B	None--------	---	---	>6.0	---	---	Moderate----	Moderate	Low.
102B---------- Clarion	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Low.
106B, 106C2------- Lester	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Moderate.
109---------- Cordova	C/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
110---------- Marna	C/D	None--------	---	---	1.0-2.5	Apparent	Nov-Jun	High--------	High-----	Low.
112---------- Harps	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
113---------- Webster	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	High--------	High-----	Low.
114---------- Glencoe	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jul	High--------	High-----	Low.
118---------- Crippin	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	High--------	High-----	Low.
130---------- Nicollet	B	None--------	---	---	2.5-5.0	Apparent	Mar-Jun	High--------	High-----	Low.
134---------- Okoboji	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High--------	High-----	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
222B---------- Lasa	A	None--------	---	---	>6.0	---	---	Low---------	Low------	Moderate.
239---------- Le Sueur	B	None--------	---	---	2.0-4.0	Apparent	Nov-May	High--------	High-----	Low.
317---------- Oshawa	D	Frequent----	Long------	Mar-Jul	+1-1.0	Apparent	Nov-Jul	High--------	High-----	Low.
329---------- Chaska	B/D	Occasional	Brief-----	Mar-Jun	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
336---------- Delft	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High--------	High-----	Low.
386---------- Okoboji	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High--------	High-----	Low.
463B---------- Minneiska	B	Rare--------	---	---	3.0-6.0	Apparent	Mar-Jun	Moderate----	Low------	Low.
525---------- Muskego	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Aug	High--------	Moderate	Moderate.
539---------- Klossner	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jul	High--------	High-----	Moderate.
743---------- Glencoe	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jul	High--------	High-----	Low.
772F:										
Swanlake----------	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Low.
Lasa----------	A	None--------	---	---	>6.0	---	---	Low---------	Low------	Moderate.
887B:										
Clarion----------	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Low.
Swanlake----------	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Low.
919:										
Canisteo----------	B/D	None--------	---	---	1.0-3.0	Apparent	Oct-Jul	High--------	High-----	Low.
Mayer----------	B/D	None--------	---	---	1.0-3.0	Apparent	Oct-Jun	High--------	High-----	Low.
920B:										
Clarion----------	B	None--------	---	---	>6.0	---	---	Moderate----	Low------	Low.
Hawick----------	A	None--------	---	---	>6.0	---	---	Low---------	Low------	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
920C2:										
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Hawick	A	None	---	---	>6.0	---	---	Low	Low	Low.
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
921C2:										
Clarion	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
944B:										
Lester	B	None	---	---	>6.0	---	---	Moderate	Low	Moderate.
Hawick	A	None	---	---	>6.0	---	---	Low	Low	Low.
944C2:										
Lester	B	None	---	---	>6.0	---	---	Moderate	Low	Moderate.
Hawick	A	None	---	---	>6.0	---	---	Low	Low	Low.
Swanlake	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
945D2, 945F:										
Lester	B	None	---	---	>6.0	---	---	Moderate	Low	Moderate.
Storden	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
946:										
Nicollet	B	None	---	---	2.5-5.0	Apparent	Mar-Jun	High	High	Low.
Linder	B	None	---	---	2.0-4.0	Apparent	Mar-Jul	High	Moderate	Low.
956:										
Canisteo	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jul	High	High	Low.
Glencoe	B/D	None	---	---	+1-1.0	Apparent	Oct-Jul	High	High	Low.
978:										
Cordova	C/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	High	Low.
Rolfe	C	None	---	---	+1-1.0	Apparent	Nov-Jul	High	High	Moderate.
1016 Udorthents	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
1030:										
Udorthents.										
Pits.										
1075:										
Klossner	D	None	---	---	+3-1.0	Apparent	Jan-Dec	High	High	Moderate.
Muskego	D	None	---	---	+3-1.0	Apparent	Jan-Dec	High	Moderate	Moderate.
1081:										
Minneiska	B	Occasional	Very brief or brief.	Mar-Jul	3.0-6.0	Apparent	Mar-Jun	Moderate	Low	Low.
Abscota	A	Occasional	Brief	Mar-Jun	2.5-5.0	Apparent	Mar-May	Low	Low	Low.
1093:										
Webster	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	High	High	Low.
Biscay	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	Moderate	Low.
1833 Coland	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Low.
1834 Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High	High	Low.
1901B:										
Lester	B	None	---	---	>6.0	---	---	Moderate	Low	Moderate.
Le Sueur	B	None	---	---	2.0-4.0	Apparent	Nov-May	High	High	Low.
1999:										
Minneiska	B	Frequent	Very brief or brief.	Mar-Jul	3.0-6.0	Apparent	Mar-Jun	Moderate	Low	Low.
Kalmarville	B/D	Frequent	Brief	Mar-Jun	0-1.0	Apparent	Nov-Aug	High	Moderate	Low.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is 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
Abscota	Mixed, mesic Typic Udipsamments
Biscay	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Blue Earth	Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Chaska	Fine-loamy, mixed (calcareous), mesic Aeric Fluvaquents
Clarion	Fine-loamy, mixed, mesic Typic Hapludolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Cordova	Fine-loamy, mixed, mesic Typic Argiaquolls
Crippin	Fine-loamy, mixed, mesic Aquic Hapludolls
Dakota	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls
Delft	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Glencoe	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Harps	Fine-loamy, mesic Typic Calciaquolls
Hawick	Sandy, mixed, mesic Entic Hapludolls
*Kalmarville	Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Klossner	Loamy, mixed, euic, mesic Terric Medisaprists
*Lasa	Sandy, mixed, mesic Entic Hapludolls
Lester	Fine-loamy, mixed, mesic Mollic Hapludalfs
Le Sueur	Fine-loamy, mixed, mesic Aquic Argiudolls
Linder	Coarse-loamy, mixed, mesic Aquic Hapludolls
Marna	Fine, montmorillonitic, mesic Typic Haplaquolls
Mayer	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls
Minneiska	Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents
Muskego	Coprogenous, euic, mesic Limnic Medisaprists
Nicollet	Fine-loamy, mixed, mesic Aquic Hapludolls
Okoboji	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Oshawa	Fine-loamy, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Rolfe	Fine, montmorillonitic, mesic Typic Argialbolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Swanlake	Fine-loamy, mixed, mesic Entic Hapludolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Udorthents	Udorthents
Webster	Fine-loamy, mixed, mesic Typic Haplaquolls

Interpretive Groups

INTERPRETIVE GROUPS

(Absence of an entry indicates that the soil is not assigned to the interpretive group)

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
5B Dakota	2e	Yes	6G
27B Dickinson	3e	Yes	6G
35 Blue Earth	3w	No	2W
86 Canisteo	2w	Yes*	2K
94B Terril	2e	Yes	3
102B Clarion	2e	Yes	3
106B Lester	2e	Yes	3
106C2 Lester	3e	No	3
109 Cordova	2w	Yes*	2
110 Marna	2w	Yes*	2
112 Harps	2w	Yes*	2K
113 Webster	2w	Yes*	2
114 Glencoe	3w	Yes*	2W
118 Crippin	1	Yes	1K
130 Nicollet	1	Yes	1
134 Okoboji	3w	Yes*	2W
222B Lasa	3s	No	7
239 Le Sueur	1	Yes	1
317 Oshawa	6w	No	10

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
329 Chaska	2w	Yes*	1K
336 Delft	2w	Yes*	2
386 Okoboji	3w	Yes*	2W
463B Minneiska	2e	Yes	1K
525 Muskego	4w	No	2(O)
539 Klossner	3w	No	2(O)
743 Glencoe	3w	Yes*	2W
772F:			
Swanlake	7e	No	8
Lasa	7e	No	7
887B:			
Clarion	2e	Yes	3
Swanlake	2e	Yes	8
919:			
Canisteo	2w	Yes*	2K
Mayer	2w	Yes*	2K
920B:			
Clarion	2e	No	3
Hawick	4s	No	7
920C2:			
Clarion	3e	No	3
Hawick	4s	No	7
Storden	3e	No	8
921C2:			
Clarion	3e	No	3
Storden	3e	No	8
944B:			
Lester	2e	No	3
Hawick	4s	No	7
944C2:			
Lester	3e	No	3
Hawick	4s	No	7

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
944C2:			
Swanlake	3e	No	8
945D2:			
Lester	4e	No	3
Storden	4e	No	8
945F:			
Lester	7e	No	3
Storden	7e	No	8
946:			
Nicollet	1	Yes	1
Linder	2s	Yes	1
956:			
Canisteo	2w	Yes*	2K
Glencoe	3w	Yes*	2W
978:			
Cordova	2w	Yes*	2
Rolfe	3w	Yes*	2
1016. Udorthents			
1030. Udorthents-Pits			
1075:			
Klossner	8w	No	10
Muskego	8w	No	10
1081:			
Minneiska	2w	Yes	1K
Abscota	4s	Yes	1
1093:			
Webster	2w	Yes*	2
Biscay	2w	Yes*	2
1833 Coland	2w	Yes*	2
1834 Coland	5w	No	2
1901B:			
Lester	2e	Yes	3
Le Sueur	1	Yes	1

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
1999:			
Minneiska	5w	No	1K
Kalmarville	5w	No	2

* Where drained.

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