United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Le Sueur County, Minnesota

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How To Use This Soil Survey

General Soil Map

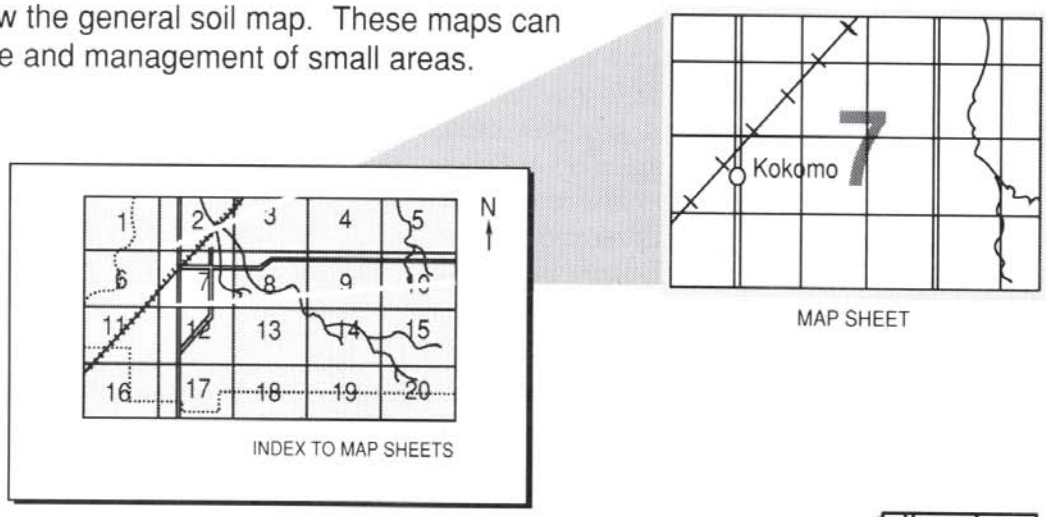
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

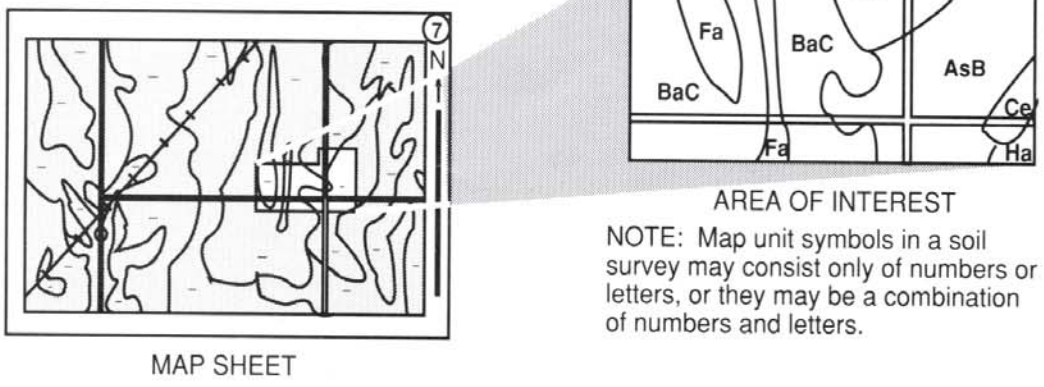
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



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.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station. It was partially funded by the Legislative Commission for Minnesota Resources and by Le Sueur County. Other assistance was provided by the Minnesota Agricultural Extension Service, the Minnesota Soil and Water Conservation Board, and the Le Sueur County Soil and Water Conservation District. The survey is part of the technical assistance furnished to the Le Sueur County Soil and Water Conservation District.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

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

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

Cover: Nearly level to steeply sloping Lester, Le Sueur, and Hamel soils in the southern part of Le Sueur County.

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Issued September 1989

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Summary of Tables

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Foreword

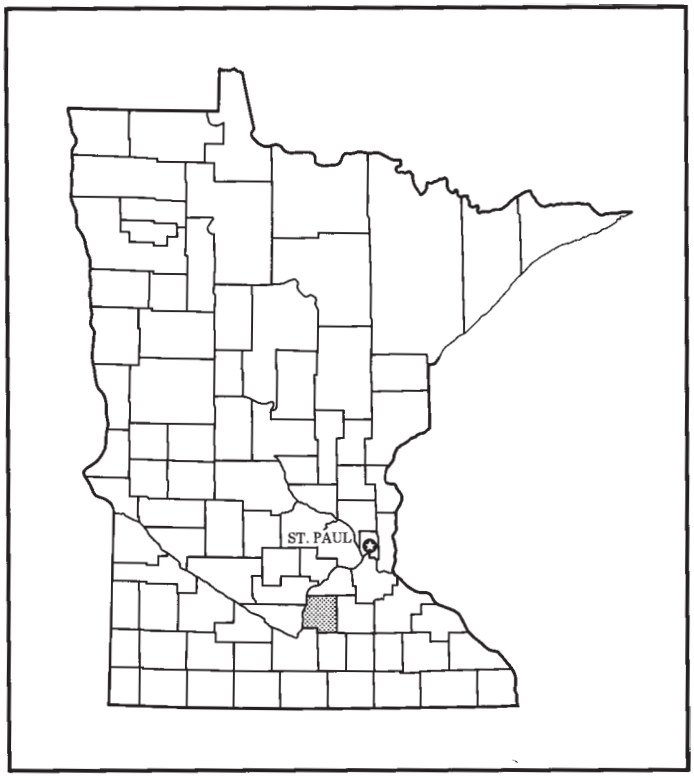
This soil survey contains information that can be used in land-planning programs in Le Sueur County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

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

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

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

Gary R. Nordstrom
State Conservationist
Soil Conservation Service



Location of Le Sueur County in Minnesota.

Soil Survey of Le Sueur County, Minnesota

By James U. Schulzetendberg, Soil Conservation Service

Fieldwork by Carroll R. Carlson, Caryl A. Radatz Ess, and James U. Schulzetendberg, Soil Conservation Service, and Terry Bovee, Minnesota Agricultural Experiment Station

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

General Nature of the County

LE SUEUR COUNTY is located in the south-central part of Minnesota. It has a total area of 281,600 acres, or 440 square miles, of which 2,900 acres is bodies of water.

In 1980, the population of the county was 23,434. Le Center, the county seat, had a population of 1,967. Other cities and towns in the county are Cleveland, Elysian, Kasota, Kilkenny, Le Sueur, Montgomery, New Prague, Ottawa, and Waterville. Approximately 55 percent of the population lives in cities and towns.

The region that includes this survey area was originally inhabited by American Indians. In the 18th century, traders and missionaries were the only white people in the valley of the Minnesota River. In 1851, the first settlers arrived in the county and established the settlements of Kasota, Le Sueur, and Ottawa. In a relatively short time, pioneers moved eastward from the Minnesota River. They cleared dense timber and undergrowth in an area called the Big Woods. By 1875, more than 34,000 acres had been plowed. Today, small tracts of hardwoods are the only remnants of the Big Woods.

This survey updates the soil survey of Le Sueur County published in 1954 *(6)*. It provides additional information and larger maps, which show the soils in greater detail.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at St. Peter, in Nicollet County, in the period 1951 to 1981. 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 6 degrees. The lowest temperature on record, which occurred at St. Peter on January 30, 1951, is -38 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at St. Peter on July 10, 1976, is 102 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 28 inches. Of this, more than 21 inches, or about 75 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 8.62 inches at St. Peter on August 7, 1968. Thunderstorms occur on about 38 days each year.

The average seasonal snowfall is about 40 inches. The greatest snow depth at any one time during the period of record was 29 inches. On the average, 50 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.

Farming

The earliest settlers in Le Sueur County found an abundance of ginseng, which provided a source of income. The crops planted then were mostly wheat, oats, and barley. By the late 1890's, corn was the primary cash crop.

Modern technological advances in farming have resulted in increased yields and changes in the kinds of crops grown in the county. About 80 percent of the county is farmland. In 1983, about 57,800 acres was used for corn, 64,000 acres for corn silage, 63,300 acres for soybeans, 21,800 acres for oats, 14,200 acres for alfalfa hay, and 9,000 acres for wheat. Raising livestock has been an important farm enterprise in the county. Specialty crops, such as sweet corn and green peas, are grown in some areas. Several canning companies are in the area.

Transportation Facilities

One railway in the eastern part of the county serves New Prague, Montgomery, Kilkenny, and Waterville. Another railway serves Le Sueur, Ottawa, and Kasota in the extreme western part of the county.

The major highways are paved or blacktopped. U.S. Highway 169 and State Highways 13, 19, 60, and 99 form a network of routes which serve the entire county. Graveled or blacktopped county or township roads serve rural areas.

Water Supply

The water supply for Le Sueur County is drawn from two major sources: sand and gravel deposits in glacial drift and Paleozoic sedimentary rocks of Cambrian and Ordovician age. Wells of moderate depth in the sandy and gravelly layers of glacial drift produce sufficient water to supply small industries as well as households and farms. Municipalities in the southeastern part of the county draw water from the St. Peter sandstone formation, which is of Ordovician age. Elsewhere in the county, the St. Peter formation does not occur and the Jordan sandstone of Cambrian age, which underlies the entire county, produces supplies adequate for most purposes. Municipal wells or industries, which need large supplies of water, rely on very deep wells which draw water from the Dresbach formation, also of Cambrian age.

Livestock watering pits can be dug in areas of very poorly drained or poorly drained soils. Farm ponds can be constructed on intermittent streams and drainageways. These water sources are not suitable for domestic use.

Physiography, Relief, and Drainage

Le Sueur County lies in an area called the Minnesota River lowland. This topographic trough is an area where several glaciers advanced and retreated during the Pleistocene. This period of glaciation began about 2 million years ago and ended about 10,000 years ago. The most recent glacier, the Des Moines Lobe of the Late Wisconsin Glaciation, deposited yellowish gray, calcareous, medium textured material across the entire county.

Recessional moraines in the eastern and southern parts of the county are rolling to steep. The landscape in the eastern part is generally one of circular, flat-topped hills separated by swales and bogs. In the southern moraine area, the hills are more irregular in shape; the knolls and ridges are separated by swales and drainageways. Most of the lakes in the county are in these morainic regions. The remainder of the upland areas in the county are nearly level to rolling ground moraines.

The Minnesota River forms the western boundary of the county. The flood plain ranges from about ⅛ mile to 2 miles wide. Above this flood plain are well defined terraces, which rise abruptly above the river. One terrace is about 2 miles wide and extends south from Kasota to beyond the county line. It is a structural

bench of Jordan sandstone capped with Oneota dolomite, which has a thin mantle of soil. This bedrock bench, which rises about 75 feet above the river, also crops out near Ottawa. Sandy terraces are at the higher elevations along the Minnesota River. Those near Le Sueur are 3 to 4 miles wide. They result from the late and early postglacial erosion and deposition associated with the melting of the Des Moines Lobe.

Relief in the county is characteristic of that in a glaciated area. The elevation of the till plain ranges from 940 to about 1,020 feet above sea level. In the moraine area the hills and ridges rise 50 to 150 feet above the swales and drainageways. The highest elevation in the county, about 1,180 feet, is in the southern morainic area. The lowest elevation, about 720 feet, is in an area in the northwest corner where the Minnesota River leaves the county.

Le Sueur County has immature surface drainage networks, which are typical of recently glaciated landscapes. Much of the farmland in the county is artificially drained by ditches that eventually empty into natural creeks, which flow into the two major streams in the county. The Minnesota River drains about three-fourths of the county. Its principal tributaries are Cherry, Forest Prairie, Le Sueur, and Shanaska Creeks. In the southeastern part of the county, water drains eastward through the Big and Little Cannon Rivers and through Tetonka and Sakatah Lakes. It eventually empties into the Mississippi River.

How This Survey Was Made

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

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the 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 considerable 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, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. 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 interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were 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 were 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 state with a fairly high degree of probability 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.

The soil scientists were denied access to a few tracts in the county. These areas were mapped through the use of knowledge of the surrounding area and through aerial photo interpretation. Soil boundaries are less accurately drawn on these tracts than on tracts where the soil scientists had access to the land and could examine the soils.

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 several 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 noncontrasting (similar) inclusions. They are 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.

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.

As a result of changes in soil series concepts, different soil patterns, and variations in the design of map units, some soil boundaries and names in this survey do not agree with those in the published soil surveys of Scott, Rice, and Waseca Counties.

Soil Descriptions

1. Dickinson-Estherville-Wadena Association

Nearly level to sloping, well drained and somewhat excessively drained, loamy soils on uplands

The soils in this association are on flats, side slopes, and knolls in the uplands. Slopes range from 0 to 12 percent.

This association makes up about 5 percent of the county. It is about 35 percent Dickinson soils, 30 percent Estherville soils, 15 percent Wadena soils, and 20 percent minor soils (fig. 1).

Dickinson soils are nearly level to sloping. They are well drained and are on broad flats, knolls, and side slopes. Typically, the surface layer is black sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is dark brown and dark yellowish brown sandy loam about 12 inches thick. The underlying material to a depth of about 60 inches is yellowish brown sand.

Estherville soils are gently sloping. They are well drained and somewhat excessively drained and are on convex side slopes. Typically, the surface layer is very dark brown sandy loam about 9 inches thick. The subsoil is dark brown sandy loam about 9 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and brown coarse sand.

Wadena soils are nearly level and gently sloping. They are well drained and are on broad flats and small knolls. Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is very dark gray loam about 4 inches thick. The subsoil is dark brown and brown loam about 24 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and dark brown gravelly sand.

Of minor extent in this association are the Kasota, Sparta, Hawick, Dickman, and Fairhaven soils. Hawick soils are on sloping to steep escarpments. The other minor soils are in landscape positions similar to those of the major soils.

Nearly all of the acreage in this association is used as cropland. Corn, soybeans, and small grain are the major crops. The major soils are fairly well suited or well suited to cropland and are well suited to pasture and hay. Soil blowing is a severe hazard if the soils are fall plowed. The main management concerns are controlling water erosion, increasing the level of fertility, maintaining or increasing the organic matter content, and compensating for the limited supply of available water.

2. Copaston Association

Nearly level to gently undulating, well drained, loamy soils that are shallow to bedrock; on stream terraces

The soils in this association are on stream terraces along the Minnesota River. Slopes generally range from 1 to 6 percent but are very steep in some areas adjacent to the flood plains along the river.

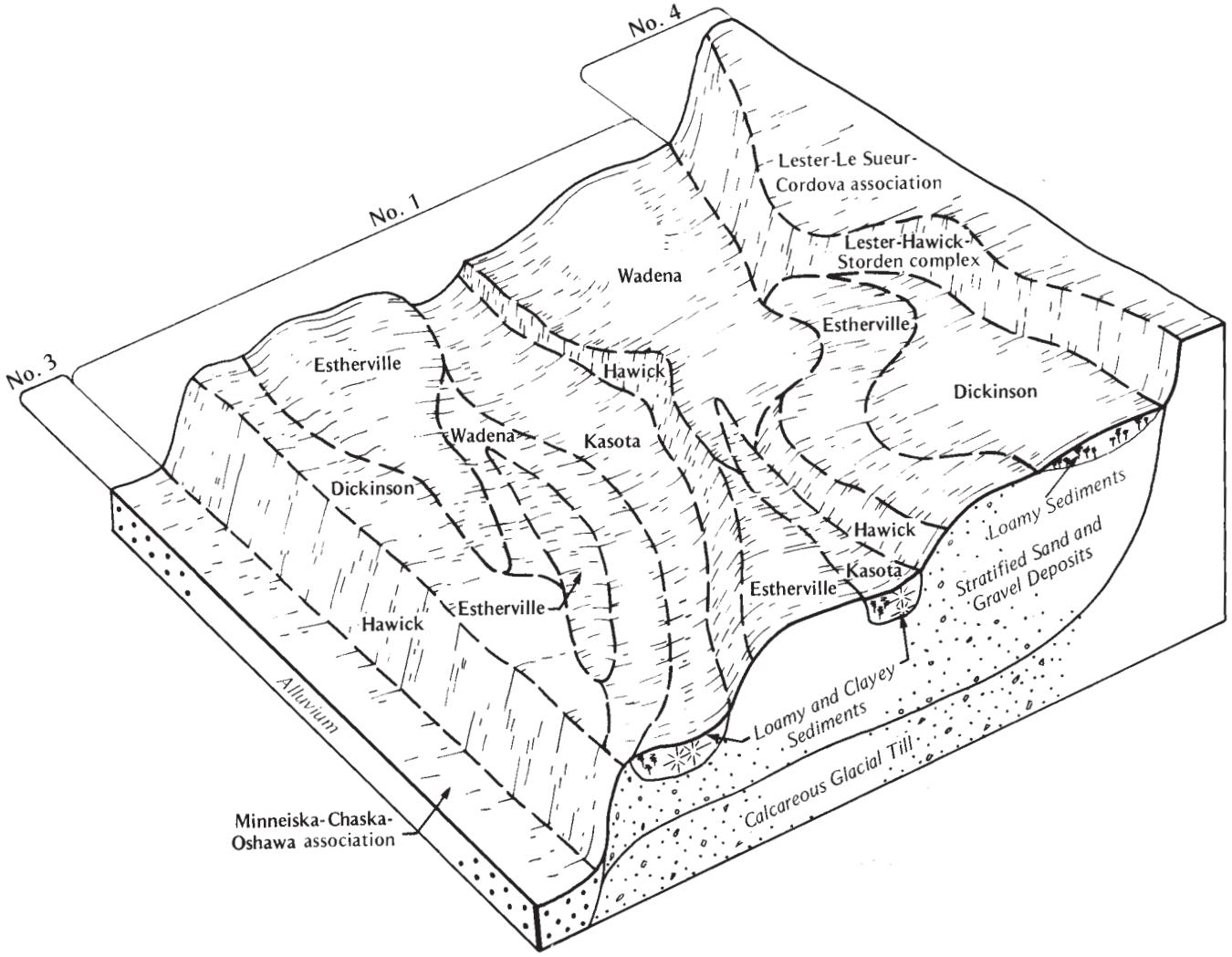


Figure 1.—Pattern of soils and parent material in the Dickinson-Estherville-Wadena association.

This association makes up about 1 percent of the county. It is about 85 percent Copaston soils and 15 percent minor soils.

Copaston soils are nearly level and gently sloping. They are well drained and are on broad flats and on knolls and convex side slopes. Typically, the surface layer is very dark brown gravelly loam about 10 inches thick. The subsoil is dark brown gravelly loam about 6 inches thick. Limestone bedrock is at a depth of about 16 inches.

Of minor extent in this association are the deep Sparta and Terril soils. Sparta soils are at the slightly higher elevations. Terril soils are on foot slopes of the escarpments.

Most of the acreage is used for pasture, but some areas are used for cultivated crops or are developed for commercial or recreational uses. The Copaston soils are only fairly well suited to crops because of the low supply of available water and the shallowness to bedrock.

3. Minneiska-Chaska-Oshawa Association

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

The soils in this association are on the flood plains along the major rivers in the county. Slopes range from 0 to 2 percent.

This association makes up about 2 percent of the county. It is about 29 percent Minneiska soils, 28

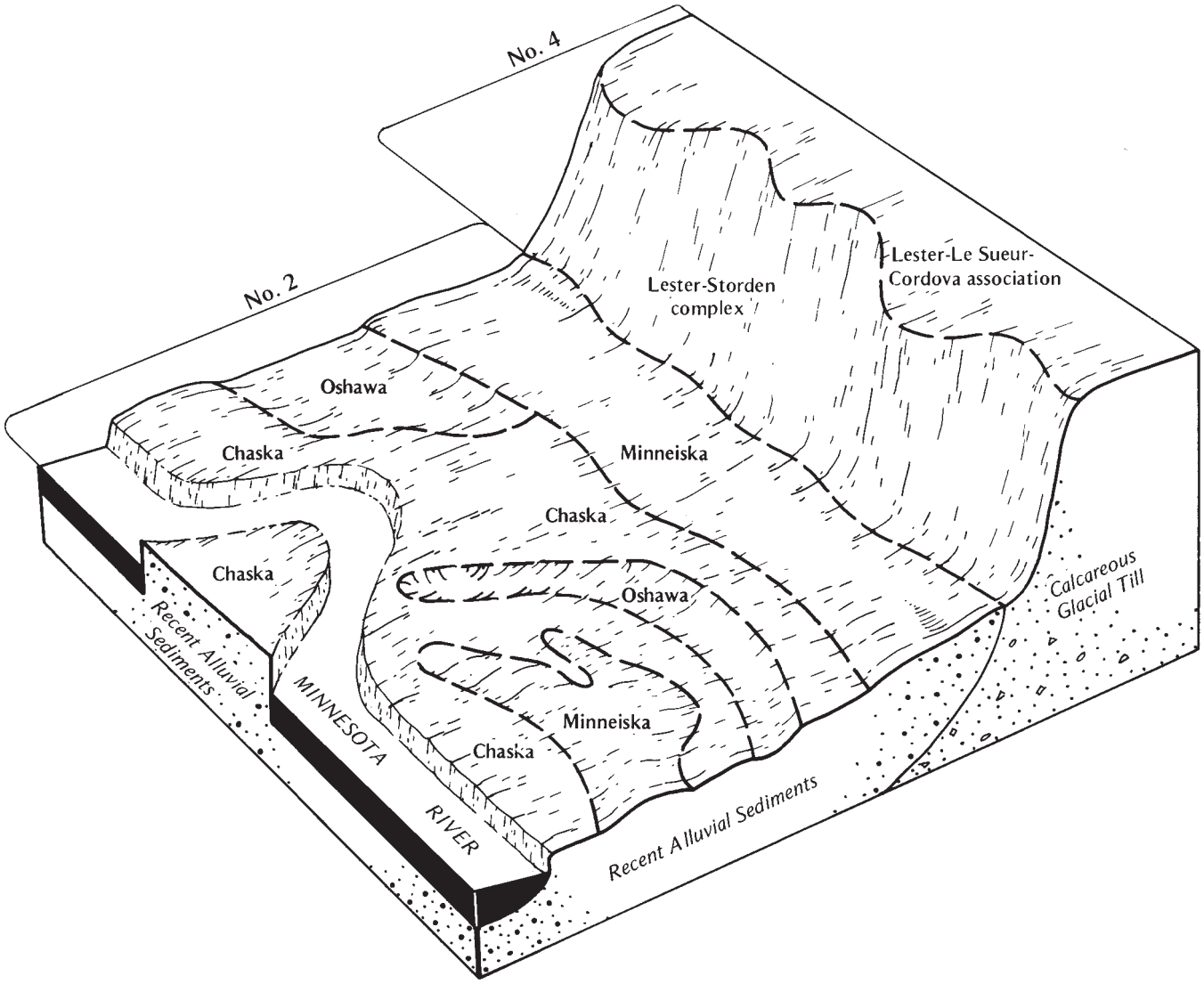


Figure 2.—Pattern of soils and parent material in the Minneiska-Chaska-Oshawa association.

percent Chaska soils, 27 percent Oshawa soils, and 16 percent minor soils (fig. 2).

Minneiska soils are moderately well drained and are on low rises. Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The underlying material to a depth of about 60 inches is dark brown, stratified loamy fine sand and fine sandy loam.

Chaska soils are poorly drained and somewhat poorly drained and are on broad flats. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown and dark gray, stratified silt loam and loam.

Oshawa soils are very poorly drained and are in swales and abandoned river channels. Typically, the surface layer is black, mottled silt loam about 12 inches thick. The underlying material extends to a depth of about 60 inches or more. The upper part is stratified olive gray and dark olive gray, mottled silt loam. The next part is stratified dark olive gray, very dark gray, and brown, mottled silt loam. The lower part is very dark gray, mottled silty clay loam.

Of minor extent in this association are the Blue

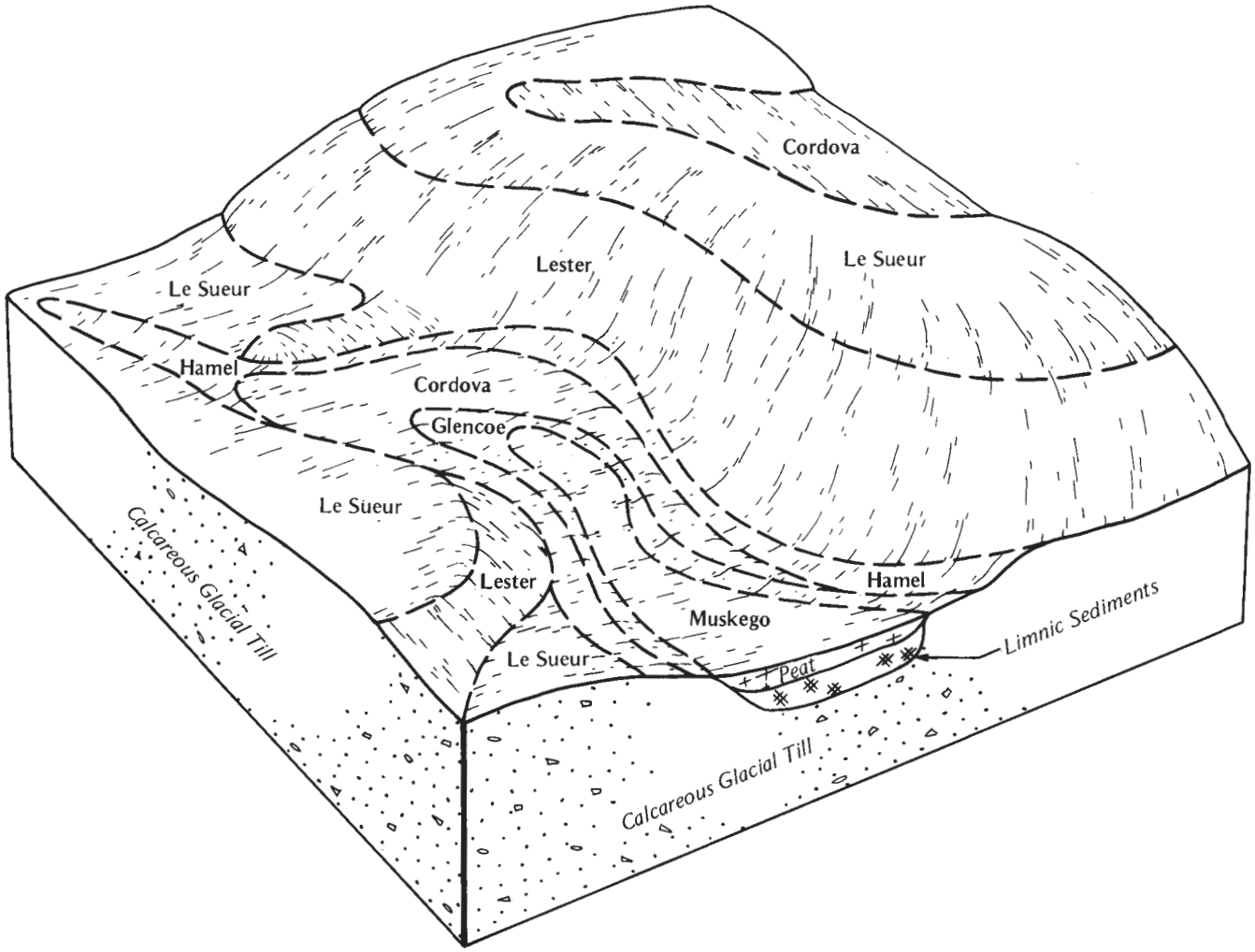


Figure 3.—Pattern of soils and parent material in the Lester-Le Sueur-Cordova association.

Earth, Muskego, and Terril soils. Blue Earth and Muskego soils are in the lower areas on flood plains. Terril soils are on the foot slopes of escarpments.

About half of the acreage in this association is used for cultivated crops. The rest is pastured or wooded. The Chaska and Minneiska soils are well suited to cultivated crops, such as corn, soybeans, and small grain. The Oshawa soils are too wet for crop production. Flooding on all three soils is the main management concern.

4. Lester-Le Sueur-Cordova Association

Nearly level to moderately steep, well drained to poorly drained, loamy soils on uplands

The soils in this association are on flats, side slopes, rises, and knolls on ground moraines. Bogs, depressions, and drainageways are common. Slopes range from 0 to 18 percent.

This association makes up about 44 percent of the county. It is about 24 percent Lester soils, 21 percent Le Sueur soils, 20 percent Cordova soils, and 35 percent minor soils (fig. 3).

Lester soils are gently sloping to moderately steep. They are well drained and are on knolls and convex side slopes. Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 37 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam.

Le Sueur soils are nearly level and gently sloping. They are moderately well drained and somewhat poorly drained and are on low rises and knolls and the lower parts of side slopes. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark brown clay loam about 7 inches thick. The subsoil is dark grayish brown, mottled clay loam about 29 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled loam.

Cordova soils are nearly level. They are poorly drained and are on broad flats and in slight depressions. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is clay loam about 30 inches thick. The upper part is very dark gray, the next part is very dark gray and grayish brown and is mottled, and the lower part is olive gray and mottled. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam.

Of minor extent in this association are the Glencoe, Hamel, Hawick, Muskego, and Storden soils. Glencoe soils are very poorly drained and are in depressions. Hamel soils are poorly drained and are in drainageways. The organic Muskego soils are very poorly drained and are in bogs and depressions. Hawick soils are excessively drained and are on convex hilltops and side slopes. Storden soils are well drained and are on knolls and convex side slopes.

Nearly all of the acreage in this association is used as cropland. Corn and soybeans are the major crops, but small grain, alfalfa, sweet corn, and peas also are grown. The major soils are fairly well suited or well suited to the cultivated crops commonly grown in the county. Erosion and excess soil moisture are the main management concerns.

5. Lester-Le Sueur-Hamel Association

Nearly level to steep, well drained to poorly drained, loamy soils on uplands

The soils in this association are on recessional moraines in the uplands. They are on knolls, rises, side slopes, and foot slopes and in drainageways and swales. Scattered bogs and depressions are throughout the association. Lakes also are common. Slopes range from 0 to 24 percent.

This association makes up about 13 percent of the county. It is about 43 percent Lester soils, 15 percent Le Sueur soils, 9 percent Hamel soils, and 33 percent minor soils.

Lester soils are gently sloping to steep. They are well drained and are on knolls and side slopes. Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 37 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam.

Le Sueur soils are nearly level and gently sloping. They are moderately well drained and somewhat poorly drained and are on low rises and knolls and the lower parts of side slopes. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark brown clay loam about 7 inches thick. The subsoil is dark grayish brown, mottled clay loam about 29 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled loam.

Hamel soils are nearly level. They are poorly drained and are in swales, in drainageways, and on concave foot slopes. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is black clay loam about 12 inches thick. The subsoil is mottled silty clay loam about 17 inches thick. The upper part is black, the next part is very dark gray, and the lower part is olive gray. The underlying material to a depth of about 60 inches is dark grayish brown, mottled clay loam.

Of minor extent in this association are the Cordova, Glencoe, Hawick, Palms, Storden, and Terril soils. Cordova soils are poorly drained and are on flats and in swales. Glencoe and Palms soils are very poorly drained and are in depressions. Hawick and Storden soils are in landscape positions similar to those of the Lester soils. Hawick soils have gravelly underlying material. Storden soils are calcareous throughout. Terril soils formed in alluvium or colluvium and are on plane or concave foot slopes.

Most of this association is cropland. Corn and soybeans are the major crops, but small grain and alfalfa also are grown. The major soils are well suited or fairly well suited to the cultivated crops commonly grown in the county. Erosion and excess soil moisture are the main management concerns. Unless careful management is applied, erosion is a severe hazard on the Lester soils.

6. Lester-Storden-Hawick Association

Rolling to very steep, well drained and excessively drained, loamy soils on uplands

The soils in this association are on hilltops and side

slopes on recessional moraines in the uplands and on steep valley walls adjacent to rivers. Slopes range from 6 to 40 percent.

This association makes up about 6 percent of the county. It is about 50 percent Lester soils, 20 percent Storden soils, 18 percent Hawick soils, and 12 percent minor soils.

Lester soils are well drained and are on convex side slopes and hilltops. Typically, the surface layer is dark brown loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam.

Storden soils are well drained and are on convex hilltops and side slopes. Typically, the surface soil is dark brown loam about 8 inches thick. The next layer is dark yellowish brown loam about 5 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and light olive brown loam.

Hawick soils are excessively drained and are on convex hilltops and side slopes. Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsoil is dark brown loamy sand about 5 inches thick. The underlying material to a depth of about 60 inches is brown or pale brown gravelly coarse sand.

Of minor extent in this association are the Glencoe, Hamel, Palms, and Terril soils. Glencoe and Palms soils are very poorly drained and are in depressions. Hamel soils are poorly drained and are on flats and in drainageways. Terril soils are moderately well drained and are on foot slopes.

Most of this association is cropland, but a significant acreage is pastured or wooded. The rolling areas are fairly well suited to cultivated crops, such as corn, soybeans, and small grain. The hilly to very steep areas are poorly suited or generally unsuited to cultivated crops because of a serious erosion hazard. Erosion control is the main management need.

7. Le Sueur-Cordova-Mazaska Association

Nearly level to gently sloping, moderately well drained to poorly drained, loamy and silty soils on uplands

The soils in this association are on ground moraines in the uplands. They are on slightly convex, low knolls and on broad flats. Slopes range from 0 to 4 percent.

This association makes up about 7 percent of the county. It is about 26 percent Le Sueur soils, 22 percent Cordova soils, 16 percent Mazaska soils, and 36 percent minor soils.

Le Sueur soils are nearly level to gently sloping. They are moderately well drained and somewhat poorly drained and are on low knolls and rises. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark brown clay loam about 7 inches thick. The subsoil is dark grayish brown, mottled clay loam about 29 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled loam.

Cordova soils are nearly level. They are poorly drained and are on broad flats. Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is clay loam about 30 inches thick. The upper part is very dark gray, the next part is very dark gray and grayish brown and is mottled, and the lower part is olive gray. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam.

Mazaska soils are nearly level. They are poorly drained and are on broad flats. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black clay loam about 4 inches thick. The subsoil is about 20 inches thick. It is very dark gray, mottled clay in the upper part and very dark grayish brown and dark grayish brown, mottled clay and silty clay in the lower part. The underlying material to a depth of about 60 inches is olive, mottled silty clay loam and clay loam.

Of minor extent in this association are the Canisteo, Glencoe, Muskego, Palms, and Lester soils. Canisteo soils are poorly drained and are on the rims of depressions. Glencoe, Muskego, and Palms soils are very poorly drained and are in depressions and bogs. Lester soils are on convex side slopes and on hilltops.

Nearly all of the acreage in this association is used as cropland. Corn and soybeans are the major crops, but small grain, alfalfa, and sweet corn also are grown. The major soils are well suited to all of the cultivated crops commonly grown in the county. A drainage system generally is needed. Soil blowing is a hazard. Measures that reduce this hazard and help to maintain tilth and fertility are the main management needs.

8. Kilkenny-Lerdal-Mazaska Association

Nearly level to steep, well drained to poorly drained, loamy and silty soils on uplands

The soils in this association are on moraines in the uplands. They are on the tops and sides of flat-topped hills separated by swales, bogs, and drainageways. Slopes range from 0 to 24 percent.

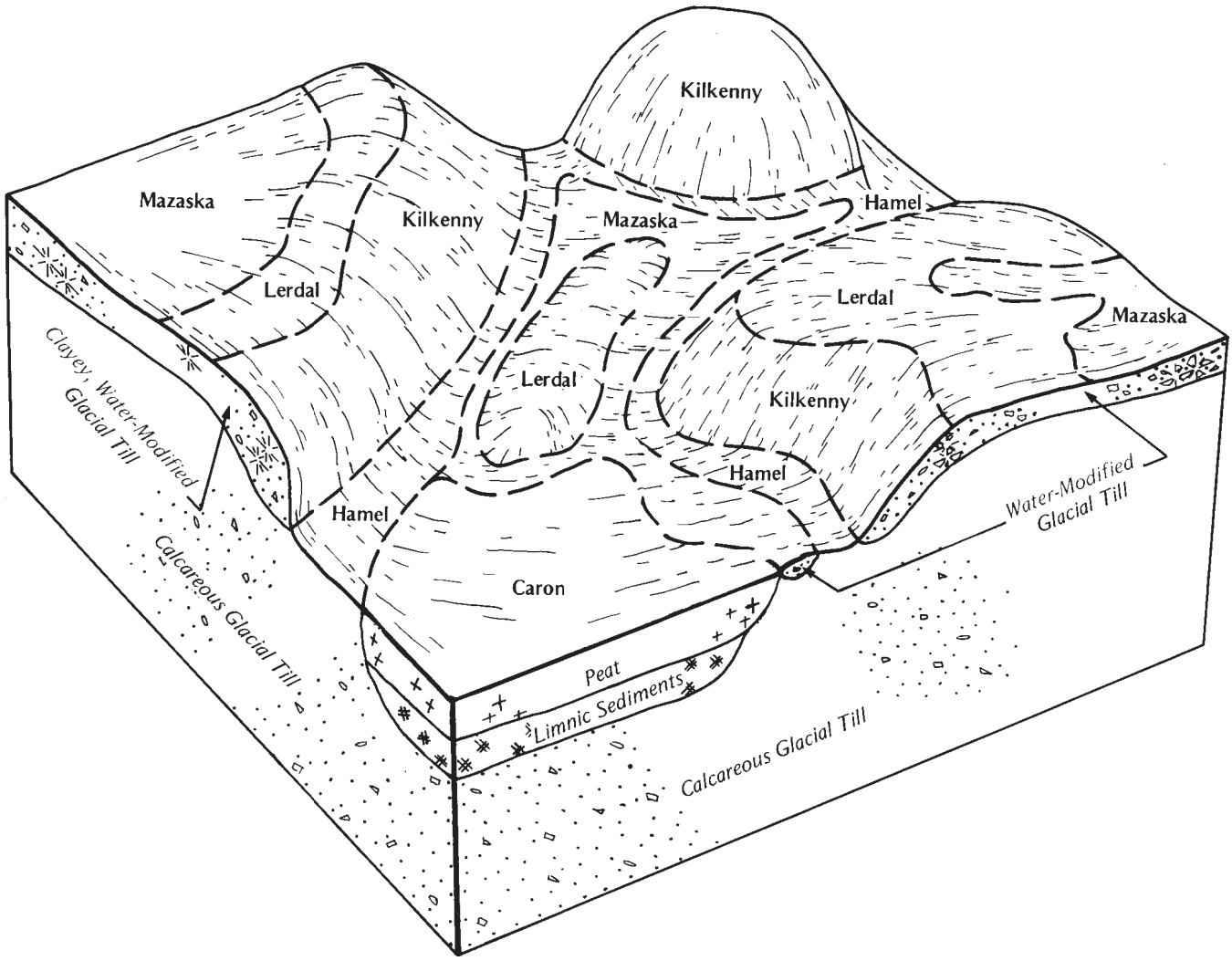


Figure 4.—Pattern of soils and parent material in the Kilkenny-Lerdal-Mazaska association.

This association makes up about 22 percent of the county. It is about 30 percent Kilkenny soils, 21 percent Lerdal soils, 12 percent Mazaska soils, and 37 percent minor soils (fig. 4).

Kilkenny soils are gently sloping to steep. They are well drained and moderately well drained and are on convex side slopes. Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 44 inches thick. It is brown silty clay loam in the upper part and dark yellowish brown clay loam in the lower part. The underlying material to a depth of about 60 inches is olive brown, mottled loam.

Lerdal soils are gently sloping and sloping. They are somewhat poorly drained and are on low rises and slightly convex to slightly concave side slopes. Typically, the surface layer is black clay loam about 8 inches thick. The subsoil is about 32 inches thick. It is dark grayish brown and mottled. The upper part is silty clay, and the lower part is clay loam. The underlying material to a depth of about 60 inches is olive brown, mottled clay loam.

Mazaska soils are nearly level. They are poorly drained and are on the tops of hills and on the lower flats. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black clay loam about 4 inches thick. The subsoil is about 20 inches thick. It is very dark gray, mottled clay loam in the upper part and very dark grayish brown and dark

grayish brown, mottled clay and silty clay in the lower part. The underlying material to a depth of about 60 inches is olive, mottled silty clay loam and clay loam.

Of minor extent in this association are the Caron, Glencoe, Hamel, Muskego, and Shields soils. Caron, Glencoe, and Muskego soils are very poorly drained and are in bogs and depressions. Hamel soils are poorly drained and are in drainageways. Shields soils are somewhat poorly drained and are on flats and gentle rises.

Nearly all of the acreage in this association is used as cropland. Corn and soybeans are the major crops, but small grain and hay also are grown. The major soils are well suited or fairly well suited to the cultivated crops commonly grown in the county. Erosion and wetness are the main management concerns. Unless careful management is applied, erosion is a severe hazard on the Kilkenny soils. A drainage system may be needed on the Mazaska soils.

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 "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. Le Sueur-Lester complex, 1 to 6 percent slopes, 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. The map unit Caron, Blue Earth, and Palms 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. Pits, quarry, 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.

As a result of changes in soil series concepts, different soil patterns, and variations in the design of map units, some soil boundaries and names in this survey do not match those in the published soil surveys of Rice, Scott, and Waseca counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

8B—Sparta loamy fine sand, 1 to 6 percent slopes. This gently sloping, excessively drained soil is on slightly convex slopes on stream terraces. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark brown loamy

fine sand about 9 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsoil is dark brown fine sand about 12 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown fine sand. In some areas the subsoil and underlying material have thin strata of loamy sediments.

Included with this soil in mapping are small areas of the well drained Dickman and Dickinson soils. Also included are small areas of soils that are underlain by loamy sediments at a depth of 30 inches or more. All of the included soils are in positions on the landscape similar to those of the Sparta soil. They make up 2 to 15 percent of the unit.

Permeability is rapid in the Sparta soil. Available water capacity is low. Organic matter content is moderately low. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture. This soil is poorly suited to cropland because of droughtiness. The crops selected for planting should be those that grow well in a droughty soil. They should be planted early in the spring, when the amount of rainfall is higher than the amount in later periods and temperatures are cooler. The soil is highly susceptible to water erosion. Leaving crop residue on the surface helps to control water erosion and increases the rate of water intake. In some areas long slopes are suitable for farming on the contour. Lime and fertilizer should be applied according to the results of soil tests.

This soil is fairly well suited to pasture and hay. Drought is the main hazard. Many pastures are dominated by cool-season grasses, such as Kentucky bluegrass. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the droughtiness. Some vegetation should be left on the surface during the early years of seedling establishment because the soil is subject to soil blowing. Cultivation or applications of herbicide help to remove competing vegetation.

The land capability classification is IVs. No woodland ordination symbol is assigned.

8C—Sparta loamy fine sand, 6 to 12 percent slopes. This sloping, excessively drained soil is on convex slopes on stream terraces. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 6 inches thick. The subsoil is dark brown fine sand about 14 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown fine sand. In some areas the subsoil and underlying material have thin strata of loamy sediments.

Included with this soil in mapping are small areas of the well drained Dickman and Dickinson soils. These soils are in positions on the landscape similar to those of the Sparta soil. Also included are small areas of soils that are underlain by loamy sediments at a depth of 28 inches or more. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Sparta soil. Available water capacity is low. Organic matter content is moderately low. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture. Because of droughtiness, this soil is generally unsuitable as cropland and is poorly suited to pasture and hay. Many pastures are dominated by cool-season grasses, such as Kentucky bluegrass. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable native grasses, such as little bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the droughtiness. Some vegetation should be left on the surface during the early years of seedling establishment because the soil is subject to soil blowing. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is VIs. No woodland ordination symbol is assigned.

27A—Dickinson sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on plane and slightly convex slopes on uplands and stream benches. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black sandy loam about

9 inches thick. The subsoil is sandy loam about 16 inches thick. It is dark brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is yellowish brown sand. In some areas the dark surface soil is more than 24 inches thick.

Included with this soil in mapping are small areas of the well drained Dickman and excessively drained Sparta soils. Dickman soils are sandier than the Dickinson soil. They are in positions on the landscape similar to those of the Dickinson soil. Sparta soils are on slight rises. Also included are small areas of soils that are underlain by loamy sediments at a depth of 40 inches or more. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil and rapid in the lower part. Available water capacity is low or moderate. Organic matter content is moderately low. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture. Corn and soybeans are the most common crops. This soil is well suited to cropland. Droughtiness and soil blowing are the main management concerns. Minimizing tillage, applying a system of no-till planting, maintaining a good cover crop, and returning crop residue to the soil conserve moisture and help to control soil blowing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness can reduce hay and forage yields in some years. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIs. No woodland ordination symbol is assigned.

27B—Dickinson sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on slightly convex slopes on uplands and stream benches. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is dark brown and dark yellowish brown sandy loam about 12 inches thick. The underlying material to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the well drained Dickman and excessively drained Sparta soils. Dickman soils are sandier than the Dickinson soil. They are in positions on the landscape similar to those of the Dickinson soil. Sparta soils are on the higher rises. Also included are small areas of soils that are underlain by glacial till or loamy sediments at a depth of 40 inches or more. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil and rapid in the lower part. Available water capacity is low. Organic matter content is moderately low. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture. Corn and soybeans are the most common crops. This soil is well suited to most of the crops commonly grown in the county. It is best suited to early maturing crops, such as small grain. Droughtiness and water erosion are the main management concerns. Minimum tillage, a good cover crop, and crop residue management conserve moisture, help to control water erosion, and allow for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness can reduce hay and forage yields in some years. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIe. No woodland ordination symbol is assigned.

27C—Dickinson sandy loam, 6 to 12 percent slopes. This sloping, well drained soil is on convex slopes on stream benches. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish

brown sandy loam about 9 inches thick. The subsoil is dark brown and dark yellowish brown sandy loam about 12 inches thick. The underlying material to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the well drained Dickman and excessively drained Sparta soils. These soils are in positions on the landscape similar to those of the Dickinson soil. Dickman soils are sandier than the Dickinson soil. Also included are small areas of soils that are underlain by loamy sediments at a depth of 40 inches or more. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil and rapid in the lower part. Available water capacity is low. Organic matter content is moderately low. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture. This soil is poorly suited to such cultivated crops as corn and soybeans. It is best suited to early maturing crops, such as small grain, which can make the best use of the limited amount of soil moisture. Water erosion and seasonal droughtiness are the main management concerns. A system of conservation tillage in which crop residue is left on the surface helps to control water erosion and allows for the maximum infiltration of rainfall. Some areas are suitable for farming on the contour. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to keep the pasture in good condition and help to control erosion.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IVe. No woodland ordination symbol is assigned.

35—Blue Earth mucky silt loam. This nearly level, very poorly drained soil is in depressions in drained lake basins. It is subject to rare flooding and to ponding. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is black mucky silt loam (coprogenous earth) about 10 inches thick. The underlying material to a depth of about 60 inches is very dark gray and dark olive gray mucky silt loam (coprogenous earth).

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Dassel and very poorly drained Muskego soils. Dassel soils are on the higher parts of the landscape. Muskego soils are in depressions on uplands. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Blue Earth soil. Available water capacity is high or very high. Organic matter content also is high or very high. Surface runoff is very slow or ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

About 50 percent of the acreage is used as cropland. Corn, soybeans, and small grain are the most common crops. If adequately drained, this soil is fairly well suited to cropland. It is also suitable for sod and truck crops. It is best suited to early maturing crops. Wetness and soil blowing are the main management concerns. A drainage system is needed. Some areas lack suitable drainage outlets and thus cannot be drained. Because the soil is in depressions, crops are susceptible to frost late in spring and early in fall. The soil is subject to soil blowing when it is dry. A conservation tillage system that leaves crop residue on the surface helps to control soil blowing and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. A mixture of bromegrass and alfalfa or reed canarygrass can improve forage yields in drained areas. Reed canarygrass forms a tough, dense sod that supports grazing animals and equipment even when the soil is partially wet. Careful management is needed to prevent overgrazing and damage to the surface. Pastures should not be grazed when the soil is very wet.

This soil is well suited to wetland wildlife habitat. Suitable wetland habitat can be easily developed, and wetland plants can grow well.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

39A—Wadena loam, 0 to 2 percent slopes. This nearly level, well drained soil is on plane or slightly convex slopes in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is very dark gray loam about 4 inches thick. The subsoil is dark brown and brown loam about 24 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and dark brown gravelly sand. In some areas the surface layer and subsoil are silt loam.

Included with this soil in mapping are small areas of the well drained and excessively drained Estherville soils and the well drained Dickinson and Kasota soils. Estherville soils are on the higher parts of the landscape. Dickinson and Kasota soils are in positions on the landscape similar to those of the Wadena soil. Dickinson soils have more sand and Kasota soils have more clay than the Wadena soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Wadena soil and rapid in the lower part. Available water capacity is moderate. Organic matter content is moderate or high. Surface runoff is slow.

Most areas are used as cropland, but some are used for pasture or hay. Corn and soybeans are the most common crops. This soil is well suited to cropland. The main management concern is droughtiness, which can reduce yields during years of low rainfall. Leaving crop residue on the surface allows for the maximum infiltration of rainfall and keeps water erosion to a minimum. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness may limit forage production in dry years. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIs. No woodland ordination symbol is assigned.

39B—Wadena loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on convex slopes in the uplands. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown and dark yellowish brown loam. The lower part is yellowish brown sandy loam. The underlying material to a depth of about 60 inches is yellowish brown gravelly sand. In some areas the surface layer and subsoil are silt loam.

Included with this soil in mapping are small areas of the well drained and excessively drained Estherville soils and the well drained Dickinson and Kasota soils. Estherville soils are on crests on the higher parts of the landscape. Dickinson and Kasota soils are in positions on the landscape similar to those of the Wadena soil. Dickinson soils have more sand and Kasota soils have more clay than the Wadena soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Wadena soil and rapid in the lower part. Available water capacity is moderate. Organic matter content is moderate or high. Surface runoff is slow.

Most areas are used as cropland, but some are used for pasture or hay. Corn and soybeans are the main crops. This soil is well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour. Droughtiness can reduce crop yields during periods of low rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness may limit forage production in dry years. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIe. No woodland ordination symbol is assigned.

41B—Estherville sandy loam, 1 to 6 percent slopes. This gently sloping, well drained and somewhat excessively drained soil is on convex slopes on uplands and outwash plains. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown sandy loam about 9 inches thick. The subsoil is dark brown sandy loam about 9 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and brown coarse sand.

Included with this soil in mapping are small areas of the well drained Dickinson and Wadena soils. These soils are in positions on the landscape similar to those of the Estherville soil. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Estherville soil and rapid or very rapid in the lower part. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture. Corn and soybeans are the main crops. This soil is fairly well suited to cropland. Drought is the main hazard. The crops selected for planting should be those that grow well in a droughty soil, can be planted early in the year, and mature early. The soil is highly susceptible to water erosion unless the surface is protected. A system of conservation tillage in which crop residue is left on the surface helps to control erosion and allows for the maximum infiltration of rainfall. Fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Forage production may be low in the summer because of droughtiness. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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

The land capability classification is IIIs. No woodland ordination symbol is assigned.

86—Canisteo clay loam. This nearly level, poorly drained, calcareous soil is on flats and the rims of depressions on till plains. Individual areas are irregular in shape and range from 2 to 100 acres in size.

Typically, the surface layer is black, calcareous clay loam about 9 inches thick. The subsurface layer is very dark gray, calcareous silty clay loam about 10 inches thick. The subsoil is mottled, calcareous clay loam about 16 inches thick. The upper part is dark grayish brown, and the lower part is olive gray. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous loam. In some areas the depth to carbonates is more than 24 inches.

Included with this soil in mapping are small areas of the very poorly drained Glencoe and moderately well drained and somewhat poorly drained Le Sueur soils. Glencoe soils are in depressions. Le Sueur soils are on rises. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Canisteo soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland or pasture. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The wetness and the high content of lime are the main management concerns. A drainage system is needed. The high content of lime creates a fertility imbalance by restricting the availability of phosphorus, potassium, and trace nutrients. Nutrients should be applied according to the results of soil tests. Water erosion can be controlled by a system of conservation tillage that keeps crop residue on the surface.

This soil is well suited to pasture and hay. The wetness is the main management concern. A drainage system can improve forage yields. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses, such as bromegrass and red fescue, and legumes, such as birdsfoot trefoil and alfalfa. Applying fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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 and the

wetness. The free carbonates in the soil restrict the availability of nutrients. Because of wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIw. No woodland ordination symbol is assigned.

94B—Terril loam, 1 to 8 percent slopes. This gently sloping and sloping, moderately well drained soil is on plane or concave foot slopes in the uplands. Individual areas are elongated and range from 5 to 35 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is about 35 inches of very dark brown loam and very dark grayish brown clay loam. The subsoil to a depth of about 60 inches is dark brown loam. In some areas the surface layer and subsoil are sandy loam.

Included with this soil in mapping are small areas of the poorly drained Hamel and well drained Lester soils. Hamel soils are in drainageways. Lester soils are on convex slopes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Terril soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium.

Most areas are used as cropland or pasture. Corn, soybeans, and small grain are the main crops. This soil is well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface and applying a system of conservation tillage help to control erosion and increase the rate of water intake. Some areas are suitable for farming on the contour or terracing. Grassed waterways can help to prevent the formation of gullies. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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

The land capability classification is IIe. No woodland ordination symbol is assigned.

100B—Copaston loam, 1 to 6 percent slopes. This gently sloping, well drained, shallow soil is on plane or convex slopes on rock-cored stream terraces. Individual areas are irregular in shape and range from 40 to 200 acres in size.

Typically, the surface layer is very dark brown loam about 10 inches thick. The subsoil is dark brown gravelly loam about 6 inches thick. Limestone bedrock is at a depth of about 16 inches. In some places the depth to limestone bedrock is less than 12 or more than 40 inches. In other places the slope exceeds 6 percent.

Included with this soil in mapping are small areas of poorly drained and very poorly drained soils in depressions. Also included are outcrops of limestone. Included areas make up less than 5 percent of the unit.

Permeability is moderate or moderately rapid in the Copaston soil. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow or medium.

Most areas are used for pasture or are left idle (fig. 5). Some are used as cropland. This soil is fairly well suited to cropland. It is best suited to early maturing crops, such as small grain, which can make the best use of the limited amount of moisture available early in the growing season. The main management concerns are the shallowness to bedrock, droughtiness, and water erosion. Droughtiness is a problem during most years. Tillage equipment may be damaged by the bedrock. A system of conservation tillage that leaves crop residue on the surface can help to control erosion, conserves moisture, and allows for the maximum infiltration of rainfall.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem, little bluestem, and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

This soil is generally unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Seedling mortality is severe because of the droughtiness. Onsite investigation may identify areas where trees and shrubs can be established if special management is applied.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

Figure 5.—Prairie vegetation in an area of Copaston loam, 1 to 6 percent slopes.

106B—Lester loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on convex slopes on till plains. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsoil is clay loam about 40 inches thick. It is dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam. In some areas the soil is eroded or has a lighter colored surface layer.

Included with this soil in mapping are small areas of the poorly drained Cordova and moderately well drained and somewhat poorly drained Le Sueur soils. Cordova soils are in swales. Le Sueur soils are in the lower, less sloping areas. Also included are small areas of soils that have a subsoil of clay. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Lester soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can

be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to control erosion and keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Weed control, cultivation, and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIe. The woodland ordination symbol is 5A.

106C2—Lester loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on convex slopes on till plains. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 37 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam. In some areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel and moderately well drained and somewhat poorly drained Le Sueur soils. Hamel soils are on foot slopes and in drainageways. Le Sueur soils are in the less sloping areas. Also included are small areas of soils that have a subsoil of clay. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Lester soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is fairly well suited to cropland. The main management concern is water erosion, which can be severe if the soil is not carefully managed. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake (fig. 6). Some areas are suitable for farming on the contour or terracing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Weed control, cultivation, and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a hazard if the ground cover is removed.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

106D2—Lester loam, 12 to 18 percent slopes, eroded. This moderately steep, well drained soil is on convex slopes on till plains. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam. In some areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel soils on foot slopes and in drainageways. Also included are small areas of soils that have a subsoil of clay. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Lester soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is rapid.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is poorly suited to cropland because of the hazard of water erosion. In some areas contour farming or terraces can be effective, but in other areas slopes are too short and irregular for contouring or terracing. A system of conservation tillage that leaves crop residue on the surface helps to control water erosion and allows for the maximum infiltration of rainfall. Grassed waterways can control runoff and prevent the formation of gullies.

Figure 6.—A protective cover of crop residue in an area of Lester loam, 6 to 12 percent slopes, eroded.

Operation of farm equipment is difficult on these slopes.

This soil is well suited to pasture and hay. Overgrazing is the main management concern. Pastures that are in poor condition can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition and help to control erosion.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. The normal effectiveness of windbreaks is reduced

because of the slope. Water erosion is a severe hazard unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is fairly well suited to woodland. Black walnut is a desirable species for planting. The main management concerns are the erosion hazard and the difficulty in operating equipment on these slopes. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees.

The land capability classification is IVe. The woodland ordination symbol is 5R.

106E—Lester loam, 18 to 24 percent slopes. This steep, well drained soil is on convex side slopes on till plains. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown loam about 6 inches thick. The subsoil is clay loam about 20 inches thick. It is dark brown and dark yellowish brown in the upper part and olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam. In some areas the soil has a light colored surface layer, which is less than 6 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel and moderately well drained Terril soils. Hamel soils are on foot slopes and in drainageways. Terril soils are on foot slopes. Also included are small areas of soils that have a subsoil of clay. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Lester soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is rapid.

Most areas are used as pasture or woodland. Because of the hazard of water erosion, this soil is generally unsuited to cultivated crops. It is fairly well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition and help to control erosion.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. The normal effectiveness of windbreaks is reduced because of the slope. Water erosion is a severe hazard unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is fairly well suited to woodland. Black walnut is a desirable species for planting. The erosion hazard and the difficulty in operating equipment on these slopes are the main management concerns. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees.

The land capability classification is VIe. The woodland ordination symbol is 5R.

109—Cordova clay loam. This nearly level, poorly drained soil is in broad swales and slight depressions on uplands. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is clay loam about 30 inches thick. The upper part is very dark gray, the next part is very dark gray and grayish brown and is mottled, and the lower part is olive gray and mottled. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam. In some areas free carbonates are at a depth of about 10 inches. In other areas the dark surface soil is more than 24 inches thick. In places the content of clay in the subsoil is more than 35 percent.

Included with this soil in mapping are small areas of the very poorly drained Glencoe and Rolfe soils and the moderately well drained and somewhat poorly drained Le Sueur soils. Glencoe and Rolfe soils are in depressions. Le Sueur soils are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Cordova soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Wetness is the main management

concern. A drainage system is needed. It allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Tilling when the soil is wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The wetness is the main management concern. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Because of the wetness, seedling mortality is moderate and planting may be delayed in the spring. Cultivation or applications of herbicide help to control competing vegetation.

This soil is only fairly well suited to woodland because of the wetness. The use of equipment is restricted during wet periods, when the soil is soft and cannot support heavy equipment. Harvesting activities should be limited to periods when the ground is frozen. Wetness during the tree-planting season limits reforestation. A high rate of seedling mortality, which is caused by the seasonal wetness, can be reduced by planting the older, larger nursery stock and by increasing plant density. Plant competition around new seedlings is a management concern. It can be controlled by applications of herbicide.

The land capability classification is IIw. The woodland ordination symbol is 5W.

114—Glencoe clay loam. This level, very poorly drained soil is in depressions and swales on uplands. It is subject to rare flooding and to ponding. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is about 32 inches thick. It is black silty clay loam in the upper part and very dark gray, mottled clay loam in the lower part. The subsoil is olive gray, mottled loam about 17 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous loam. In some areas the soil has an organic surface layer about 16 inches thick. In other areas the content of clay is more than 35 percent in the underlying material.

Included with this soil in mapping are small areas of the poorly drained Canisteo and Cordova soils. Canisteo soils are on the rims of depressions. Cordova soils are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Glencoe soil. Available water capacity is high. Organic matter content is high or very high. Surface runoff is slow to ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most of the acreage is pasture or idle land. Some areas are used as cropland. Corn, soybeans, and small grain are the most common crops. If drained, this soil is fairly well suited to cropland. The wetness and the ponding are the main management concerns. A drainage system is needed. It allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Some areas cannot be easily drained because of their low position on the landscape and the difficulty in locating suitable outlets for drainage systems. Tilling when the soil is wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. A drainage system can improve forage yields and trafficability. Grazing when the soil is too wet can result in compaction and can destroy the cover of pasture grasses. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of grasses and legumes that can withstand the wetness. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Undrained areas are generally unsuited to trees and shrubs. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

123—Dundas loam. This nearly level, somewhat poorly drained and poorly drained soil is on flats and gentle rises in the uplands. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsoil is mottled clay loam about 27 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam. In some areas the content of clay is more than 35 percent in the subsoil.

Included with this soil in mapping are small areas of the poorly drained Cordova, well drained Lester, and moderately well drained and somewhat poorly drained Le Sueur soils. Cordova soils are in the lower landscape positions. Lester soils are on the higher knolls and side slopes. Le Sueur soils are in the slightly higher positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Dundas soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Wetness is the main management concern. A drainage system is needed. It allows the soil to warm up earlier and thus allows it to be worked earlier in the spring. Tilling when the soil is wet results in compaction and deterioration of tilth. Conservation tillage keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The wetness is the main management concern. A drainage system can improve forage yields. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

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

This soil is only fairly well suited to woodland because of the seasonal wetness. The use of equipment is restricted during wet periods, when the soil is soft and cannot support heavy equipment. Wetness during the tree-planting season limits reforestation. A high rate of seedling mortality, which is caused by the seasonal wetness, can be reduced by planting the older, larger nursery stock and by increasing plant density. Control of plant competition around new seedlings is needed.

The land capability classification is IIw. The woodland ordination symbol is 5W.

129—Cylinder loam, 1 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on slight knolls and rises in the uplands. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark brown loam about 3 inches thick. The next layer is very dark grayish brown clay loam about 4 inches thick. The subsoil is about 19 inches thick. It is dark grayish brown. It is clay loam in the upper part and sandy loam in the lower part. The underlying material to a depth of about 60 inches is olive gray and gray, mottled, stratified fine sand and loamy fine sand. In some areas the subsoil has strata of fine sand or gravel. In other areas the underlying material is loam or clay loam.

Included with this soil in mapping are small areas of the poorly drained Biscay and Cordova soils, well drained Dickinson soils, and well drained and somewhat excessively drained Estherville soils. Biscay and Cordova soils are on the lower parts of the landscape. Dickinson and Estherville soils are in the slightly higher landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Cylinder soil and very rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn and soybeans are the most common crops. This soil is well suited to cropland. The main management concern is droughtiness, which can reduce yields during periods of low rainfall. A system of conservation tillage keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Wetness may delay fieldwork in the spring. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay.

Droughtiness can lower forage production during periods of low rainfall. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. The trees and shrubs selected for planting should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIs. No woodland ordination symbol is assigned.

138B—Lerdal clay loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on slightly convex to slightly concave slopes on glacial moraines. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and dark brown, mottled silty clay, and the lower part is dark grayish brown, mottled clay loam. The underlying material to a depth of about 60 inches is olive brown, mottled clay loam. In some areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the well drained and moderately well drained Kilkenny soils and the poorly drained Mazaska soils. Kilkenny soils are in the slightly higher positions on the landscape. Mazaska soils are on flats and in swales. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Lerdal soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The main management concerns are water erosion and wetness. Leaving crop residue on the surface helps to control water erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. A drainage system may be needed to lower the water table enough for optimum crop growth. The wetness may delay fieldwork in the spring. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. A drainage system can improve forage yields and trafficability. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control erosion and keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIe. The woodland ordination symbol is 5A.

138C—Lerdal clay loam, 6 to 12 percent slopes. This sloping, somewhat poorly drained soil is on glacial moraines. Individual areas are irregular in shape and range from 4 to 60 acres in size.

Typically, the surface layer is very dark brown clay loam about 7 inches thick. The subsoil is about 28 inches thick. The upper part is dark brown and dark grayish brown, mottled silty clay loam, and the lower part is dark grayish brown, mottled clay loam. The underlying material to a depth of about 60 inches is olive brown, mottled clay loam. In some areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the well drained and moderately well drained Kilkenny soils. These soils are in the more convex areas. They make up 5 to 15 percent of the unit.

Permeability is slow in the Lerdal soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is fairly well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control water erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. Wetness may delay fieldwork

in the spring. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control water erosion and keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a hazard if the ground cover is removed.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

156A—Fairhaven silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is in plane or slightly convex areas on stream terraces. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer also is black silt loam. It is about 7 inches thick. The subsoil is about 39 inches thick. The upper part is dark brown, brown, and dark yellowish brown silt loam, and the lower part is yellowish brown loam. The underlying material to a depth of about 60 inches is pale brown gravelly sand. In some areas the surface layer and subsoil are sandy loam.

Included with this soil in mapping are small areas of the well drained Dickinson and well drained and somewhat excessively drained Estherville soils. Dickinson soils have more sand than the Fairhaven soil. They are in positions on the landscape similar to those of the Fairhaven soil. Estherville soils are in the slightly higher positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Fairhaven soil and rapid in the lower part. Available water capacity is high. Organic matter content is moderate or high. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture or hayland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Droughtiness and soil blowing are the main management concerns. The droughtiness reduces crop yields during years of low rainfall. Crop residue management conserves moisture and minimizes soil blowing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness may limit forage production during dry periods. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIs. No woodland ordination symbol is assigned.

156B—Fairhaven silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is in convex areas on stream terraces. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer also is black silt loam. It is about 6 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and dark yellowish brown silt loam, and the lower part is yellowish brown loam. The underlying material to a depth of about 60 inches is pale brown gravelly sand. In some areas the surface layer and subsoil are sandy loam.

Included with this soil in mapping are small areas of the well drained Dickinson and well drained and somewhat excessively drained Estherville soils. These soils are in landscape positions similar to those of the Fairhaven soil. Dickinson soils have more sand than the Fairhaven soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Fairhaven soil and rapid in the lower part. Available water capacity is high. Organic matter content is moderate or high. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or hayland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to

cropland. The main management concern is water erosion. Also, droughtiness during years of low rainfall reduces crop yields. Crop residue management conserves moisture and helps to prevent excessive soil loss. Some areas are suitable for farming on the contour. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness may limit forage production during dry periods. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIe. No woodland ordination symbol is assigned.

183—Dassel loam. This nearly level, poorly drained and very poorly drained soil is on plane or slightly convex beaches and sandbars along the edges of present or former lakes and ponds. In places it is subject to ponding. Individual areas are elongated and range from 5 to 20 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer also is black loam. It is about 3 inches thick. The next layer is very dark grayish brown sandy loam about 3 inches thick. The subsoil is about 5 inches of dark grayish brown, stratified loamy sand, fine sand, and very fine sandy loam. The underlying material to a depth of about 60 inches is olive gray and dark gray, mottled, stratified sand, fine sandy loam, sandy loam, silt loam, and loamy sand. In some places the soil has an organic surface layer about 6 inches thick. In other places the surface layer is stony. Some areas have short, steep escarpments.

Included with this soil in mapping are small areas of the poorly drained Canisteo and very poorly drained Caron, Glencoe, Muskego, and Palms soils. Canisteo soils are in landscape positions similar to those of the Dassel soil or are slightly higher on the landscape. Caron, Glencoe, Muskego, and Palms soils are in the slightly lower positions. Also included are small areas where the surface soil is fine sand or loamy fine sand more than 25 inches thick. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Dassel soil. Available water capacity is moderate. Organic matter content is moderate to very high. Surface runoff is slow to ponded. The seasonal high water table is at a depth of 0.5 foot to 3.0 feet.

Most of the acreage is idle land, but some areas are cropped or pastured. Corn, soybeans, and small grain are the most common crops. If drained, this soil is fairly well suited to cropland. Wetness and ponding are the main management concerns. A drainage system is needed. Applying commercial fertilizer increases the supply of plant nutrients.

This soil is fairly well suited to pasture and hay. The wetness is the main limitation. A drainage system can improve forage yields. Grazing when the soil is very wet causes surface compaction. Pastures that are in poor condition because of overgrazing can be reseeded with suitable mixtures of grasses and legumes. Applying fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, rotation or deferred grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to openland wildlife habitat and is fairly well suited to wetland and woodland wildlife habitat. Food and cover crops grow fairly well.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

206B—Kasota silt loam, 1 to 6 percent slopes. This gently sloping, well drained soil is in slightly convex areas on stream terraces. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is dark brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is brown clay, and the lower part is yellowish brown loam. The underlying material to a depth of about 60 inches is yellowish brown sand. In some areas the subsoil has strata of silt and fine sand. In other areas the content of clay is less than 35 percent in the subsoil.

Included with this soil in mapping are small areas of

the well drained Dickinson and well drained and somewhat excessively drained Estherville soils. These soils are in positions on the landscape similar to those of the Kasota soil. Dickinson soils have more sand than the Kasota soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Kasota soil and rapid in the underlying material. Available water capacity is moderate. Organic matter content is moderate to high. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or hayland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The main management concern is water erosion. Also, droughtiness may limit yields during periods of low rainfall. Leaving crop residue on the surface helps to control water erosion and increases the rate of water intake. Some areas are suitable for farming on the contour. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness may limit forage production in dry years. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIe. No woodland ordination symbol is assigned.

238B—Kilkenny loam, 2 to 6 percent slopes. This gently sloping, well drained and moderately well drained soil is in convex areas on glacial moraines. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown loam about 9 inches thick. The subsoil is clay loam about 45 inches thick. It is dark yellowish brown in the upper part and brown in the lower part. The underlying material to a depth of about 60 inches is olive brown, mottled loam. In some areas the dark surface layer is more than 10 inches thick. In other areas the content of clay is less than 35 percent in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Lerdal and moderately well drained and somewhat poorly drained Le Sueur soils in the slightly lower landscape positions. These soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Kilkenny soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control erosion and keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIe. The woodland ordination symbol is 5A.

238C2—Kilkenny clay loam, 6 to 12 percent slopes, eroded. This sloping, well drained and moderately well drained soil is in convex areas on glacial moraines. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark brown clay loam about 9 inches thick. The subsoil is about 44 inches thick. It is brown. It is silty clay loam in the upper part and clay loam in the lower part. The underlying material to a depth of about 60 inches is olive brown, mottled loam. In some areas the content of clay is less than 35 percent in the subsoil. In other areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel and somewhat poorly drained Lerdal soils. Hamel soils are on foot slopes and in drainageways. Lerdal soils are in the less sloping areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Kilkenny soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is fairly well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control erosion and keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a hazard if the ground cover is removed.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

238D2—Kilkenny clay loam, 12 to 18 percent slopes, eroded. This moderately steep, well drained and moderately well drained soil is in convex areas on glacial moraines. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 5 to about 50 acres in size.

Typically, the surface layer is very dark brown clay loam about 8 inches thick. The subsoil is about 38 inches thick. It is brown. It is silty clay loam in the upper part and clay loam in the lower part. The underlying material to a depth of about 60 inches is olive brown, mottled loam. In some areas the content of clay is less than 35 percent in the subsoil. In other areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel and somewhat poorly drained Lerdal soils. Hamel soils are on foot slopes and in drainageways. Lerdal soils are in the less sloping areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Kilkenny soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is rapid.

Most areas are used as cropland, but some are used as pasture or woodland. This soil is poorly suited to crops because of a severe hazard of water erosion. In some areas contour farming or terraces can be effective in controlling erosion, but in other areas slopes are too short and irregular for terracing or contouring. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and allows for the maximum infiltration of rainfall. Grassed waterways can control runoff and prevent the formation of gullies. Operating farm equipment is difficult on these moderately steep slopes.

This soil is well suited to pasture and hay. Water erosion and overgrazing are management concerns. Pastures that are in poor condition can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control water erosion and keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. The normal effectiveness of windbreaks is reduced because of the slope. Water erosion is a severe hazard unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is well suited to woodland. Black walnut is a desirable species for planting. The erosion hazard and the difficulty in operating equipment on these slopes are limitations. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover. Weed control minimizes plant competition. Pruning and thinning help to establish and maintain a good stand of trees.

The land capability classification is IVe. The woodland ordination symbol is 5R.

238E—Kilkenny clay loam, 18 to 24 percent slopes. This steep, well drained and moderately well drained soil is in convex areas on end moraines. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown clay loam about 7 inches thick. The subsoil is about 31 inches thick. It is dark brown. It is silty clay loam in the upper part and clay loam in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled loam. In some areas the content of clay is less than 35 percent in the subsoil. In other areas the soil has a light colored surface layer less than 4 inches thick.

Included with this soil in mapping are small areas of the poorly drained Hamel and somewhat poorly drained Lerdal soils. Hamel soils are on foot slopes and in drainageways. Lerdal soils are in the less sloping areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Kilkenny soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is rapid.

Most of the acreage is pasture or woodland. Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is fairly well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition and help to control erosion.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. The normal effectiveness of windbreaks is reduced because of the slope. Water erosion is a severe hazard unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is well suited to woodland. Black walnut is a desirable species for planting. The hazard of water erosion and the difficulty in operating equipment on these steep slopes are the main management concerns. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover. Weed control minimizes plant competition. Pruning and thinning help to establish and maintain a good stand of trees.

The land capability classification is VIe. The woodland ordination symbol is 5R.

239B—Le Sueur clay loam, 1 to 4 percent slopes. This nearly level and gently sloping, moderately well drained and somewhat poorly drained soil is on slight knolls and rises and the lower parts of side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer is very dark brown clay loam about 7 inches thick. The subsoil is dark grayish brown, mottled clay loam about 29 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled loam. In some areas the subsoil has more clay. In other areas the soil has a light colored surface layer less than 6 inches thick.

Included with this soil in mapping are small areas of the poorly drained Cordova and well drained Lester soils. Cordova soils are in the slightly lower landscape positions. Lester soils are in the steeper areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Le Sueur soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. A drainage system allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and

applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is I. The woodland ordination symbol is 5A.

256—Mazaska silty clay loam. This nearly level, poorly drained soil is in plane or slightly concave areas on the tops of broad ridges on end moraines. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black clay loam about 4 inches thick. The subsoil is about 20 inches thick. It is very dark gray, mottled clay loam in the upper part and very dark grayish brown and dark grayish brown, mottled clay and silty clay in the lower part. The underlying material to a depth of about 60 inches is olive, mottled silty clay loam and clay loam. In some areas the content of clay is less than 35 percent in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Lerdal and Shields soils. These soils are in the slightly higher landscape positions. They make up 5 to 15 percent of the unit.

Permeability is slow in the Mazaska soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Wetness is the main management concern. A drainage system is needed. It allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Tilling when the soil is very wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of excessive wetness. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIw. No woodland ordination symbol is assigned.

271—Minneiska fine sandy loam, frequently flooded. This nearly level, moderately well drained soil is on slight rises on flood plains. Individual areas are elongated and range from 40 to 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 12 inches thick. The upper part of the underlying material is brown, stratified loamy fine sand and fine sandy loam. The lower part to a depth of about 60 inches is dark grayish brown and very dark grayish brown loam. In some areas the soil is flooded less frequently.

Included with this soil in mapping are small areas of the somewhat poorly drained and poorly drained Chaska soils and the very poorly drained Oshawa soils. Chaska soils are in the lower areas. Oshawa soils are in depressions and meander channels. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Minneiska soil. Available water capacity is moderate or high. Organic matter content also is moderate or high. Surface runoff is slow. The seasonal high water table is at a depth of 3 to 6 feet.

Most of the acreage is woodland or idle land, but some areas are used as pasture. Because of the frequent flooding, this soil is generally unsuitable as cropland. It is poorly suited to hay and is only fairly well suited to pasture. Production of pasture grasses is low during dry summers. Delaying grazing in the spring and after heavy rains helps to prevent surface compaction. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Flooding can cause severe erosion and can damage seedlings unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is well suited to woodland. Black walnut is a

desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Untimely flooding may cause severe erosion unless vegetation protects the surface.

The land capability classification is Vw. The woodland ordination symbol is 9A.

317—Oshawa silt loam. This nearly level, very poorly drained soil is in abandoned river channels and swales on flood plains. It is frequently flooded and is subject to ponding. Individual areas are irregular in shape and range from 10 to about 100 acres in size.

Typically, the surface layer is black, mottled silt loam about 12 inches thick. The upper part of the underlying material is stratified olive gray and dark olive gray, mottled silt loam. The next part is stratified dark olive gray, very dark gray, and brown, mottled silt loam. The lower part to a depth of about 60 inches is very dark gray, mottled silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Chaska soils in the slightly higher positions on the flood plains. These soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Oshawa soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow to ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most of the acreage is idle land, but some areas are used as pasture and hayland. Because of the wetness and the flooding, this soil is generally unsuited to cultivated crops and is poorly suited to pasture and hay. Grazing when the soil is very wet can cause surface compaction and can destroy the stand of pasture grasses. Proper stocking rates, selection of water-tolerant grasses for planting, timely deferment of grazing, and restricted use during wet periods help to keep the pasture productive.

This soil is well suited to wetland wildlife habitat. It provides feeding, nesting, and escape areas. The habitat can be improved by controlling the water level and by fencing out livestock.

The land capability classification is VIw. No woodland ordination symbol is assigned.

323—Shields silty clay loam. This nearly level, somewhat poorly drained soil is on flats and gentle rises on end moraines. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsoil is about 41 inches thick. The upper part is dark grayish brown silty clay loam and dark grayish brown, mottled silty clay. The lower part is grayish brown, mottled silty clay and dark grayish brown, mottled silty clay loam. The underlying material to a depth of about 60 inches is olive brown, mottled loam. In some areas the content of clay is less than 40 percent in the subsoil.

Included with this soil in mapping are small areas of the poorly drained Mazaska and very poorly drained Rolfe soils. Mazaska soils are in plane or slightly concave areas. Rolfe soils are in depressions. Included soils make up 5 to 10 percent of the unit.

Permeability is slow in the Shields soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is fairly well suited to cropland. Reducing wetness and maintaining good tilth are the main management concerns. A drainage system is needed. It allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Tilling when the soil is wet results in puddling and in deterioration of soil structure and tilth, which hinders aeration. A system of conservation tillage that incorporates crop residue into the soil allows for the maximum infiltration of rainfall and improves soil structure and tilth. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Wetness and overgrazing are the main management concerns. A drainage system improves forage yields. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses, such as bromegrass, and legumes, such as birdsfoot trefoil and alfalfa. Nutrients should be applied according to the results of soil tests. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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

This soil is only fairly well suited to woodland because of the wetness. The use of equipment is restricted during wet periods, when the soil is soft and cannot support heavy equipment. Wetness during the tree-planting season limits reforestation and causes a

high rate of seedling mortality. This rate can be reduced by planting the older, larger nursery stock. Also, the plant density should be increased. Measures that control plant competition are needed.

The land capability classification is IIIw. The woodland ordination symbol is 5W.

327A—Dickman fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is in plane or slightly convex areas on stream terraces. Individual areas are irregular in shape and range from 5 to about 80 acres in size.

Typically, the surface layer is black fine sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsoil is about 15 inches thick. It is dark brown sandy loam in the upper part and dark yellowish brown loamy fine sand in the lower part. The underlying material to a depth of about 60 inches is light yellowish brown fine sand.

Included with this soil in mapping are small areas of the well drained Dickinson and excessively drained Sparta soils. Dickinson soils are not so sandy as the Dickman soil. They are in landscape positions similar to those of the Dickman soil. Sparta soils are in the slightly higher positions. Also included are small areas of soils that are underlain by loamy sediments at a depth of 40 inches or more. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickman soil and rapid in the lower part. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture. This soil is fairly well suited to cropland. It is best suited to early maturing crops, such as small grain. Droughtiness and soil blowing are the main management concerns. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the droughtiness. Some vegetation should be left on the surface during the early years of seedling establishment because the soil is subject to soil blowing. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIs. No woodland ordination symbol is assigned.

327B—Dickman fine sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on rises on upland plains and stream terraces. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is dark yellowish brown loamy fine sand about 14 inches thick. The underlying material to a depth of about 60 inches is yellowish brown fine sand.

Included with this soil in mapping are small areas of the well drained Dickinson and excessively drained Sparta soils. These soils are in positions on the landscape similar to those of the Dickman soil. Dickinson soils are not so sandy as the Dickman soil. Also included are small areas of soils that are underlain by glacial till or loamy sediments at a depth of 40 inches or more. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickman soil and rapid in the lower part. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow.

Most areas are used as cropland, but some are used as pasture. This soil is fairly well suited to cropland. Water erosion, soil blowing, and droughtiness are the main management concerns. Minimizing tillage, applying a system of no-till planting, maintaining a good cover crop, and returning crop residue to the soil conserve moisture and help to control soil blowing and water erosion. Some areas are suitable for farming on the contour. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa, or native grasses, such as big bluestem and sideoats grama. Applying lime and fertilizer according to the results of

soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the droughtiness. Some vegetation should be left on the surface during the early years of seedling establishment because of the susceptibility to soil blowing. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

329—Chaska silt loam. This nearly level, somewhat poorly drained and poorly drained soil is on flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown and dark gray, stratified silt loam and loam.

Included with this soil in mapping are small areas of the moderately well drained Minneiska and very poorly drained Oshawa soils. Minneiska soils are on gentle rises on the flood plains. Oshawa soils are in old stream channels. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Chaska soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The main management concerns are the wetness and the flooding. A drainage system is needed. The occasional flooding may damage crops and delay fieldwork. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The main management concerns are the wetness and the occasional flooding. Delaying grazing in the spring and after heavy rains helps to prevent surface compaction. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, rotation or deferred grazing, and restricted use during wet periods can help to keep the pasture in good condition.

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 and the wetness. Untimely flooding can cause severe water erosion and can damage seedlings unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Planting may be delayed in the spring because of the wetness. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIw. No woodland ordination symbol is assigned.

392—Biscay loam. This nearly level, poorly drained soil is on stream terraces. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is black clay loam about 15 inches thick. The next layer is very dark grayish brown clay loam about 9 inches thick. The subsoil is dark grayish brown and grayish brown, mottled loam about 13 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown and grayish brown, mottled gravelly loamy coarse sand. In some areas the soil is calcareous at or near the surface. In other areas the underlying material is stratified with loamy material or is entirely loam or clay loam.

Included with this soil in mapping are small areas of the very poorly drained Glencoe and moderately well drained and somewhat poorly drained Le Sueur soils. Glencoe soils are in the lower landscape positions. Le Sueur soils are in the slightly higher positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Biscay soil and rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture. This soil is well suited to cropland. Wetness is the main management concern. It can delay spring planting. A drainage system is needed. Tilling when the soil is wet results in compaction and deterioration of tilth. The susceptibility to erosion can be reduced by a system of conservation tillage that keeps crop residue on the surface. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The wetness is the main management concern. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses, such as bromegrass, and legumes, such as birdsfoot trefoil and alfalfa. Applying fertilizer according to the results of soil tests helps to establish and maintain a good stand of the desirable grasses and legumes. Proper stocking rates, rotation or deferred grazing, and restricted use during wet periods help to keep the pasture in good condition.

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

The land capability classification is IIw. No woodland ordination symbol is assigned.

414—Hamel clay loam. This nearly level, poorly drained soil is in swales, on concave foot slopes, and in drainageways in the uplands. Individual areas are elongated and range from 5 to 100 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer also is black clay loam. It is about 12 inches thick. The subsoil is mottled silty clay loam about 17 inches thick. It is black in the upper part, very dark gray in the next part, and olive gray in the lower part. The underlying material to a depth of about 60 inches is dark grayish brown, mottled clay loam. In some areas the dark surface soil is less than 24 inches thick. In other areas the content of clay is more than 35 percent in the subsoil. In places the surface layer is lighter colored.

Included with this soil in mapping are small areas of the moderately well drained and somewhat poorly drained Le Sueur soils and the very poorly drained Glencoe soils. Le Sueur soils are in the slightly higher positions. Glencoe soils are in the lower parts of swales and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Hamel soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow or medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. Wetness is the main management concern. A drainage system is needed. It allows the soil to warm up earlier in the spring and thus allows it to be worked earlier. Tilling when the soil is wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The wetness is the main management concern. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

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

This soil is poorly suited to woodland because of the wetness. The use of equipment is restricted during wet periods, when the soil is soft and cannot support heavy equipment. Wetness during the tree-planting season limits reforestation and causes a high rate of seedling mortality. This rate can be reduced by planting the older, larger nursery stock. Also, the plant density should be increased. Measures that control plant competition around new seedlings are needed.

The land capability classification is IIw. The woodland ordination symbol is 5W.

463—Minneiska fine sandy loam, occasionally flooded. This nearly level, moderately well drained soil is on slight rises on flood plains. Individual areas are irregular in shape and range from 15 to 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The underlying material to a depth of about 60 inches is dark brown, stratified loamy fine sand and fine sandy loam. It is mottled in the lower part. In some areas the soil is frequently flooded.

Included with this soil in mapping are small areas of the somewhat poorly drained and poorly drained Chaska soils and the very poorly drained Oshawa soils. Chaska soils are in low areas. Oshawa soils are in

depressions and meander channels. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Minneiska soil. Available water capacity is moderate or high. Organic matter content also is moderate or high. Surface runoff is slow. The seasonal high water table is at a depth of 3 to 6 feet.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. This soil is well suited to cropland. The occasional flooding may damage crops and delay fieldwork. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. The occasional flooding is the main management concern. Delaying grazing in the spring and after heavy rains helps to prevent the pasture damage caused by compaction. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Untimely flooding may cause severe water erosion unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

This soil is well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Untimely flooding may cause severe water erosion unless vegetation protects the surface.

The land capability classification is IIw. The woodland ordination symbol is 9A.

468—Otter silt loam. This level, poorly drained soil is on flood plains adjacent to upland streams. It is frequently flooded. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 10 inches thick. The subsurface layer is black, mottled silt loam about 35 inches thick. The underlying material to a depth of about 60 inches is black silt loam. In some areas the content of clay is more than 27 percent. In other areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of the very poorly drained Caron and Glencoe soils in depressions. These soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Otter soil. Available water capacity is high. Organic matter content is high or very high. Surface runoff is slow. The seasonal high water table is within a depth of 2 feet.

Most of the acreage is idle land, but some areas are used as pasture or woodland. Because of the frequent flooding, this soil is generally unsuited to cultivated crops. It is poorly suited to hay and fairly well suited to pasture. The flooding and the wetness are the main management concerns in pastured areas. Deferring grazing in the spring and after heavy rains helps to prevent surface compaction. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

This soil is generally unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Onsite investigation may indicate that certain trees and shrubs can be established if special management is applied. Planting may be delayed because of the excess moisture.

This soil is poorly suited to woodland because of the wetness. The use of equipment is restricted during wet periods, when the soil is soft and cannot support heavy equipment. Measures that control plant competition are needed. Wetness during the tree-planting season limits reforestation and causes a high rate of seedling mortality. This rate can be reduced by planting the older, larger nursery stock. Also, the plant density should be increased.

The land capability classification is Vw. The woodland ordination symbol is 3W.

524—Caron muck. This level, very poorly drained soil is in upland depressions. It is subject to ponding. Individual areas are irregular in shape and range from 5 to about 200 acres in size.

Typically, the surface layer is very dark brown muck about 13 inches thick. The next layer is very dark brown mucky peat about 18 inches thick. The underlying material to a depth of about 60 inches is very dark gray

mucky silt loam (coprogenous earth). In some areas the organic material is more than 51 or less than 16 inches thick. In other areas it is highly decomposed.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Dassel and very poorly drained Glencoe soils. Dassel soils are on the rims of the depressions. Glencoe soils formed in loamy mineral material. They are in positions on the landscape similar to those of the Caron soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid or rapid in the organic part of the Caron soil and moderately slow in the underlying material. Available water capacity is very high. Organic matter content also is very high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most of the acreage is cropland, pasture, or idle land. If drained, this soil is fairly well suited to cropland. It is suitable for sod and truck crops. Corn, soybeans, and small grain are the most common crops. A drainage system is needed. Some areas cannot be easily drained because of their low position on the landscape and the difficulty in locating suitable drainage outlets. Because the soil is in depressions, crops are susceptible to frost late in spring and early in fall. Early maturing crops are better suited than other crops. The soil is subject to soil blowing when it is dry. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Wetness and overgrazing are the main management concerns. A mixture of bromegrass and alfalfa or reed canarygrass can improve forage yields in drained areas. Reed canarygrass forms a tough, dense sod that can support grazing animals and haying equipment even when the soil is partially wet. Careful management is needed to prevent the damage to the surface caused by overgrazing. The pasture should not be grazed when the soil is very wet.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation. Undrained areas are generally unsuited to trees and shrubs.

This soil is well suited to the development of wetland wildlife habitat. Suitable wetland habitat can be easily developed, and wetland food and cover crops can grow well.

The land capability classification is IIIw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

525—Muskego muck. This level, very poorly drained soil is in upland depressions. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black muck about 14 inches thick. The next layer is dark brown and very dark brown muck about 13 inches thick. The underlying material to a depth of about 60 inches is black mucky silt loam (coprogenous earth). In some areas the muck is more than 51 or less than 16 inches thick. In other areas it is moderately decomposed.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Dassel and very poorly drained Glencoe soils. Dassel soils are on the rims of the depressions. Glencoe soils formed in loamy mineral material. They are in positions on the landscape similar to those of the Muskego soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the organic part of the Muskego soil and slow in the underlying material. Available water capacity is very high. Organic matter content also is very high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most of the acreage is cropland, pasture, wetland wildlife habitat, or idle land. If drained, this soil is poorly suited to cropland. It is suitable for sod and truck crops. A drainage system is needed. Some areas cannot be easily drained because of their low position on the landscape and the difficulty in locating suitable drainage outlets. Because the soil is in depressions, crops are susceptible to frost late in spring and early in fall. Early maturing crops are better suited than other crops. The soil is subject to soil blowing when it is dry. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Wetness and overgrazing are the main management concerns. A mixture of bromegrass and alfalfa or reed canarygrass can improve forage yields in drained areas. Reed canarygrass forms a tough, dense sod that can support grazing animals and haying equipment even when the soil is partially wet. Careful management is needed to prevent the damage to the surface caused by

overgrazing. The pasture should not be grazed when it is very wet.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation. Undrained areas are generally unsuited to trees and shrubs.

This soil is well suited to the development of wetland wildlife habitat. Suitable wetland habitat can be easily developed, and wetland food and cover crops can grow well.

The land capability classification is IVw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

539—Palms muck. This level, very poorly drained soil is in upland depressions. It is subject to ponding. Individual areas are irregular in shape and range from 5 to about 40 acres in size.

Typically, the surface layer is black muck about 34 inches thick. The underlying material to a depth of about 60 inches is very dark gray and light brownish gray silt loam. In some areas the muck is more than 51 or less than 16 inches thick.

Included with this soil in mapping are small areas of the poorly drained Canisteo and Cordova soils. These soils are in positions on the landscape similar to the Palms soil or are in the slightly higher positions. They make up 5 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the organic part of the Palms soil and moderately slow or moderate in the underlying material. Available water capacity is very high. Organic matter content also is very high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most of the acreage is cropland, pasture, wetland wildlife habitat, or idle land. If drained, this soil is fairly well suited to cropland. It is suitable for sod and truck crops. Corn, soybeans, and small grain are the most common crops. A drainage system is needed. Some areas cannot be easily drained because of their low position on the landscape and the difficulty in locating suitable drainage outlets. Because the soil is in depressions, crops are susceptible to frost late in spring and early in fall. Early maturing crops are better suited than other crops. The soil is subject to soil blowing when it is dry. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Wetness and overgrazing are the main management concerns. A mixture of bromegrass and alfalfa or reed canarygrass can improve forage yields in drained areas. Reed canarygrass forms a tough, dense sod that can support grazing animals and haying equipment even when the soil is partially wet. Careful management is needed to prevent the damage to the surface caused by overgrazing. The pasture should not be grazed when the soil is very wet.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to control competing vegetation. Undrained areas are generally unsuited to trees and shrubs.

This soil is well suited to the development of wetland wildlife habitat. Suitable wetland habitat can be easily developed, and wetland food and cover crops can grow well.

The land capability classification is IIIw in drained areas and VIw in undrained areas. No woodland ordination symbol is assigned.

611C—Hawick sandy loam, 6 to 12 percent slopes. This sloping, excessively drained soil is on convex side slopes in the uplands. Individual areas are elongated and range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is dark brown loamy sand about 5 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and brown gravelly coarse sand. In places the soil has no coarse fragments within 60 inches of the surface.

Included with this soil in mapping are small areas of the moderately well drained Terril soils on concave foot slopes. These soils make up 10 to 15 percent of the unit.

Permeability is rapid or very rapid in the Hawick soil. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture or woodland. This soil is poorly suited to cropland. The main management concerns are the droughtiness and a severe hazard of water erosion. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases

the rate of water intake. The slope limits some kinds of fieldwork. Fertilizer should be applied according to the results of soil tests.

This soil is fairly well suited to pasture and hay. Forage production is fair in the spring. During the summer, however, production is low and supplemental pastures may be needed. Proper stocking rates, pasture rotation, and timely deferment of grazing will help to maintain a good cover of the more desirable grasses and help to control erosion. If planting is necessary to improve stands, the more drought resistant native grasses, such as little bluestem and sideoats grama, are desirable species.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughtiness. Seedling mortality is moderate because of the droughtiness. Some vegetation should be left on the surface during the early years of seedling establishment because the soil is subject to soil blowing. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IVs. No woodland ordination symbol is assigned.

611D—Hawick sandy loam, 12 to 18 percent slopes. This moderately steep, excessively drained soil is on convex side slopes on stream terraces and uplands. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsoil is dark brown loamy coarse sand about 8 inches thick. The underlying material to a depth of about 60 inches is brown and pale brown gravelly coarse sand. In places the soil has no coarse fragments within 60 inches of the surface.

Included with this soil in mapping are a few small areas of the moderately well drained Terril soils on concave foot slopes. These soils make up 10 to 15 percent of the unit.

Permeability is rapid or very rapid in the Hawick soil. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is rapid.

Most of the acreage is pasture or idle land, but some areas are used as cropland or woodland. Because of droughtiness, this soil is generally unsuited to cultivated crops. It is poorly suited to pasture and hay because of the droughtiness and the hazard of water erosion. Forage production is fair in the spring. During the summer, however, production is low and supplemental pastures may be needed. Proper stocking rates, pasture rotation, and timely deferment of grazing help to maintain a good cover of the more desirable grasses and help to control erosion. Pastures that are in poor condition because of overgrazing can be reseeded to the more drought resistant native grasses, such as little bluestem and sideoats grama.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the droughtiness. The effectiveness of windbreaks is reduced because of the slope. Water erosion or soil blowing can be severe unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is VIs. No woodland ordination symbol is assigned.

611F—Hawick sandy loam, 18 to 40 percent slopes. This steep and very steep, excessively drained soil is on side slopes on stream terraces and uplands. Individual areas are elongated and range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsoil is dark brown loamy coarse sand about 4 inches thick. The underlying material to a depth of about 60 inches is yellowish brown gravelly coarse sand. In some areas the soil has no coarse fragments within 60 inches of the surface. In other areas it has a surface layer that is lighter colored and is less than 7 inches thick.

Included with this soil in mapping are small areas of the moderately well drained Terril soils on concave foot slopes. These soils make up 10 to 15 percent of the unit.

Permeability is rapid or very rapid in the Hawick soil. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is rapid.

Most of the acreage is idle land, but some areas are used as pasture. Because of droughtiness and a severe hazard of water erosion, this soil is generally unsuited to cultivated crops and to hay and pasture.

The trees and shrubs grown as windbreaks and environmental plantings on this soil should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the droughtiness. The effectiveness of windbreaks is reduced because of the slope. Soil blowing or water erosion can be severe unless the site is protected by a plant cover and site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is VIIs. No woodland ordination symbol is assigned.

944B—Lester-Estherville complex, 2 to 6 percent slopes. These gently sloping soils are on knolls and side slopes in the uplands. The Lester soil is well drained, and the Estherville soil is well drained or somewhat excessively drained. Individual areas are irregular in shape and range from 5 to 30 acres in size. They are about 50 percent Lester soil and 40 percent Estherville soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark brown loam about 8 inches thick. The subsoil is clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown clay loam.

Typically, the Estherville soil has a surface layer of very dark brown sandy loam about 9 inches thick. The subsoil is dark brown sandy loam about 9 inches thick. The underlying material to a depth of about 60 inches is brown and dark yellowish brown coarse sand.

Included with these soils in mapping are small areas of the poorly drained Hamel, moderately well drained and somewhat poorly drained Le Sueur, and moderately well drained Terril soils. Hamel soils are in swales and drainageways. Le Sueur soils are in the lower positions on the landscape. Terril soils are on foot slopes. Also included are small areas of soils in which coarse textured sediments are underlain by glacial till or loamy sediments and small areas of soils in which glacial till is underlain by coarse textured sediments. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Lester soil. It is moderately rapid in the upper part of the Estherville soil and rapid or very rapid in the lower part. Available water capacity is high in the Lester soil and low in the Estherville soil. Organic matter content is moderate in both soils. Surface runoff is medium on the Lester soil and slow on the Estherville soil.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are well suited to cropland. The main management concerns are droughtiness and water erosion. The droughtiness can reduce yields in periods of low rainfall. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Black walnut, sugar maple, and American basswood are some of the more desirable species for planting. A vegetative cover during periods when the trees and shrubs are becoming established helps to control soil blowing. Cultivation or applications of herbicide help to control competing vegetation.

These soils are well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a hazard if the plant cover is removed.

The land capability classification is IIe. The woodland ordination symbol assigned to the Lester soil is 5A.

944C—Lester-Hawick-Storden complex, 6 to 12 percent slopes. These sloping soils are on knolls and convex side slopes in the uplands (fig. 7). The Lester and Storden soils are well drained, and the Hawick soil is excessively drained. Individual areas are irregular in shape and range from 5 to 120 acres in size. They are about 40 percent Lester soil, 35 percent Hawick soil, and 10 percent Storden soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 37 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam. In places the subsoil is sandy clay loam.

Typically, the Hawick soil has a surface layer of very dark grayish brown sandy loam about 9 inches thick. The subsoil is dark brown loamy sand about 5 inches thick. The underlying material to a depth of about 60 inches is brown and yellowish brown gravelly coarse sand.

Typically, the Storden soil has a surface layer of dark brown loam about 8 inches thick. The underlying

Figure 7.—An area of Lester-Hawick-Storden complex, 6 to 12 percent slopes. The Hawick and Storden soils are in the lighter areas, and the Lester soil is in the darker areas.

material to a depth of about 60 inches is dark yellowish brown and light olive brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel, moderately well drained and somewhat poorly drained Le Sueur, and moderately well drained Terril soils. Hamel soils are in swales and

drainageways. Le Sueur soils are in the less sloping areas. Terril soils are on foot slopes. Also included are small areas of soils in which coarse textured sediments are underlain by glacial till or loamy sediments and areas of soils in which glacial till is underlain by coarse textured sediments. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Lester and Storden soils and rapid or very rapid in the Hawick soil. Available water capacity is high in the Lester and Storden soils and low in the Hawick soil. Organic matter content is moderate in the Lester soil, moderately low in the Storden soil, and moderately low or moderate in the Hawick soil. Surface runoff is medium on all three soils.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are fairly well suited to cropland. The main management concern is controlling water erosion. Another concern is droughtiness, which can reduce yields in some years. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. A high content of lime in the Storden soil can create a nutrient imbalance. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Droughtiness can limit forage production during the summer. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Hawick soil should be those that are tolerant of droughty conditions. The ones grown on the Storden soil should be those that are tolerant of a high content of lime, which can create a nutrient imbalance. Cultivation or applications of herbicide help to remove competing vegetation. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing.

These soils are well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a severe hazard if the ground cover is removed.

The land capability classification is IIIe. The woodland ordination symbol assigned to the Lester soil is 5A.

944D—Lester-Hawick-Storden complex, 12 to 18 percent slopes. These moderately steep soils are on knolls and convex side slopes in the uplands. The Lester and Storden soils are well drained, and the Hawick soil is excessively drained. Individual areas are irregular in shape and range from 5 to 150 acres in size. They are about 40 percent Lester soil, 35 percent Hawick soil, and 10 percent Storden soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of dark brown loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam. In places the subsoil is sandy clay loam.

Typically, the Hawick soil has a surface layer of very dark brown sandy loam about 8 inches thick. The subsoil is dark brown loamy coarse sand about 8 inches thick. The underlying material to a depth of about 60 inches is brown and pale brown gravelly coarse sand.

Typically, the Storden soil has a surface layer of dark brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown and light olive brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel and moderately well drained Terril soils. Hamel soils are in small depressions and drainageways. Terril soils are on foot slopes. Also included are small areas of soils in which coarse textured sediments are underlain by glacial till or loamy sediments and small areas of soils in which glacial till is underlain by coarse textured sediments. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Lester and Storden soils and rapid or very rapid in the Hawick soil. Available water capacity is high in Lester and Storden soils and low in the Hawick soil. Organic matter content is moderate in the Lester soil, moderately low in the Storden soil, and moderate or moderately low in the Hawick soil. Surface runoff is rapid on all three soils.

Most of the acreage is cropland, pasture, or woodland.These soils are poorly suited to cultivated crops because of a severe hazard of water erosion. In some areas terraces or contour farming are effective in controlling erosion, but in other areas the slopes are too short and too irregular for terracing and for farming on

the contour. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and allows for the maximum infiltration of rainfall. Grassed waterways can control runoff and prevent the formation of gullies. Operating farm equipment is difficult on these moderately steep slopes. A high content of lime in the Storden soil can create a nutrient imbalance. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to keep the pasture in good condition and control erosion.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Hawick soil should be those that are tolerant of droughty conditions. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing on this soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime, which can create a nutrient imbalance. The normal effectiveness of windbreaks on these soils is reduced because of the slope. Water erosion is a severe hazard unless vegetation protects the surface. Site preparation should be limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to control competing vegetation.

These soils are well suited to woodland. The hazard of water erosion and the difficulty in operating equipment on these moderately steep slopes are the main management concerns. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover.

The land capability classification is IVe. The woodland ordination symbol assigned to the Lester soil is 5R.

944F—Lester-Hawick-Storden complex, 18 to 40 percent slopes. These steep and very steep soils are on knolls and convex hilltops and side slopes in the uplands. The Lester and Storden soils are well drained, and the Hawick soil is excessively drained. Individual areas are irregular in shape and range from 5 to 200 acres in size. They are about 40 percent Lester soil, 35 percent Hawick soil, and 10 percent Storden soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark brown loam about 6 inches thick. The subsoil is clay loam about 19 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown clay loam. In places the subsoil is sandy clay loam.

Typically, the Hawick soil has a surface layer of very dark brown sandy loam about 8 inches thick. The subsoil is dark brown loamy coarse sand about 4 inches thick. The underlying material to a depth of about 60 inches is yellowish brown gravelly coarse sand.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel and moderately well drained Terril soils. Hamel soils are in drainageways. Terril soils are on foot slopes. Also included are small areas of soils in which coarse textured sediments are underlain by glacial till or loamy sediments and small areas of soils in which glacial till is underlain by coarse textured sediments. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Lester and Storden soils and rapid in the Hawick soil. Available water capacity is high in the Lester and Storden soils and low in the Hawick soil. Organic matter content is moderate in the Lester soil, moderately low in the Storden soil, and moderate or moderately low in the Hawick soil. Surface runoff is rapid on all three soils.

Most areas are wooded. These soils are generally unsuited to cultivated crops and to hay and pasture. Water erosion is a severe hazard in cultivated areas.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Hawick soil should be those that are tolerant of droughty conditions. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing on this soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime. The free carbonates in the Storden soil tie up plant nutrients and limit their availability. The

normal effectiveness of windbreaks on these soils is reduced because of the slope. Water erosion is a severe hazard unless vegetation protects the surface. Site preparation should be limited to the area within 2 feet of where the plant is to be established. Cultivation and applications of herbicide help to control competing vegetation.

These soils are best suited to permanent woodland. A good woodland understory reduces the hazard of erosion. In some areas timber can be harvested. These areas revegetate naturally if the trees to be harvested are carefully selected. In most areas trees cannot be planted by machine because of the slope. Pruning and thinning help to maintain a good stand of trees. Water erosion is a severe hazard if the plant cover is removed. The use of equipment is severely limited because of the slope. Cultivation and applications of herbicide help to control competing vegetation.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Lester soil is 5R.

945B—Lester-Storden loams, 2 to 6 percent slopes. These gently sloping, well drained soils are on knolls and convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 30 acres in size. They are about 60 percent Lester soil and 30 percent Storden soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark brown loam about 8 inches thick. The subsoil is clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel, moderately well drained and somewhat poorly drained Le Sueur, and moderately well drained Terril soils. Hamel soils are in drainageways and swales. Le Sueur soils are in the lower areas. Terril soils are on foot slopes. Also included are small areas of sand and gravel. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Lester and Storden soils. Available water capacity is high. Organic matter content is moderate in the Lester soil and moderately low in the Storden soil. Surface runoff is medium on both soils.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are well suited to cropland. The main management concern is water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. A high content of lime in the Storden soil can create a nutrient imbalance. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control erosion and keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime. The free carbonates in this soil can create a nutrient imbalance. Cultivation or applications of herbicide help to remove competing vegetation.

These soils are fairly well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIe. The woodland ordination symbol assigned to the Lester soil is 5A.

945C—Lester-Storden loams, 6 to 12 percent slopes. These sloping, well drained soils are on knolls and convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 30 acres in size. They are about 60 percent Lester soil and 30 percent Storden soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam.

Typically, the Storden soil has a surface layer of dark

grayish brown loam about 8 inches thick. The next layer is dark yellowish brown loam about 5 inches thick. The underlying material to a depth of about 60 inches is light olive brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel, moderately well drained and somewhat poorly drained Le Sueur, and moderately well drained Terril soils. Hamel soils are in drainageways and swales. Le Sueur soils are in low areas. Terril soils are on foot slopes. Also included are small areas of sand and gravel. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Lester and Storden soils. Available water capacity is high. Organic matter content is moderate in the Lester soil and moderately low in the Storden soil. Surface runoff is medium on both soils.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are fairly well suited to cropland. The main management concern is controlling water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. A high content of lime in the Storden soil can create a nutrient imbalance. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing help to control erosion and keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime, which can cause a nutrient imbalance. Cultivation or applications of herbicide help to remove competing vegetation.

These soils are fairly well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIIe. The woodland ordination symbol assigned to the Lester soil is 5A.

945D—Lester-Storden loams, 12 to 18 percent slopes. These moderately steep, well drained soils are on knolls and convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size. They are about 60 percent Lester soil and 30 percent Storden soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of dark brown loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam.

Typically, the Storden soil has a surface layer of dark brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel and moderately well drained Terril soils. Hamel soils are in small depressions and drainageways. Terril soils are on foot slopes. Also included are small areas of sand and gravel. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Lester and Storden soils. Available water capacity is high. Organic matter content is moderate in the Lester soil and moderately low in the Storden soil. Surface runoff is medium on both soils.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are poorly suited to cultivated crops because of a severe hazard of water erosion. In some areas contour farming or terraces can be effective in controlling erosion, but in other areas the slopes are too short and too irregular for terracing and for farming on the contour. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and allows for the maximum infiltration of rainfall. Grassed waterways can control runoff and prevent the formation of gullies. Operating farm equipment is difficult on these moderately steep slopes. A high content of lime in the Storden soil can create a nutrient imbalance. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and

rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. The normal effectiveness of windbreaks on these soils is reduced because of the slope. Water erosion is a severe hazard unless vegetation protects the surface. Site preparation should be limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing vegetation.

These soils are fairly well suited to woodland. The hazard of water erosion and the difficulty in operating equipment on these moderately steep slopes are the main management concerns. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion can be controlled by maintaining a good ground cover. The use of equipment should be limited because excessive use can destroy the ground cover.

The land capability classification is IVe. The woodland ordination symbol assigned to the Lester soil is 5R.

945F—Lester-Storden loams, 18 to 40 percent slopes. These steep and very steep, well drained soils are on knolls and convex side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 200 acres in size. They are about 50 percent Lester soil and 25 percent Storden soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Lester soil has a surface layer of very dark brown loam about 6 inches thick. The subsoil is clay loam about 19 inches thick. The upper part is dark brown and dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown clay loam. In places the subsoil is sandy clay loam.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and brown loam.

Included with these soils in mapping are small areas of the poorly drained Hamel and moderately well drained Terril soils. Hamel soils are in drainageways. Terril soils are on foot slopes and along drainageways. Also included are small areas of sand and gravel. Included soils make up about 25 percent of the unit.

Permeability is moderate in the Lester and Storden soils. Available water capacity is high. Organic matter content is moderate in the Lester soil and moderately low in the Storden soil. Surface runoff is rapid on both soils.

Most areas are wooded. These soils are generally unsuited to cultivated crops and to hay and pasture. Water erosion is a severe hazard in cultivated areas.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Lester soil. The trees and shrubs grown on the Storden soil should be those that are tolerant of a high content of lime. The normal effectiveness of windbreaks on these soils is reduced because of the slope. Water erosion is a severe hazard unless vegetation protects the surface. Site preparation should be limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing vegetation.

These soils are best suited to permanent woodland. A good woodland understory reduces the hazard of erosion. In some areas timber can be harvested. These areas revegetate naturally if the trees to be harvested are carefully selected. In most areas trees cannot be planted by machine because of the slope. The use of equipment is limited by the slope. Pruning and thinning help to maintain a good stand of trees. Water erosion is a severe hazard if the plant cover is removed. Cultivation and applications of herbicide help to control competing vegetation.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Lester soil is 5R.

978—Cordova-Rolfe complex. These nearly level soils are in the uplands. The poorly drained Cordova soil is on flats and in swales. The very poorly drained Rolfe soil is in small depressions. It is subject to ponding (fig. 8). Individual areas are irregular in shape and range from 5 to 60 acres in size. They are about 65 percent Cordova soil and 25 percent Rolfe soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Cordova soil has a surface layer of black clay loam about 9 inches thick. The subsurface layer is about 9 inches of very dark gray, mottled silty clay loam and clay loam. The subsoil is clay loam about 27 inches thick. The upper part is dark grayish brown and grayish brown and is mottled, and the lower part is olive gray and mottled. The underlying material to a

Figure 8.—An area of the Cordova-Rolfe complex. The Rolfe soil is subject to ponding.

depth of about 60 inches is olive gray, mottled, calcareous clay loam.

Typically, the Rolfe soil has a surface layer of black silt loam about 9 inches thick. The subsurface layer is black silt loam about 3 inches thick. The next layer is dark gray, mottled silt loam about 8 inches thick. The subsoil is about 31 inches thick. The upper part is very dark gray, mottled clay, and the lower part is olive gray, mottled clay loam. The underlying material to a depth of about 60 inches is gray, mottled loam.

Included with these soils in mapping are small areas of the poorly drained Canisteo, very poorly drained Glencoe, and moderately well drained and somewhat poorly drained Le Sueur soils. Canisteo soils are on the rims of depressions. Glencoe soils are in landscape positions similar to those of the Rolfe soil. Le Sueur soils are in the higher positions. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Cordova soil and slow in the Rolfe soil. Available water capacity is high in both soils. Organic matter content also is high. Surface runoff is slow on the Cordova soil and very slow or ponded on the Rolfe soil. The seasonal high water table is within a depth of 1 to 3 feet in the Cordova soil and is 1 foot above to 1 foot below the surface of the Rolfe soil.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are fairly well suited to cropland. Wetness is the main management concern. A drainage system is needed. It allows the soils to be worked earlier in the spring. Working the soils when they are wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Wetness and overgrazing are the main management concerns. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition

because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

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

The Cordova soil is fairly well suited to woodland. Wetness is the main management concern. The use of equipment on this soft, wet soil is limited to periods when the ground is frozen. Wetness during the tree-planting season limits reforestation. A high rate of seedling mortality, which is caused by the seasonal wetness, can be reduced by planting the older, larger nursery stock and by increasing plant density. Plant competition around new seedlings is a management concern. Seedlings grow well if competing vegetation is controlled or removed by herbicides or by other means.

The land capability classification is IIIw. The woodland ordination symbol assigned to the Cordova soil is 5W.

1013—Pits, quarry. This map unit occurs as areas that have been mined for limestone or sandstone bedrock (fig. 9). It consists of excavations and piles of unconsolidated material, including bedrock fragments. Water fills the deeper parts of some quarries. Such features as relief, slope, drainage, and texture vary greatly. Individual areas are irregular in shape and range from 3 to more than 200 acres in size.

If the topsoil is carefully stockpiled prior to quarrying, some parts of the quarries can be reclaimed. The results of reclamation vary, depending on such factors as the nature of the original soil, drainage, slope, depth of the replaced soil, and land use in the reclaimed area.

No land capability classification or woodland ordination symbol is assigned.

1030—Udorthents-Pits, gravel, complex. This map unit consists of areas that formerly were or currently are mined for sand or gravel. It includes excavations, stockpiles of sand and gravel, and areas filled with waste soil material. Some of the pits contain water. Individual areas are irregular in shape and range from 3 to 500 acres in size.

Areas of this unit can be reclaimed and used for a variety of purposes. Reclamation generally includes extensive filling and grading. If the loamy topsoil is carefully stockpiled, some areas can be reclaimed for agricultural uses. Some can be used for commercial, industrial, or residential development. Areas that include ponds can be used for wildlife habitat or recreational purposes if vegetation is established. Onsite investigation is needed to determine the suitability for any proposed use and the limitations affecting that use.

No land capability classification or woodland ordination symbol is assigned.

1057—Caron, Blue Earth, and Palms soils, ponded. These level, very poorly drained soils are in depressions bordering lakes and rivers on till plains. Individual areas are irregular in shape and range from 10 to 200 acres in size. Some mapped areas are made up of only one of these soils, and some are made up of two or all three of the soils.

Typically, the Caron soil has a surface layer of very dark brown mucky peat about 13 inches thick. The next layer is very dark brown mucky peat about 18 inches thick. The underlying material to a depth of about 60 inches is very dark gray mucky silt loam (coprogenous earth). In some areas the organic material is more than 51 or less than 16 inches thick.

Typically, the Blue Earth soil has a surface layer of black mucky silt loam (coprogenous earth) about 10 inches thick. The underlying material to a depth of about 60 inches is very dark gray and dark olive gray, mottled mucky silt loam (coprogenous earth).

Typically, the Palms soil has a surface layer of black muck about 34 inches thick. The underlying material to a depth of about 60 inches is very dark gray and light brownish gray, mottled silt loam. In some areas the muck is more than 51 or less than 16 inches thick.

Included with these soils in mapping are small areas of the poorly drained and very poorly drained Dassel and very poorly drained Glencoe soils. These included soils are in the slightly higher landscape positions. Glencoe soils formed in loamy mineral material. Inclusions make up about 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Caron and Palms soils and moderately slow in the lower part. It is moderate or moderately slow in the Blue Earth soil. Available water capacity is very high in all three soils. Organic matter content also is very high. Surface runoff is ponded on the Caron soil and very slow or ponded on the Blue Earth and Palms soils. The seasonal high water table is 1 foot above to 1 foot below the surface of all three soils.

Figure 9.—A limestone quarry.

Because of the ponding and the lack of suitable drainage outlets, most areas of these soils are generally unsuitable as cropland or pasture. They are well suited to wetland wildlife habitat. Feeding, nesting, and escape areas are available for waterfowl, furbearers, and upland game. The habitat commonly can be improved by controlling the water level, by increasing the number of nesting and courting areas for waterfowl, and by fencing out livestock.

The land capability classification is VIIIw. No woodland ordination symbol is assigned.

1855B—Dickinson sandy loam, loamy substratum, 2 to 6 percent slopes. This gently sloping, well drained soil is on knolls and convex side slopes on outwash plains and on stream terraces and uplands. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsurface layer is dark brown sandy loam about 4 inches thick. The subsoil is about 21 inches thick. It is dark brown sandy loam in the upper part and dark yellowish brown loamy fine

sand in the lower part. The upper part of the underlying material is dark yellowish brown loamy sand. The lower part to a depth of about 60 inches is dark yellowish brown loam. In some areas the depth to the loamy underlying material is more than 60 or less than 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Cylinder and well drained Dickman soils. These soils are in landscape positions similar to those of the Dickinson soil. Dickman soils have more sand than the Dickinson soil. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil, rapid in the next part, and moderate in the lower part. Available water capacity is moderate or low. Organic matter content is moderately low. Surface runoff is medium.

Most areas are used as cropland, but some are used as pasture. This soil is well suited to cropland. Corn, soybeans, and small grain are the most common crops. Water erosion and droughtiness are the main management concerns. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and allows for the maximum infiltration of rainfall. Some areas are suitable for farming on the contour. In some years yields are reduced because the amount of water available to plants is limited. Lime and fertilizer should be applied according to the results of soil tests.

This soil is well suited to pasture and hay. Droughtiness can reduce forage production during periods of low rainfall. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Growth rates are reduced in years when the amount of water available to plants is limited. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIe. No woodland ordination symbol is assigned.

1901B—Le Sueur-Lester complex, 1 to 6 percent slopes. These gently sloping soils are on knolls and convex side slopes in the uplands. The Le Sueur soil is moderately well drained or somewhat poorly drained, and the Lester soil is well drained. Individual areas are irregular in shape and range from 5 to 80 acres in size. They are about 60 percent Le Sueur soil and 30 percent Lester soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Le Sueur soil has a surface layer of black clay loam about 9 inches thick. The subsurface layer is very dark brown clay loam about 7 inches thick. The subsoil is dark grayish brown, mottled clay loam about 29 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled loam.

Typically, the Lester soil has a surface layer of very dark brown loam about 8 inches thick. The subsoil is clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is olive brown. The underlying material to a depth of about 60 inches is light olive brown loam.

Included with these soils in mapping are small areas of the poorly drained Cordova and Hamel soils. These included soils are in the lower positions on the landscape. They make up about 10 percent of the unit.

Permeability is moderate in the Le Sueur and Lester soils. Available water capacity is high. Organic matter content is moderate. Surface runoff is slow on the Le Sueur soil and medium on the Lester soil. The seasonal high water table is within a depth of 2 to 4 feet in the Le Sueur soil.

Most areas are used as cropland, but some are used as pasture or woodland. Corn, soybeans, and small grain are the most common crops. These soils are well suited to cropland. The main management concern is controlling water erosion. Leaving crop residue on the surface helps to control erosion and increases the rate of water intake. Some areas are suitable for farming on the contour or terracing. The wetness of the Le Sueur soil can delay fieldwork in the spring unless a drainage system is installed. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates and rotation or deferred grazing can help to keep the pasture in good condition.

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 control competing vegetation.

These soils are well suited to woodland. Black walnut is a desirable species for planting. Cultivation and applications of herbicide help to control competing vegetation. Pruning and thinning help to establish and maintain a good stand of trees. Water erosion is a slight hazard if the ground cover is removed.

The land capability classification is IIe. The woodland ordination symbol is 5A.

1962—Mazaska-Rolfe complex. These nearly level soils are on moraines and uplands. The poorly drained Mazaska soil is on flats and in swales. The very poorly drained Rolfe soil is in small depressions. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 60 acres in size. They are about 65 percent Mazaska soil and 25 percent Rolfe soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Mazaska soil has a surface layer of black silty clay loam about 8 inches thick. The subsurface layer is black clay loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is very dark gray and very dark grayish brown, mottled clay loam and clay, and the lower part is dark grayish brown, mottled silty clay loam. The underlying material to a depth of about 60 inches is olive, mottled silty clay loam and clay loam.

Typically, the Rolfe soil has a surface layer of black silt loam about 9 inches thick. The subsurface layer is black silt loam about 3 inches thick. The next layer is dark gray, mottled silt loam about 8 inches thick. The subsoil is about 31 inches thick. The upper part is very dark gray, mottled clay, and the lower part is olive gray, mottled clay loam. The underlying material to a depth of about 60 inches is gray, mottled loam.

Included with these soils in mapping are small areas of the somewhat poorly drained Lerdal and Shields soils on the higher parts of the landscape. These included soils make up about 10 percent of the unit.

Permeability is slow in the Mazaska and Rolfe soils. Available water capacity is high. Organic matter content also is high. Surface runoff is slow on the Mazaska soil and very slow or ponded on the Rolfe soil. The seasonal high water table is within a depth of 1 to 2 feet in the Mazaska soil and is 1 foot above to 1 foot below the surface of the Rolfe soil.

Most areas are used as cropland, but some are used as pasture or woodland. These soils are fairly well suited to cropland. Wetness is the main management concern. A drainage system is needed. It allows the soils to be worked earlier in the spring. Working the soils when they are wet results in compaction and deterioration of tilth. Crop residue management keeps soil losses to a minimum and allows for the maximum infiltration of rainfall. Lime and fertilizer should be applied according to the results of soil tests.

These soils are well suited to pasture and hay. Wetness is the main management concern. A drainage system can improve forage yields and trafficability. Pastures that are in poor condition because of overgrazing can be reseeded with mixtures of suitable grasses and legumes, such as bromegrass and alfalfa or birdsfoot trefoil. Applying lime and fertilizer according to the results of soil tests helps to establish and maintain a good stand of grasses and legumes. Proper stocking rates, restricted use during wet periods, and rotation or deferred grazing can help to keep the pasture in good condition.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness. Planting may be delayed in the spring. Cultivation or applications of herbicide help to control competing vegetation.

The land capability classification is IIIw. No woodland ordination symbol is assigned.

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 and 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 inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime

farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 178,000 acres in the survey area, or more than 63 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county. Most of the prime farmland is used for crops, mainly corn and soybeans.

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

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

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

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid 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 behavior 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 woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops 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 "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service, the Le Sueur Soil and Water Conservation District, or the Cooperative Extension Service.

Most of the cropland in Le Sueur County is used for crops, mainly corn; soybeans; small grain, such as wheat and oats; and hay. In 1983, more than 230,000 acres in the county was used as cropland or pasture. Of this, 185,000 acres was used for row crops, mainly corn and soybeans; 30,800 acres for close-growing crops, mainly wheat and oats; 14,200 acres for hay; and 11,000 acres for permanent pasture. The rest was woodland or wetland.

Some basic management is needed for nearly all of the soils used for crops and pasture. The following paragraphs specify the practices needed for controlling water erosion and soil blowing, improving drainage or overcoming droughtiness, and maintaining fertility and tilth. Technical assistance in planning and applying practices suitable for the soils on a particular farm can be obtained from the Le Sueur Soil and Water Conservation District.

Water erosion is an important management concern on many of the soils suitable for cropland in Le Sueur County. Even undisturbed soils, soils in their natural state, are subject to erosion. The rate at which any soil erodes depends on many factors, including the gradient and length of slopes, soil texture, type and amount of vegetative cover, and climate. Over time, soil moves from high landscape positions to lower ones. As a result, soils on shoulder slopes and back slopes, such as Lester and Kilkenny soils, generally have a thinner surface layer than soils on foot slopes and toe slopes,

such as Hamel and Terril soils. Erosion is greatly accelerated if the protective vegetative cover is removed and then poor management practices, such as operating machinery up and down the slopes, are applied. The rapid loss of topsoil is damaging for a number of reasons. Productivity is lost when nutrients and organic matter are removed. Replacing these elements is costly but is necessary to maintain yields. The loss of organic matter and incorporation of subsoil material into the tillage zone result in poor tilth and reduced infiltration of moisture and exchange of air within the soil.

In some areas eroded soils are specifically identified by map unit names, such as Lester clay loam, 2 to 6 percent slopes, eroded. Some erosion also occurs within map units not identified as eroded. For example, Lester loam, 6 to 12 percent slopes, is not designated as eroded because the area of erosion within this unit is too small to show on the maps.

Water erosion is a major problem on the sloping soils, particularly those in Elysian, Kilkenny, Montgomery, and Waterville Townships. To control water erosion, it is necessary to reduce the runoff rate and increase the rate of water infiltration. Some practices which help to control water erosion are terraces, stripcropping, contour farming, grassed waterways, conservation tillage, and crop residue management. Including legumes and grasses in the cropping sequence also reduces the hazard of erosion and increases the amount of nitrogen in the soil for the following crop. A combination of these practices commonly is needed.

Soil blowing occurs throughout the county but is most severe on Dickinson and Fairhaven soils in Ottawa and Sharon Townships and in drained and cultivated areas of Palms, Muskego, and Caron soils. Conservation tillage, field windbreaks, and winter cover crops help to control soil blowing.

Droughtiness is a limitation in some soils, including Dickinson, Dickman, Estherville, and Sparta soils. Conservation tillage, stripcropping, timely tillage, applications of fertilizer, and a cropping system that includes grasses and legumes reduce the rates of evaporation and runoff and increase the fertility of these soils. In some areas irrigation systems are used to compensate for the droughtiness.

Soil wetness is a major limitation on a large percentage of the soils in the county. Some soils are naturally so wet that the production of the crops commonly grown in the county is not possible without artificial drainage. An extensive system of surface ditches that includes county, judicial, and private ditches improves drainage. A drainage system also is needed to control seepage along drainageways on hillsides. Removal of excess water improves root development and allows the soil to warm up earlier in the spring. Improved drainage is beneficial on poorly drained and very poorly drained soils, such as Cordova, Glencoe, Hamel, and Mazaska soils.

Seasonal flooding is a hazard on some soils, such as Chaska and Minneiska soils. It is difficult to find adequate outlets for tile drainage systems on these soils because of fluctuations in the water level of the Minnesota River.

Information about the design of drainage systems for each soil is available in the Technical Guide, which is available at the office of the Le Sueur Soil and Water Conservation District.

Soil fertility is naturally medium or high in most of the soils in the county. It is low, however, in some of the sandy soils. Crops on most of the soils in the county respond well to applications of fertilizer. The kinds and amounts of fertilizer needed depend on the kind of soil, past and present management, and the kind of crop that is grown. Fertilizer should be applied according to the results of soil tests.

Some soils require applications of lime to correct acidity. Specifications for liming depend on the natural acidity of the soil, previous management, and the planned cropping system. The need for and response to lime vary considerably. Applications of lime should be made according to the results of soil tests. Correcting the acidity in the surface layer helps to make plant nutrients available to crops. It also improves the response to the inoculation of legumes.

Tilth is an important factor affecting the preparation of a desirable seedbed. Soils that have good structure and tilth are granular and porous. Regular applications of crop residue, manure, and other organic material improve soil structure. Cultivating moderately fine textured and fine textured soils when they are wet damages soil structure, results in cloddiness, and makes seedbed preparation difficult. Primary tillage should be done in the fall on these soils because freezing and thawing break up the clods. A system of chisel plowing, disking, or ridge tillage that leaves at least 50 percent of the crop residue on the surface is desirable. Plowing does not leave enough crop residue on the surface to protect the soil from soil blowing and water erosion.

A secondary spring tillage system in which at least 30 percent of the surface is covered by crop residue after planting is beneficial. Soils that are excessively tilled are very susceptible to erosion and frequently seal

over after a rain. Excessive tillage also buries the crop residue and destroys soil structure.

The *pasture* in the county is generally on the steeper hillsides. Overgrazing and high stocking rates result in poor pasture stands and increase the hazard of erosion. Timely deferment of grazing, reduced stocking rates, and pasture rotation are needed to overcome most of the limitations in pastured areas. Applications of fertilizer can improve the productivity of many pastures.

Yields Per Acre

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

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

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

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

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

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

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

In class I there are no subclasses because the soils

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

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

Woodland Management and Productivity

Le Sueur County is within the northern deciduous forest region. Originally, almost all of the county was forested. The current forested areas support primarily sugar maple, black walnut, American elm, American basswood, red oak, and white ash. The forests on the flood plains along the Minnesota River support eastern cottonwood, black ash, green ash, American elm, and willow.

Most of the woodland in the county occurs as small woodlots or is on steep slopes adjacent to the major rivers and streams. The woodlots make up about 6 percent of the county. The tree species are similar to the original forest types, but wood production is limited. Many areas are used for homesites or recreation, and some are grazed. Eastern hophornbeam and boxelder have taken over many sites where oak and elm were predominant in the past. On many of these sites, timber stand improvement is needed. The major wood products in the county are firewood, veneer, and lumber.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe*

indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the most important species for woodland production on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks have been planted since the days of the early settlers to protect farmsteads and livestock. In the 1930's, they were planted to control soil blowing. In recent years field windbreaks have been planted to trap snow and thus increase the moisture supply. Maximum growth and survival rates can be obtained by controlling weeds around new seedlings.

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 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The landscape characteristics of Le Sueur County offer many opportunities for recreational development. The numerous lakes in the county are used for boating, fishing, and swimming. Public access areas are available on most of the larger lakes. Campsites and picnic areas also are available along many of these lakes. The Minnesota River provides fishing and boating opportunities in addition to the picturesque scenery within the river valley. Boat and canoe landings are located in several areas along the river. Other rivers and streams provide opportunities for fishing and other recreational activities.

The rolling landscape and wooded hills in many parts of the county provide beautiful scenery and spectacular fall color displays. Richter Woods County Park preserves a remnant of the "Big Woods," a large expanse of deciduous hardwood forest which covered the county before settlement. This park also offers nature trails through different plant communities. Winter recreational opportunities are available for snowmobiling, cross-county skiing, and fishing.

The soils of the survey area are rated in table 9 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 recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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 have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

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

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

Wildlife Habitat

Le Sueur County has a wide range of wildlife habitats, including cropland, woodland, lakes, wetlands, pastures, and grassy areas. A diverse habitat increases the kinds and numbers of wildlife. Some of the species that inhabit the county include pheasants; white-tailed deer; cottontail rabbit; red-tailed hawk; red, gray, and fox squirrels; pileated woodpecker; great blue heron; and a large variety of songbirds, waterfowl, shore birds, and small mammals.

Cropland management greatly affects wildlife. Conservation practices can provide wildlife with the habitat necessary for survival. Seeding highly eroded areas and establishing grassed waterways provide grass for nesting cover. Planting field windbreaks slows erosive winds and provides nesting sites and travel lanes for wildlife. Cropping practices that leave crop residue on the surface provide grain for birds and animals during winter.

Proper management of the scattered woodlots throughout the county not only provides a sustained yield of trees but also improves the habitat for wildlife. Wide, dense farmstead shelterbelts also provide woody cover for various wildlife species. Trees and shrubs provide food, cover, and den and nest sites.

The large number of lakes in Le Sueur County provide excellent opportunities for fishing (fig. 10). Some of the lakes include Washington, German, Jefferson, Francis, Tetonka, and Sakatah Lakes and other lakes in the Cannon River chain. The fish commonly caught include northern pike, walleye, bass, panfish, and rough fish. These lakes and the smaller lakes provide resting areas for migrating waterfowl and

Figure 10.—One of the many small lakes in Le Sueur County.

nesting sites for some other species. Marshes and other wetland areas provide nesting cover and food for many birds and animals.

Properly managed areas of pasture and grass can provide good wildlife habitat. Many species of birds, such as pheasants and ducks, nest in grass. Delaying mowing of road ditches and other grassy areas until after mid-July increases the likelihood that young birds will survive.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bluegrass, 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 flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, little bluestem, switchgrass, indiangrass, sideoats grama, and blue grama.

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, walnut, apple, hawthorn, dogwood, hickory, blackberry, and gooseberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, chokecherry, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl-feeding areas, 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. The 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 woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: 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 need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind 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 (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) 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 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil),

shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, 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 12 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 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of 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, bedrock, and cemented pans 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 needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type 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 type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 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 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 the depth to the water table is less than 1 foot. These soils 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. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable

source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal 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 14 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 and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. 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 and depth to bedrock or to a cemented pan. 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 reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

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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 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.

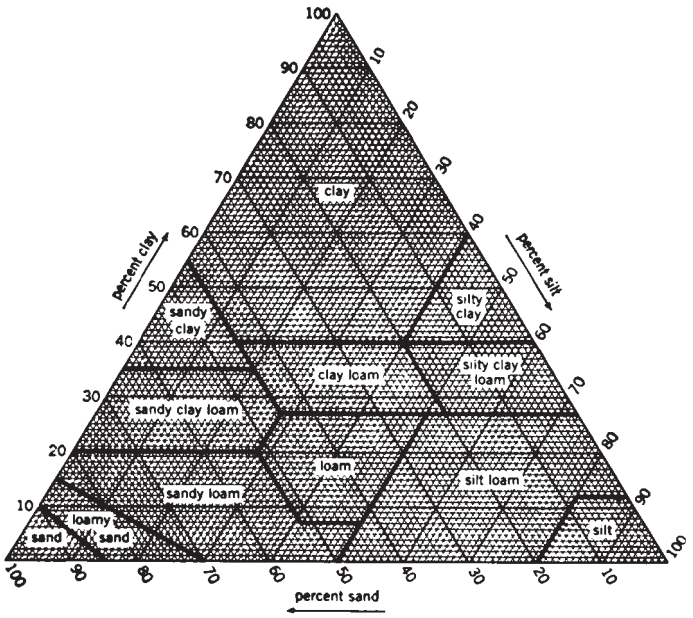

Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 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 "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. 11). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and 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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

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 change is based on the soil fraction less than 2 millimeters in diameter. 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. Sands, coarse 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 sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse 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, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, 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. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, 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 17 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 17, 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 17 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; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

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 absence of distinctive horizons that form in soils that are not subject to flooding.

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 depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

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.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the total subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

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 creates a severe corrosion environment. 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 *(5)*. 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 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten 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 Alfisol.

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 Udalf (*Ud*, meaning Humid, plus *alf*, from Alfisol).

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 Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

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

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, mesic Mollic Hapludalfs.

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 (4)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (5)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Biscay Series

The Biscay series consists of poorly drained soils on stream terraces. These soils formed in medium textured and moderately fine textured alluvium over coarse

textured sediments. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Biscay loam, 2,350 feet south and 300 feet east of the northwest corner of sec. 1, T. 112 N., R. 23 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.
A—9 to 14 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
AB—14 to 22 inches; very dark grayish brown (2.5Y 3/2) clay loam; weak medium subangular blocky structure; friable; neutral; gradual wavy boundary.
Bg—22 to 35 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) loam; few fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; about 4 percent coarse fragments; neutral; gradual smooth boundary.
2C—35 to 60 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) gravelly loamy coarse sand; few fine distinct yellowish brown (10YR 5/8) mottles; massive; loose; about 30 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to sand and gravel range from 20 to 40 inches. The mollic epipedon ranges from 16 to 24 inches in thickness. The solum is typically free of coarse fragments, but in some pedons the content of these fragments is as much as 35 percent in the lower part of the solum.

The A horizon has hue of 10YR or 2.5Y and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is loam, clay loam, sandy clay loam, or silty clay loam.

The B horizon has hue of 2.5Y or 5Y and chroma of 1 to 3. It is loam, sandy clay loam, or clay loam. Some pedons have a thin 2B horizon of gravelly sandy loam or gravelly loam.

The 2C horizon has hue of 2.5Y or 5Y and chroma of 1 or 2. It is loamy coarse sand or loamy sand in which the content of gravel ranges from 5 to 50 percent.

Blue Earth Series

The Blue Earth series consists of very poorly drained, moderately permeable soils in drained lakebeds on till plains. These soils formed in coprogenous earth. Slopes are 0 to 1 percent.

Typical pedon of Blue Earth mucky silt loam, 200 feet east and 200 feet south of the northwest corner of sec. 8, T. 110 N., R. 25 W.

Ap—0 to 10 inches; black (10YR 2/1) mucky silt loam (coprogenous earth), very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few snail shells and fragments of snail shells; strong effervescence; moderately alkaline; abrupt smooth boundary.
Cg1—10 to 17 inches; very dark gray (10YR 3/1) mucky silt loam (coprogenous earth), dark gray (10YR 4/1) dry; common fine distinct strong brown (7.5YR 5/6) mottles; weak thin platy structure; friable; many snail shells and fragments of snail shells; strong effervescence; moderately alkaline; clear smooth boundary.
Cg2—17 to 25 inches; dark olive gray (5Y 3/2) mucky silt loam (coprogenous earth), dark gray (5Y 4/1) dry; common fine distinct dark brown (7.5YR 4/4) mottles; massive; friable; many snail shells and fragments of snail shells; violent effervescence; moderately alkaline; clear wavy boundary.
Cg3—25 to 60 inches; very dark gray (5Y 3/1) mucky silt loam (coprogenous earth), dark gray (5Y 4/1) dry; massive; friable; few snail shells and fragments of snail shells; strong effervescence; moderately alkaline.

The thickness of the coprogenous earth ranges from 30 to more than 80 inches. Free carbonates are in all parts of these sediments. The content of snail shells and snail shell fragments averages less than 15 percent in the solum. A layer of sapric material as much as 5 inches thick is at the surface in some pedons.

The coprogenous earth has hue of 10YR, 2.5Y, or 5Y, value of 2 to 4, and chroma of 1 or 2. It has distinct or prominent mottles in most or all parts. It is silt loam, silty clay loam, or the mucky analog of these textures.

Canisteo Series

The Canisteo series consists of poorly drained, moderately permeable soils on moraines. These soils formed in medium textured and moderately fine textured, calcareous glacial till. Slopes are 0 to 2 percent.

Typical pedon of Canisteo clay loam, 1,700 feet west and 2,050 feet south of the northeast corner of sec. 5, T. 110 N., R. 24 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark

gray (10YR 3/1) dry; weak fine granular structure; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

AB—9 to 19 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; slight effervescence; moderately alkaline; clear smooth boundary.

Bg1—19 to 24 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct dark gray (5Y 4/1) mottles; weak medium subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; moderately alkaline; clear smooth boundary.

Bg2—24 to 35 inches; olive gray (5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/6) and olive (5Y 5/4) mottles; weak medium subangular blocky structure; friable; about 2 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cg—35 to 60 inches; olive gray (5Y 5/2) loam; common coarse distinct yellowish brown (10YR 5/8) mottles; massive; about 4 percent coarse fragments; friable; strong effervescence; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. It is clay loam, loam, silty clay loam, or silt loam. The mollic epipedon ranges from 14 to 24 inches in thickness. The content of coarse fragments generally ranges from 2 to 8 percent in the solum, but the upper part of some pedons has no coarse fragments.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4. It is clay loam or loam.

Caron Series

The Caron series consists of very poorly drained soils on moraines. These soils formed in a layer of moderately decomposed herbaceous material and in the underlying coprogenous earth. Permeability is moderately rapid or rapid in the upper part of the profile and moderately slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Caron muck, 1,900 feet west and 600 feet north of the southeast corner of sec. 14, T. 109 N., R. 26 W.

Oa—0 to 13 inches; sapric material, very dark brown (10YR 2/2) rubbed and unrubbed; about 25 percent primarily herbaceous fibers, 15 percent rubbed; weak thin platy structure; very friable; slightly acid; clear smooth boundary.

Oe—13 to 31 inches; hemic material, very dark brown (10YR 2/2) rubbed and unrubbed; about 50 percent primarily herbaceous fibers, 25 percent rubbed; weak medium platy structure; very friable; slightly acid; clear smooth boundary.

C—31 to 60 inches; very dark gray (10YR 3/1) mucky silt loam (coprogenous earth); massive; very friable; violent effervescence; mildly alkaline.

The depth to coprogenous earth ranges from 16 to 51 inches. Hemic soil material is dominant in the organic part of the control section. It has hue of 5YR to 10YR, value of 2 to 4, and chroma of 2 or 3 before rubbing. After rubbing, it has similar colors or has value, chroma, or both of 1 unit lower. The coprogenous earth has hue of 10YR to 5Y, value of 2 to 4, and chroma of 1 or 2. It has snail shells in some pedons. The content of plant detritus ranges from a trace to as much as 40 percent.

Chaska Series

The Chaska series consists of somewhat poorly drained and poorly drained, moderately permeable soils on flood plains. These soils formed in medium textured and moderately fine textured, calcareous alluvium. Slopes are 0 to 2 percent.

Typical pedon of Chaska silt loam, 2,100 feet south and 100 feet east of the northwest corner of sec. 7, T. 109 N., R. 26 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fine fragments of snail shells; strong effervescence; mildly alkaline; clear smooth boundary.

C1—8 to 38 inches; dark grayish brown (2.5Y 4/2), stratified loam and silt loam; massive; friable; few fine distinct dark brown (10YR 4/3) and few fine distinct olive gray (5Y 4/2) mottles; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—38 to 60 inches; dark gray (10YR 4/1), stratified loam and silt loam; massive; few fine distinct dark brown (7.5YR 4/4) mottles; friable; strong effervescence; mildly alkaline.

Some pedons have no free carbonates in the upper 10 inches. The upper 40 inches has no coarse fragments.

The A horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. It is loam, silt loam, silty clay loam, or clay loam.

The C horizon generally has hue of 10YR or 2.5Y, value of 2 to 5, and chroma of 1 or 2, but in some pedons it has hue of 5Y in the lower part. This horizon typically is stratified loam and silt loam, but in some pedons it has strata of fine sand, loamy fine sand, silty clay loam, sandy clay loam, or clay loam.

Copaston Series

The Copaston series consists of well drained soils on stream terraces. These soils formed in a thin mantle of medium textured glacial drift overlying limestone bedrock. Permeability is moderate or moderately rapid. Slopes range from 1 to 6 percent.

Typical pedon of Copaston loam, 1 to 6 percent slopes, 1,500 feet west and 1,000 feet south of the northeast corner of sec. 6, T. 109 N., R. 26 W.

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

Bw—10 to 16 inches; dark brown (7.5YR 3/2) gravelly loam; dark brown (7.5YR 4/2) dry; weak fine subangular blocky structure; friable; about 20 percent coarse fragments near bottom of horizon; neutral; clear smooth boundary.

R—16 inches; limestone bedrock.

The thickness of the solum and the depth to bedrock range from 12 to 20 inches. The content of coarse fragments generally ranges from 0 to 20 percent in the solum and is more than 20 percent in the lower 2 inches of the B horizon. Limestone fragments are on the surface of some pedons. Discontinuous residuum is at the lithic contact in some pedons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is sandy loam, fine sandy loam, loam, or silt loam. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. It is sandy loam, fine sandy loam, or loam.

Cordova Series

The Cordova series consists of poorly drained, moderately slowly permeable soils in the uplands. These soils formed in medium textured and moderately fine textured glacial till. Slopes are 0 to 2 percent.

Typical pedon of Cordova clay loam, 1,650 feet west and 500 feet south of the northeast corner of sec. 5, T. 110 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; about 1 percent coarse fragments; neutral; abrupt smooth boundary.

A—9 to 15 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark brown (7.5YR 4/4) and olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; friable; few distinct coatings of clean sand and silt particles on faces of peds; about 1 percent coarse fragments; neutral; clear smooth boundary.

BA—15 to 18 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine faint dark gray (10YR 4/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine faint very dark grayish brown (2.5Y 3/2) clay films on faces of peds in the lower part; about 1 percent coarse fragments; slightly acid; clear wavy boundary.

Btg1—18 to 29 inches; dark grayish brown (10YR 4/2) clay loam; common fine prominent dark gray (5Y 4/1) mottles; moderate medium prismatic structure parting to strong fine and medium angular blocky; very firm; common prominent very dark grayish brown (2.5Y 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear wavy boundary.

Btg2—29 to 37 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent olive brown (2.5Y 4/4) and yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to moderate medium angular blocky; very firm; common moderately thick very dark grayish brown (2.5Y 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear wavy boundary.

Btg3—37 to 45 inches; olive gray (5Y 4/2) clay loam; common fine and medium prominent olive brown (2.5Y 4/4) and yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few distinct dark brown (7.5YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear wavy boundary.

Cg—45 to 60 inches; olive gray (5Y 5/2) clay loam; common fine and medium prominent olive brown (2.5Y 4/4) and yellowish brown (10YR 5/8) mottles; massive; friable; few distinct dark brown (7.5YR 3/2) clay films in root channels; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free

carbonates range from 24 to 50 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches. The content of coarse fragments generally ranges from 1 to 6 percent in the solum.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. It is loam, silty clay loam, or clay loam.

The B horizon has chroma of 1 or 2. It generally is silty clay loam or clay loam, but the lower part is loam in some pedons.

The C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam or clay loam.

Cylinder Series

The Cylinder series consists of somewhat poorly drained soils in the uplands. These soils formed in friable, medium textured and moderately fine textured sediments over coarse textured sediments. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slopes are 1 to 4 percent.

Typical pedon of Cylinder loam, 1 to 4 percent slopes, 2,500 feet south and 400 feet east of the northwest corner of sec. 36, T. 110 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—9 to 12 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

AB—12 to 16 inches; very dark grayish brown (10YR 3/2) clay loam; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

Bw—16 to 30 inches; dark grayish brown (10YR 4/2) clay loam; few fine faint olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; friable; about 5 percent coarse fragments; medium acid; abrupt wavy boundary.

BC—30 to 35 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium subangular blocky structure; friable; about 5 percent coarse fragments; slightly acid; abrupt wavy boundary.

2C—35 to 60 inches; olive gray (5Y 4/2) and gray (5Y 5/1), stratified fine sand and loamy fine sand; few fine prominent brown (7.5YR 4/4) mottles; massive; about 1 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 48 inches. The mollic epipedon ranges from 10 to 18 inches in thickness. The content of coarse fragments generally ranges from 1 to 8 percent throughout the profile.

The A horizon has value of 2 or 3. It is sandy loam, loam, or clay loam. The B horizon has value of 3 to 5 and chroma of 2 to 4. It generally is loam or clay loam, but some pedons have strata of sandy loam or coarser textures. The 2C horizon has hue of 5Y or 2.5Y and chroma of 1 to 4. It is sand, fine sand, loamy fine sand, or loamy sand.

Dassel Series

The Dassel series consists of poorly drained and very poorly drained, moderately rapidly permeable soils on beaches of present and former lakes. These soils formed in coarse textured sediments. Slopes are 0 to 1 percent.

Typical pedon of Dassel loam, 900 feet east and 1,200 feet north of the southwest corner of sec. 22, T. 110 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

A—9 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

AB—12 to 15 inches; very dark grayish brown (10YR 3/2) sandy loam, dark gray (10YR 4/1) and gray (10YR 5/1) dry; few fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

Bg—15 to 20 inches; dark grayish brown (2.5Y 4/2), stratified loamy sand, fine sand, and very fine sandy loam; few fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

Cg1— 20 to 48 inches; olive gray (5Y 4/2), stratified sandy loam, fine sandy loam, and sand; few fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Cg2—48 to 60 inches; dark gray (5Y 4/1), stratified loamy sand, sandy loam, and silt loam; few fine prominent yellowish brown (10YR 5/6) and strong

brown (7.5YR 5/6) mottles; massive; friable; violent effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 7 to 24 inches. Coarse fragments of mixed lithology make up 0 to 10 percent of the volume throughout the profile. The thickness of the solum and the depth to free carbonates range from 20 to 35 inches. Some pedons have an O horizon, which is as much as 6 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. It is loam, fine sandy loam, or sandy loam.

The B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It generally has strata of sandy loam or loamy sand, but the strata can be coarser textured, finer textured, or both.

The C horizon has hue of 2.5Y, 5Y, or 5B, value of 3 to 6, and chroma of 1 or 2. It is typically stratified loamy sand, sand, or sandy loam, but the range includes coarser or finer textured sediments.

Dickinson Series

The Dickinson series consists of well drained soils on uplands and stream benches. These soils formed in moderately coarse textured and coarse textured glacial drift or alluvium. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 12 percent.

Typical pedon of Dickinson sandy loam, 2 to 6 percent slopes, 1,800 feet north and 700 feet west of the southeast corner of sec. 18, T. 111 N., R. 25 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark brown (10YR 3/3) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.
A—8 to 12 inches; very dark grayish brown (10YR 3/2) sandy loam, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; very friable; medium acid; clear smooth boundary.
Bw1—12 to 15 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
Bw2—15 to 24 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; slightly acid; irregular wavy boundary.
C—24 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; neutral.

The thickness of the solum and the depth to loamy sand or sand range from 21 to 40 inches. The thickness of the mollic epipedon ranges from 10 to 18 inches.

The A horizon is sandy loam, fine sandy loam, or loam. The B horizon has value of 3 to 5 and chroma of 2 to 6. It is fine sandy loam or sandy loam. Some pedons have a BC horizon. This horizon and the C horizon have value of 4 or 5 and chroma of 3 to 6. They are loamy fine sand, loamy sand, fine sand, or sand.

Dickman Series

The Dickman series consists of well drained soils on stream terraces and uplands. These soils formed in moderately coarse textured and coarse textured sediments. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes are 0 to 6 percent.

Typical pedon of Dickman fine sandy loam, 2 to 6 percent slopes, 500 feet west and 75 feet north of the southeast corner of sec. 24, T. 111 N., R. 26 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.
A—9 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
Bw—16 to 30 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; medium acid; clear wavy boundary.
C—30 to 60 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; neutral.

The solum ranges from 30 to 50 inches in thickness. The depth to free carbonates is more than 30 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. The content of coarse fragments ranges from 0 to 10 percent throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is fine sandy loam, coarse sandy loam, or sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 in the upper part and 4 or 5 in the lower part, and chroma of 3 or 4. It is loamy fine sand, coarse sandy loam, or loamy sand.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 or 6, and chroma of 3 or 4. It is coarse sand, sand, or fine sand and is commonly stratified.

Dundas Series

The Dundas series consists of poorly drained and

somewhat poorly drained, moderately slowly permeable soils in the uplands. These soils formed in medium textured and moderately fine textured, calcareous glacial till. Slopes are 0 to 2 percent.

The Dundas soils in Le Sueur County have lower chroma in the upper part of the subsoil than is defined as the range for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Dundas loam, 800 feet south and 200 feet west of the northeast corner of sec. 29, T. 112 N., R. 25 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

Btg1—8 to 16 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common thick very dark brown (10YR 2/2) clay films on faces of peds; about 5 percent coarse fragments; medium acid; clear smooth boundary.

Btg2—16 to 35 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; common thin to thick very dark grayish brown (10YR 3/2) clay films on faces of peds; about 6 percent coarse fragments; slightly acid; gradual wavy boundary.

Cg—35 to 60 inches; olive gray (5Y 5/2) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 6 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 48 inches. The content of coarse fragments ranges from 1 to 8 percent in the solum.

The A horizon has value of 2 or 3. It is loam, clay loam, or fine sandy loam. The B horizon has hue of 5Y or 2.5Y and chroma of 1 to 3. It is clay loam, loam, or silty clay loam. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is loam or clay loam.

Estherville Series

The Estherville series consists of well drained and somewhat excessively drained soils on uplands and outwash plains. These soils formed in moderately coarse textured sediments and in the underlying coarse textured outwash. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slopes are 1 to 6 percent.

Typical pedon of Estherville sandy loam, 1 to 6 percent slopes, 100 feet west and 450 feet north of the southeast corner of sec. 25, T. 109 N., R. 24 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; neutral; abrupt smooth boundary.

Bw—9 to 18 inches; dark brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; friable; about 10 percent coarse fragments; neutral; clear smooth boundary.

2C—18 to 60 inches; dark yellowish brown (10YR 4/4) and brown (10YR 5/3) coarse sand; single grain; loose; about 12 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to the 2C horizon range from 15 to 24 inches. The mollic epipedon ranges from 9 to 20 inches in thickness. The content of coarse fragments ranges from 0 to 15 percent in the upper part of the profile and from 10 to 35 percent in the lower part.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is sandy loam or loam. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. It is sandy loam, coarse sandy loam, or loam. The 2C horizon has value of 4 to 7 and chroma of 2 to 6. It is coarse sand or sand.

Fairhaven Series

The Fairhaven series consists of well drained soils on stream terraces. These soils formed in medium textured sediments over coarse textured sediments. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes are 0 to 6 percent.

The Fairhaven soils in Le Sueur County are outside the range defined for the series because the solum is more than 40 inches thick. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Fairhaven silt loam, 0 to 2 percent slopes, 1,300 feet south and 1,100 feet west of the northeast corner of sec. 2, T. 111 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—9 to 16 inches; black (10YR 2/1) silt loam, very dark

gray (10YR 3/1) dry; moderate fine subangular blocky structure; neutral; slightly acid; gradual smooth boundary.
BA—16 to 20 inches; dark brown (10YR 3/3) silt loam; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.
Bw1—20 to 33 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.
Bw2—33 to 45 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; medium acid; gradual smooth boundary.
BC—45 to 55 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; slightly acid; clear smooth boundary.
2C—55 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; about 15 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 60 inches. The mollic epipedon ranges from 10 to 22 inches in thickness. The content of coarse fragments ranges from 0 to 5 percent in the loamy mantle and from 0 to 35 percent in the underlying material.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or loam.

The B horizon has value of 3 to 5. It is silt loam, silty clay loam, or loam. Some pedons have a 2B horizon, which is coarse sandy loam, sandy loam, loamy sand, or loamy coarse sand.

The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 5. It is coarse sand, sand, or the gravelly analog of those textures.

Glencoe Series

The Glencoe series consists of very poorly drained, moderately slowly permeable soils in the uplands. These soils formed in moderately fine textured sediments over medium textured glacial till. Slopes are 0 to 1 percent.

Typical pedon of Glencoe clay loam, 2,100 feet north and 1,500 feet west of the southeast corner of sec. 13, T. 112 N., R. 25 W.

A1—0 to 9 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; moderate fine granular structure; friable; about 1 percent coarse fragments; neutral; clear smooth boundary.
A2—9 to 32 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear wavy boundary.
A3—32 to 41 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine distinct olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual wavy boundary.
Bg—41 to 58 inches; olive gray (5Y 4/2) loam; common fine distinct yellowish brown (10YR 5/8) and olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; about 5 percent coarse fragments; neutral; gradual wavy boundary.
Cg—58 to 60 inches; olive gray (5Y 4/2) loam; common medium distinct olive (5Y 5/3) mottles; massive; friable; common medium distinct strong brown (7.5YR 5/6) iron oxide stains in root channels; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The solum ranges from 30 to 60 inches in thickness. It is clay loam, silty clay loam, or loam. The mollic epipedon ranges from 24 to 46 inches in thickness. Some pedons have an O horizon. The content of coarse fragments ranges from 0 to 5 percent in the solum and from 2 to 8 percent in the underlying material.

The A horizon has hue of 10YR to 5Y and value of 2 or 3. The B horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam or clay loam.

Hamel Series

The Hamel series consists of poorly drained, moderately slowly permeable soils in drainageways on upland till plains. These soils formed in local alluvium or colluvium and in the underlying medium textured and moderately fine textured glacial till. Slopes are 0 to 3 percent.

Typical pedon of Hamel clay loam, 1,500 feet west and 1,350 feet south of the northeast corner of sec. 9, T. 111 N., R. 23 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak medium granular; friable; neutral; clear smooth boundary.
A—9 to 21 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak medium granular;

friable; neutral; clear wavy boundary.

Btg1—21 to 25 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; few faint clay films on faces of peds; neutral; clear wavy boundary.

Btg2—25 to 29 inches; very dark gray (10YR 3/1) silty clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few faint clay films on faces of peds; neutral; clear wavy boundary.

Btg3—29 to 38 inches; olive gray (5Y 4/2) silty clay loam; common fine prominent dark reddish brown (5YR 3/4) streaks and common fine prominent light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; many distinct clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

Cg—38 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent dark reddish brown (5YR 3/4) streaks and common fine distinct light olive brown (2.5Y 5/4) mottles; massive; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 65 inches. The mollic epipedon ranges from 24 to 44 inches in thickness. The upper part of the solum typically does not have coarse fragments, but the content of coarse fragments in the underlying material ranges from 2 to 6 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is clay loam, silty clay loam, loam, or silt loam.

The upper part of the B horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1 or 2. The lower part has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. This horizon is silty clay loam, clay loam, or loam.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 to 4. It is clay loam or loam.

Hawick Series

The Hawick series consists of excessively drained, rapidly permeable or very rapidly permeable soils on stream terraces and uplands. These soils formed in coarse textured outwash. Slopes range from 6 to 40 percent.

Typical pedon of Hawick sandy loam, 6 to 12 percent slopes, 1,500 feet east and 175 feet north of the southwest corner of sec. 1, T. 111 N., R. 26 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; less than 5 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw—9 to 14 inches; dark brown (10YR 3/3) loamy sand; weak fine subangular blocky structure; very friable; about 12 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C1—14 to 30 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 20 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

C2—30 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; about 15 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 14 to 26 inches. The depth to free carbonates ranges from 0 to 26 inches. The mollic epipedon ranges from 7 to 16 inches in thickness. The content of coarse fragments in the solum ranges from 5 to 35 percent.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is sandy loam, loamy sand, loamy coarse sand, or coarse sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. It is loamy sand, loamy coarse sand, coarse sand, or the gravelly analog of those textures.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is stratified coarse sand, sand, or the gravelly analog of those textures.

Kasota Series

The Kasota series consists of well drained soils on stream terraces. These soils formed in medium textured, moderately fine textured, and fine textured sediments overlying coarse textured sediments. Permeability is moderately slow in the upper part of the profile and rapid in the lower part. Slopes are 1 to 6 percent.

Typical pedon of Kasota silt loam, 1 to 6 percent

slopes, 1,600 feet west and 2,400 feet south of the northeast corner of sec. 36, T. 112 N., R. 26 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; neutral; abrupt smooth boundary.
AB—8 to 14 inches; dark brown (10YR 3/3) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; slightly acid; clear wavy boundary.
Bt1—14 to 27 inches; dark brown (10YR 4/3) clay; strong medium subangular blocky structure parting to strong fine subangular blocky; firm; few distinct dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.
Bt2—27 to 35 inches; brown (10YR 5/3) clay; strong medium prismatic structure parting to strong fine subangular blocky; firm; few distinct dark brown (10YR 3/3) clay films on faces of peds; slightly acid; abrupt smooth boundary.
BC—35 to 38 inches; yellowish brown (10YR 5/4) loam; massive; friable; slightly acid; clear smooth boundary.
2C—38 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 40 inches. The depth to sandy and gravelly sediments ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 5 percent in the upper sediments and from 0 to 25 percent in the underlying material. The mollic epipedon ranges from 9 to 18 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam.

The Bt horizon has value of 3 to 5 and chroma of 3 or 4. It is clay, silty clay, clay loam, or silty clay loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 5. It is sand, coarse sand, or the gravelly analog of those textures.

Kilkenny Series

The Kilkenny series consists of well drained and moderately well drained, moderately slowly permeable soils on moraines. These soils formed in moderately fine textured sediments and the underlying medium textured glacial till. Slopes range from 2 to 24 percent.

Typical pedon of Kilkenny clay loam, 6 to 12 percent slopes, eroded, 300 feet east and 800 feet north of the southwest corner of sec. 19, T. 111 N., R. 23 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.
Bt1—9 to 19 inches; brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; about 2 percent coarse fragments; few distinct very dark brown (10YR 2/2) clay films on faces of peds; strongly acid; clear wavy boundary.
Bt2—19 to 38 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct very dark brown (10YR 2/2) clay films on faces of peds; about 4 percent coarse fragments; strongly acid; gradual wavy boundary.
Bt3—38 to 53 inches; brown (10YR 4/3) clay loam; few fine distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; friable; few distinct very dark brown (10YR 2/2) clay films on faces of peds; about 4 percent coarse fragments; medium acid; gradual smooth boundary.
C—53 to 60 inches; olive brown (2.5Y 4/4) loam; few fine prominent dark brown (7.5YR 4/4) mottles; massive; friable; about 6 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 60 inches. The content of coarse fragments ranges from 2 to 6 percent throughout the profile. These are dominantly shale fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is clay loam, loam, or silty clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 5. It is clay loam or silty clay loam.

The C horizon has value of 4 to 6 and chroma of 2 to 6. It is loam or clay loam.

Le Sueur Series

The Le Sueur series consists of moderately well drained and somewhat poorly drained, moderately permeable soils in the uplands. These soils formed in medium textured and moderately fine textured, calcareous glacial till. Slopes are 1 to 4 percent.

Typical pedon of Le Sueur clay loam, 1 to 4 percent slopes, 2,000 feet west and 1,100 feet south of the northeast corner of sec. 5, T. 110 N., R. 24 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; neutral; abrupt smooth boundary.

A—9 to 16 inches; very dark brown (10YR 2/2) clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bt1—16 to 27 inches; dark grayish brown (10YR 4/2) clay loam; few fine prominent olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; strongly acid; clear wavy boundary.

Bt2—27 to 38 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent strong brown (7.5YR 5/6) and common fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent coarse fragments; medium acid; clear wavy boundary.

Bt3—38 to 45 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine distinct olive brown (2.5Y 4/4) and common fine faint grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm; few very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.

Cg—45 to 60 inches; grayish brown (2.5Y 5/2) loam; common fine faint and distinct olive brown (2.5Y 4/4) and strong brown (7.5YR 5/6) mottles; massive; friable; about 4 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 55 inches. The mollic epipedon ranges from 10 to 18 inches in thickness. The content of coarse fragments ranges from 2 to 8 percent throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is clay loam or loam. Some pedons have an E horizon, which is as much as 3 inches thick.

The upper part of the B horizon has value of 3 to 5 and chroma of 2 or 3. In some pedons it has no mottles. The lower part has value of 4 or 5 and chroma of 2 to 4. This horizon is clay loam, silty clay loam, or loam.

The C horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay loam or loam.

Lerdal Series

The Lerdal series consists of somewhat poorly drained, slowly permeable soils on end moraines. These soils formed in moderately fine textured and fine textured sediments and glacial till. Slopes range from 2 to 12 percent.

Typical pedon of Lerdal clay loam, 2 to 6 percent slopes, 2,000 feet west and 50 feet north of the southeast corner of sec. 24, T. 111 N., R. 23 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; medium acid; abrupt smooth boundary.

Btg1—8 to 19 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear wavy boundary.

Btg2—19 to 28 inches; dark brown (10YR 4/3) silty clay; common fine distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear wavy boundary.

Btg3—28 to 40 inches; dark grayish brown (2.5Y 4/2) clay loam; many medium prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 3 percent coarse fragments; medium acid; gradual wavy boundary.

Cg—40 to 60 inches; olive brown (2.5Y 4/4) clay loam; many medium prominent strong brown (7.5YR 5/6) and common fine prominent grayish brown (10YR 5/2) mottles; massive; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 65 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is clay loam, silty clay loam, or loam. The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 to 4. It is mottled in at least one subhorizon. It is clay loam, silty clay loam, silty clay, or clay. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is loam or clay loam.

Lester Series

The Lester series consists of well drained, moderately permeable soils in the uplands. These soils

formed in medium textured and moderately fine textured, calcareous glacial till. Slopes range from 2 to 40 percent.

Typical pedon of Lester loam, 6 to 12 percent slopes, eroded, 75 feet west and 1,400 feet south of the northeast corner of sec. 7, T. 110 N., R. 24 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.
BE—6 to 8 inches; dark brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; friable; about 2 percent coarse fragments; medium acid; clear smooth boundary.
Bt1—8 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to moderate fine subangular blocky; firm; few dark brown (7.5YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear wavy boundary.
Bt2—18 to 36 inches; olive brown (2.5Y 4/4) clay loam; moderate medium prismatic structure; firm; few dark brown (7.5YR 3/2) clay films on faces of peds; about 4 percent coarse fragments; slightly acid; clear wavy boundary.
Bt3—36 to 43 inches; olive brown (2.5Y 4/4) clay loam; weak medium prismatic structure; firm; few distinct dark brown (7.5YR 3/2) clay films on faces of peds; about 4 percent coarse fragments; slightly acid; clear wavy boundary.
C—43 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; very few dark brown (7.5YR 3/2) clay films in root channels; about 8 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 54 inches. The content of coarse fragments ranges from 2 to 8 percent in the control section. The texture is loam or clay loam throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the B horizon has chroma of 3 or 4. The lower part has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. The C horizon has value of 4 to 6 and chroma of 3 to 6.

Mazaska Series

The Mazaska series consists of poorly drained, slowly permeable soils on the broad tops of ridges on end moraines. These soils formed in moderately fine textured, water-modified glacial till. Slopes are 0 to 2 percent.

Typical pedon of Mazaska silty clay loam, 1,900 feet east and 200 feet north of the southwest corner of sec. 27, T. 110 N., R. 23 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.
A—8 to 12 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; about 2 percent coarse fragments; neutral; clear smooth boundary.
Btg1—12 to 16 inches; very dark gray (10YR 3/1) clay loam, grayish brown (10YR 5/2) dry; common fine faint dark gray (10YR 4/1) mottles; moderate fine and medium subangular blocky structure; firm; very dark grayish brown (10YR 3/2) clay films on faces of peds; few faint coatings of clean sand and silt particles on faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.
Btg2—16 to 21 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (10YR 4/2) dry; common fine distinct light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.
Btg3—21 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; medium acid; clear smooth boundary.
Cg1—32 to 46 inches; olive (5Y 5/3) silty clay loam; many medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; slight effervescence; mildly alkaline; clear smooth boundary.
Cg2—46 to 60 inches; olive (5Y 5/3) clay loam; many medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 30 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 22 inches. Coarse fragments of mixed lithology make up 2 to 8 percent of the volume throughout the profile.

The A horizon has value of 2 or 3. It is silty clay loam or clay loam.

The B horizon has hue of 10YR to 5Y and value of 3 to 5. It is mottled in some or all subhorizons. It is clay loam, clay, or silty clay loam.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 to 4. It is loam, clay loam, or silty clay loam.

Minneiska Series

The Minneiska series consists of moderately well drained, moderately rapidly permeable soils on flood plains. These soils formed in stratified, medium textured and coarse textured, calcareous alluvium. Slopes are 0 to 2 percent.

Typical pedon of Minneiska fine sandy loam, occasionally flooded, 2,100 feet west and 1,350 feet north of the southeast corner of sec. 1, T. 112 N., R. 26 W.

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

C1—9 to 20 inches; dark brown (10YR 3/3), stratified loamy fine sand and fine sandy loam; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline; clear wavy boundary.

C2—20 to 60 inches; dark brown (10YR 4/3), stratified loamy fine sand and fine sandy loam; massive; few fine distinct yellowish brown (10YR 5/6) mottles; very friable; few fine snail shell fragments in the lower part; slight effervescence; mildly alkaline.

These soils have free carbonates in all horizons. The content of coarse fragments ranges from 0 to 10 percent in the lower part of the control section.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is fine sandy loam, sandy loam, very fine sandy loam, loam, or silt loam.

The C horizon has hue of 10YR or 2.5Y, value of 2 to 5, and chroma of 2 or 3. It is stratified loamy fine sand, fine sandy loam, sandy loam, fine sand, or sand.

Muskego Series

The Muskego series consists of very poorly drained soils in bogs. These soils formed in a layer of well decomposed herbaceous material and in the underlying coprogenous earth. Permeability is moderate or moderately rapid in the upper part of the profile and slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Muskego muck, 600 feet west and 2,000 feet south of the northeast corner of sec. 5, T. 110 N., R. 24 W.

Oap—0 to 7 inches; muck (sapric material), black (10YR 2/1) rubbed and unrubbed; about 15 percent primarily herbaceous fibers, 5 percent rubbed; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Oa1—7 to 14 inches; sapric material, black (10YR 2/1) rubbed and unrubbed; about 15 percent primarily herbaceous fibers, 5 percent rubbed; weak thin and medium platy structure; very friable; medium acid; clear smooth boundary.

Oa2—14 to 23 inches; dark brown (7.5YR 3/2) sapric material, very dark brown (10YR 2/2) rubbed; about 25 percent primarily herbaceous fibers, 5 to 10 percent rubbed; moderate medium platy structure; friable; medium acid; clear smooth boundary.

Oa3—23 to 27 inches; very dark brown (10YR 2/2) sapric material, black (10YR 2/1) rubbed; about 10 percent primarily herbaceous fibers, 5 percent rubbed; massive; friable; medium acid; clear smooth boundary.

C—27 to 60 inches; black (5Y 2/2) mucky silt loam (coprogenous earth); massive; very friable; violent effervescence; moderately alkaline.

The depth to coprogenous earth ranges from 16 to 51 inches. The organic part of the control section is dominantly sapric material. It has chroma of 1 to 3, or it is neutral in hue and has value of 2 and chroma of 0. The coprogenous earth has hue of 10YR, 2.5Y, or 5Y, value of 2 to 5, and chroma of 1 to 3.

Oshawa Series

The Oshawa series consists of very poorly drained, moderately slowly permeable soils on flood plains. These soils formed in calcareous, medium textured and moderately fine textured alluvium. Slopes are 0 to 1 percent.

Typical pedon of Oshawa silt loam, 1,200 feet east and 400 feet south of the northwest corner of sec. 7, T. 109 N., R. 26 W.

A—0 to 12 inches; black (5Y 2/1) silt loam, very dark gray (5Y 3/1) dry; few fine prominent dark reddish brown (5YR 3/2) mottles; weak fine and medium subangular blocky structure; friable; about 2 percent snail shells; slight effervescence; moderately alkaline; clear wavy boundary.

Cg1—12 to 20 inches; stratified olive gray (5Y 4/2) and dark olive gray (5Y 3/2) silty clay loam; common fine prominent dark brown (7.5YR 4/4) and common fine distinct dark gray (5Y 4/1) mottles; weak coarse and medium subangular blocky structure; friable; about 2 percent snail shells; slight effervescence; moderately alkaline; clear wavy boundary.

Cg2—20 to 39 inches; stratified dark olive gray (5Y 3/2) and very dark gray (5Y 3/1) silt loam; common fine and medium distinct dark gray (5Y 4/1) and dark grayish brown (2.5Y 4/2) and common fine and medium prominent dark brown (7.5YR 4/4) mottles; massive; friable; slight effervescence; moderately alkaline; clear wavy boundary.

Cg3—39 to 52 inches; stratified very dark gray (5Y 3/1) and black (5Y 2/2) silt loam; common fine and medium prominent dark brown (7.5YR 4/4) mottles; massive; friable; slight effervescence; moderately alkaline; clear wavy boundary.

Cg4—52 to 60 inches; very dark gray (5Y 3/1) silty clay loam; few fine faint olive (5Y 4/3) mottles; massive; friable; slight effervescence; moderately alkaline.

The A horizon ranges from 10 to more than 24 inches in thickness. It has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, clay loam, loam, or silt loam. Some pedons have thin strata of sapric material. Snail shell fragments are common. They make up as much as 10 percent of the volume.

The C horizon has hue of 2.5Y or 5Y, value of 2 to 5, and chroma of 1 or 2, or it is neutral in hue and has value of 3 to 5 and chroma of 0. It is dominantly loam, silt loam, silty clay loam, or clay loam, but coarser textured strata are common.

Otter Series

The Otter series consists of poorly drained, moderately permeable soils on flood plains. These soils formed in medium textured and moderately fine textured alluvium. Slopes are 0 to 1 percent.

Typical pedon of Otter silt loam, 2,450 feet south and 1,300 feet east of the northwest corner of sec. 28, T. 110 N., R. 23 W.

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

A1—10 to 26 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; common medium distinct grayish brown (10YR 5/2) mottles; friable; neutral; gradual wavy boundary.

A2—26 to 45 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; few fine distinct dark grayish brown (10YR 4/2) mottles; friable; neutral; gradual wavy boundary.

C—45 to 60 inches; black (10YR 2/1) silt loam; massive with fine laminations; friable; neutral.

The thickness of the mollic epipedon ranges from 24 to 50 inches. The A horizon is typically silt loam, mucky silt loam, or silty clay loam. The C horizon is silt loam, loam, or silty clay loam.

Palms Series

The Palms series consists of very poorly drained soils in bogs. These soils formed in a layer of well decomposed herbaceous material over medium textured and moderately fine textured glacial till. Permeability is moderately slow to moderately rapid in the upper part of the profile and moderately slow or moderate in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Palms muck, 1,900 feet north and 1,800 feet west of the southeast corner of sec. 12, T. 112 N., R. 23 W.

Oa1—0 to 23 inches; muck (sapric material), black (N 2/0) rubbed and unrubbed; about 5 percent primarily herbaceous fibers, 2 percent rubbed; weak fine and medium granular structure; very friable; common fine roots; slightly acid; diffuse wavy boundary.

Oa2—23 to 34 inches; sapric material, black (N 2/0) rubbed and unrubbed; about 5 percent primarily herbaceous fibers, 1 percent rubbed; weak medium granular structure; very friable; neutral; abrupt wavy boundary.

Cg1—34 to 47 inches; very dark gray (10YR 3/1) silt loam; massive; friable; neutral; abrupt smooth boundary.

Cg2—47 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; few fine distinct light yellowish brown (2.5Y 6/4) mottles; massive; friable; mildly alkaline.

The depth to loamy underlying material ranges from 16 to 50 inches. The organic part of the control section is dominantly sapric material, but in some pedons it has thin layers of hemic material. It has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 and chroma of 0. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 7, and chroma of 1 or 2. It is silt loam, loam, or clay loam.

Rolfe Series

The Rolfe series consists of very poorly drained, slowly permeable soils in upland depressions. These soils formed in fine textured alluvium and in the underlying medium textured and moderately fine textured glacial till. Slopes are 0 to 1 percent.

Typical pedon of Rolfe silt loam, in an area of the Cordova-Rolfe complex; 650 feet south and 2,300 feet west of the northeast corner of sec. 15, T. 109 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; slightly acid; abrupt smooth boundary.

A—9 to 12 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

E—12 to 20 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium platy structure; firm; slightly acid; clear smooth boundary.

Btg1—20 to 35 inches; very dark gray (5Y 3/1) and dark gray (5Y 4/1) clay; few fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium prismatic structure parting to strong medium angular blocky; firm; common very dark gray (10YR 3/1) clay films on faces of peds; common clean sand and silt coatings on faces of peds in the upper part; slightly acid; clear wavy boundary.

Btg2—35 to 47 inches; olive gray (5Y 4/2) clay loam; few fine prominent olive brown (2.5Y 4/4) and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; common very dark gray (10YR 3/1) clay films on faces of peds; firm; slightly acid; diffuse wavy boundary.

Btg3—47 to 51 inches; olive gray (5Y 5/2) clay loam; few fine prominent olive brown (2.5Y 4/4) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; few dark brown (7.5YR 3/2) clay films on faces of peds; friable; slightly acid; clear wavy boundary.

Cg—51 to 60 inches; gray (5Y 5/1) loam; many fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; slight effervescence; neutral.

The thickness of the solum and the depth to carbonates range from 42 to 60 inches. The mollic epipedon ranges from 10 to 18 inches in thickness. The content of coarse fragments in the control section averages less than 5 percent.

The A horizon has value of 2 or 3. It is silt loam, loam, or silty clay loam. The E horizon has value of 4 to 6. It is silt loam or loam.

The B horizon has hue of 5Y, 2.5Y, or 10YR and value of 3 to 6. It is clay loam, clay, or silty clay in the upper part and clay loam or loam in the lower part.

The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is loam or clay loam.

Shields Series

The Shields series consists of somewhat poorly drained, slowly permeable soils on end moraines. These soils formed in moderately fine textured and fine textured, water-modified glacial till. Slopes are 1 to 3 percent.

Typical pedon of Shields silty clay loam, 500 feet west and 600 feet south of the northeast corner of sec. 9, T. 110 N., R. 24 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak medium granular; friable; slightly acid; abrupt smooth boundary.

Btg1—9 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate medium subangular blocky structure; firm; few clay films on faces of peds; medium acid; clear smooth boundary.

Btg2—13 to 25 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few clay films on faces of peds; strongly acid; clear smooth boundary.

Btg3—25 to 40 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct olive brown (2.5Y 4/4) and common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to strong medium subangular blocky; firm; few very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.

BC—40 to 50 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many medium prominent dark brown (7.5YR 4/4) and many medium faint olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; about 2 percent coarse fragments; medium acid; clear smooth boundary.

C—50 to 60 inches; olive (5Y 4/3) loam; common medium distinct olive gray (5Y 5/2) mottles; massive; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 55 inches. The content of coarse fragments ranges from 0 to 8 percent throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, silt loam, loam, or clay loam.

The B horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 1 or 2. It is silty clay loam, silty clay, clay, or clay loam.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 or 3. It is silty clay loam, clay loam, or loam.

Sparta Series

The Sparta series consists of excessively drained, rapidly permeable soils on stream terraces. These soils formed in coarse textured deposits. Slopes range from 1 to 12 percent.

Typical pedon of Sparta loamy fine sand, 1 to 6 percent slopes, 4,050 feet west and 350 feet south of the northeast corner of sec. 27, T. 111 N., R. 26 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loamy fine sand, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

AB—9 to 18 inches; very dark grayish brown (10YR 3/2) loamy fine sand; dark brown (10YR 3/3) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw—18 to 30 inches; dark brown (10YR 4/3) fine sand; single grain; loose; slightly acid; clear smooth boundary.

C—30 to 60 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The mollic epipedon ranges from 10 to 24 inches in thickness. The content of coarse fragments is as much as 10 percent in some pedons.

The A, AB, and B horizons are loamy fine sand, loamy sand, fine sand, or sand. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The AB horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 to 6. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sand or sand.

Storden Series

The Storden series consists of well drained, moderately permeable soils in the uplands. These soils formed in calcareous, medium textured glacial till. Slopes range from 2 to 40 percent.

Typical pedon of Storden loam, in an area of Lester-Hawick-Storden complex, 6 to 12 percent slopes; 2,600 feet west and 50 feet north of the southeast corner of sec. 20, T. 109 N., R. 24 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; weak fine granular structure; friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

AC—8 to 13 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

C—13 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common grayish brown (2.5Y 5/2) and light gray (10YR 7/2) concretions and coatings in matrix; about 5 percent coarse fragments; violent effervescence; moderately alkaline.

Generally, the thickness of the solum is the same as the thickness of the A horizon. Free carbonates are in all horizons. The texture is loam or clay loam throughout the profile. The content of coarse fragments ranges from 2 to 10 percent in the control section. Some pedons have a B horizon.

The A horizon has value of 3 to 5 and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6.

Terril Series

The Terril series consists of moderately well drained, moderately permeable soils in the uplands. These soils formed in medium textured alluvium and colluvium derived from glacial till. Slopes range from 1 to 8 percent.

Typical pedon of Terril loam, 1 to 8 percent slopes, 800 feet east and 400 feet north of the southwest corner of sec. 2, T. 110 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—9 to 28 inches; very dark brown (10YR 2/2) loam,

very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

AB—28 to 44 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; friable; very dark brown (10YR 2/2) coatings on faces of peds; neutral; clear smooth boundary.

Bw—44 to 60 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon ranges from 24 to 44 inches in thickness. The A horizon has chroma of 1 or 2. It is loam, silt loam, or clay loam. The B horizon has value of 3 or 4 and chroma of 2 to 4. It is loam or clay loam.

Wadena Series

The Wadena series consists of well drained soils in the uplands. These soils formed in medium textured sediments over coarse textured outwash. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 6 percent.

Typical pedon of Wadena loam, 2 to 6 percent slopes, 100 feet south and 75 feet west of the northeast corner of sec. 23, T. 111 N., R. 26 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A—9 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—14 to 23 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bw2—23 to 34 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

2BC—34 to 38 inches; yellowish brown (10YR 5/4) sandy loam; massive; friable; about 5 percent coarse fragments; neutral; clear wavy boundary.

2C—38 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 15 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to the 2C horizon range from 24 to 40 inches. The mollic epipedon ranges from 12 to 20 inches in thickness. The content of coarse fragments ranges from 0 to 15 percent in the upper part of the profile and from 5 to 35 percent in the underlying material.

The A horizon is loam or clay loam. The B horizon has hue of 10YR or 7.5YR and value of 3 to 5. It is loam or clay loam in the upper part and coarse sandy loam, sandy loam, sandy clay loam, or loam in the lower part. Some pedons do not have a 2BC horizon.

The 2C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is coarse sand, sand, or the gravelly analog of those textures.

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Formation of the Soils

This section relates the factors of soil formation to the soils in the survey area and describes the kinds of geologic material in the area.

Factors of Soil Formation

Soil formed through processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material *(3)*.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

The soils of Le Sueur County formed mainly in glacial till, glacial outwash, and alluvium. Glacial till refers to drift that was deposited by continental glaciers. It consists of an unsorted, heterogeneous mass of boulders, rocks, sand, silt, and clay. Canisteo, Cordova, and Lester soils formed in glacial till.

Glacial outwash was deposited by the meltwater of retreating glacial ice. These deposits are mainly in meltwater channels and on terraces. The soils in these areas commonly have a sandy and gravelly substratum and a sandy to clayey upper layer. Biscay, Estherville, Sparta, and Wadena are the dominant soils in these areas.

Alluvial sediments are deposited on most of the flood plains in stream valleys. These sediments are generally stratified and range in particle size from silts and clays to sands and cobbles. Chaska, Minneiska, and Oshawa soils formed in alluvial sediments.

Climate

Climate is an important factor in determining the kind of vegetation, animals, bacteria, and other organisms in or on the soil. It determines the intensity of physical and chemical activities in the soil, mainly through the effects of precipitation and temperature. The effects of climate and vegetation vary, depending on relief, permeability, and the length of time that the parent material has been in place.

Le Sueur County has a subhumid, continental climate characterized by hot summers and cold winters. The climate is essentially uniform throughout the county.

Plant and Animal Life

Plants, animals, bacteria, and other organisms are active factors of soil formation. They aid in the breakdown of parent material and in the formation and decomposition of organic matter. Vegetation affects soil formation by leaving plant residue on the soil and by transferring plant nutrients from the subsoil to the surface layer. The kind of plants and animals living on and in the soil is determined by the climate, the parent material, the relief, and the age of the soil.

The formation of the soils in Le Sueur County has been influenced by prairie and forest vegetation. Before the period of the "Big Woods," prairie grasses were the dominant plants in the survey area. Cordova and Le Sueur soils initially formed under prairie vegetation. As the amount of annual precipitation increased over a long period, forest vegetation slowly replaced the prairie

grasses. This change in vegetation caused differences in the soils. Cordova and Le Sueur soils are characterized by an increased content of clay in the subsoil, which is typical of a forested soil, and a thick, dark surface layer, which is typical of a prairie soil. Soils that formed primarily under forest vegetation have a surface layer that is thinner and lighter colored than that of prairie soils. Kilkenny and Lester are examples of forested soils.

In some areas the original prairie vegetation was never succeeded by forests. Most of the soils in these areas have a thick, dark surface layer and are characterized by little or no accumulation of clay in the subsoil. Copaston, Fairhaven, and Wadena are examples of prairie soils.

Relief

Relief, or the surface configuration of the land, is an important factor in the formation of soils. It affects water distribution, erosion, the movement of parent material, soil moisture, and soil temperature. The more sloping soils are generally better drained and less extensively leached than the nearly level or concave soils because more water runs off the surface. The well drained Lester soils are an example. They are well aerated and have bright internal colors because of oxidation. Glencoe and other soils in depressional areas commonly are characterized by slow internal water movement and a high water table. Their surface layer is thicker and darker and has a higher content of organic matter than the surface layer of better drained soils. Also, the subsoil has a dull grayish color and is mottled.

In gently sloping areas where internal drainage is good, soil profiles generally are strongly developed and extend to a greater depth. The degree of profile development is mostly a function of the amount of water passing through the soil.

Aspect affects the temperature of the soil. South-facing slopes are warmer than north-facing slopes because of greater exposure to sunlight. Also, the vegetation commonly is more sparse on the south-facing slopes.

Time

Soil characteristics are affected by the length of time involved in the soil-forming process. The age of the soil is evidenced by changes in the morphology or appearance of the profile. Soluble materials are leached out as a soil begins to form. Organic matter then begins to accumulate. This accumulation initiates horizon development.

The soils in Le Sueur County are geologically young. The parent material of most of the soils was deposited during or after the last glacial period, which ended only about 10,000 years ago. A young soil has more natural plant nutrients and commonly is more fertile than an older soil. It has many of the properties of the parent material because the processes of soil formation have not had time to alter the material to any significant extent.

Geology

The materials that make up the landscape in Le Sueur County consist of Paleozoic sedimentary rocks, Pleistocene glacial sediments, and recent sediments.

The entire county is underlain by sedimentary rocks deposited during the Paleozoic Era, about 400 to 600 million years ago. These rocks were deposited on the bottoms and shores of shallow oceans that once covered this region. The lower layers formed during the Cambrian Period and are mostly sandstone and shale.

The Jordan sandstone formation, which crops out along the Minnesota River at Kasota and Ottawa, was deposited during this period. The major aquifers in Le Sueur County are in Cambrian-aged sediments. The upper layers of the sedimentary rocks in the county were deposited during the Ordovician Period. An example of these later sediments, the Oneota dolomite layer, is exposed at Kasota and Ottawa where it overlies the Jordan sandstone.

Glacial sediments of the Pleistocene Epoch cover the entire county. Most of these sediments occur as glacial till. The till consists of loamy, unsorted sediments that were deposited directly by glacial activity during the Wisconsin Glaciation, which ended about 10,000 years ago. Soils in the uplands formed in yellowish brown to light olive brown, loamy material deposited by a glacier moving in a southeasterly direction from north-central Canada. Kilkenny and Lester are examples of soils that formed in this material.

Large rivers were formed as the glaciers melted. One such river, Glacial River Warren, carved the large valley now occupied by the Minnesota River. As the glacial river cut down through glacial drift, it created terraces, which are mantled with sandy material. Estherville and Wadena are examples of soils that formed in this material.

Several kinds of sediment have been deposited during the last 10,000 years. Thick layers of loamy to silty alluvium have accumulated on the bottom land along the Minnesota River and along some of the side valley tributaries. Chaska and Minneiska are examples

of soils that formed in recent alluvium. Very poorly drained, organic soils formed in decomposed plant remains in depressions and on flood plains. Caron and Palms soils are examples.

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Glossary

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.

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

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

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

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

Bottom land. The normal flood plain of a stream, subject to flooding.

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

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

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

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

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

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

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures 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.

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.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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

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

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

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

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

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 the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

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

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

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

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

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

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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 outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

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

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 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

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

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil

material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

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

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

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

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

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

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

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

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

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

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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

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

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

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

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

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

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

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

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

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

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

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

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, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and 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 colored, 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 of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

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

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

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

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

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.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

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

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

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

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

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

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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

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

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

Reaction, soil. A measure of acidity or alkalinity of a

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

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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

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

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent

material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along 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.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at St. Peter, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	21.8	.6	11.2	48	-30	0	0.68	0.18	1.08	3	8.3
February----	28.3	7.0	17.7	53	-25	0	.78	.23	1.23	3	7.9
March-------	39.1	19.5	29.3	70	-14	14	1.55	.65	2.30	4	8.7
April-------	57.2	35.2	46.2	89	15	71	2.27	1.31	3.11	6	1.2
May---------	70.9	46.6	58.8	93	27	295	3.61	1.97	5.05	8	.1
June--------	80.0	56.6	68.3	97	41	549	4.66	2.49	6.57	8	.0
July--------	84.5	61.1	72.8	98	47	707	4.01	2.07	5.70	7	.0
August------	81.7	58.7	70.2	95	44	626	4.03	2.05	5.75	7	.0
September---	72.8	48.5	60.7	93	30	321	2.69	1.23	3.94	6	.0
October-----	61.9	37.7	49.8	88	20	132	1.78	.49	2.83	4	.1
November----	43.2	24.4	33.8	69	-4	6	1.29	.37	2.03	3	4.6
December----	28.2	10.4	19.3	52	-23	0	.86	.30	1.32	3	9.0
Yearly:											
Average---	55.8	33.9	44.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	99	-32	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,721	28.21	22.31	33.81	62	39.9

* 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 1951-81 at St. Peter, Minnesota)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 24	May 9	May 18
2 years in 10 later than--	Apr. 19	May 3	May 13
5 years in 10 later than--	Apr. 10	Apr. 23	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 11	Oct. 1	Sept. 21
2 years in 10 earlier than--	Oct. 16	Oct. 5	Sept. 26
5 years in 10 earlier than--	Oct. 26	Oct. 13	Oct. 6

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at St. Peter, 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	178	153	134
8 years in 10	185	160	141
5 years in 10	199	172	155
2 years in 10	213	185	168
1 year in 10	220	192	175

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
8B	Sparta loamy fine sand, 1 to 6 percent slopes	1,325	0.5
8C	Sparta loamy fine sand, 6 to 12 percent slopes	290	0.1
27A	Dickinson sandy loam, 0 to 2 percent slopes	1,130	0.4
27B	Dickinson sandy loam, 2 to 6 percent slopes	1,160	0.4
27C	Dickinson sandy loam, 6 to 12 percent slopes	245	0.1
35	Blue Earth mucky silt loam	1,060	0.4
39A	Wadena loam, 0 to 2 percent slopes	325	0.1
39B	Wadena loam, 2 to 6 percent slopes	975	0.3
41B	Estherville sandy loam, 1 to 6 percent slopes	2,285	0.8
86	Canisteo clay loam	5,795	2.1
94B	Terril loam, 1 to 8 percent slopes	1,955	0.7
100B	Copaston loam, 1 to 6 percent slopes	3,420	1.2
106B	Lester loam, 2 to 6 percent slopes	16,250	5.8
106C2	Lester loam, 6 to 12 percent slopes, eroded	21,940	7.8
106D2	Lester loam, 12 to 18 percent slopes, eroded	4,220	1.5
106E	Lester loam, 18 to 24 percent slopes	565	0.2
109	Cordova clay loam	27,253	9.5
114	Glencoe clay loam	13,130	4.7
123	Dundas loam	3,085	1.1
129	Cylinder loam, 1 to 4 percent slopes	470	0.2
138B	Lerdal clay loam, 2 to 6 percent slopes	10,810	3.8
138C	Lerdal clay loam, 6 to 12 percent slopes	1,170	0.4
156A	Fairhaven silt loam, 0 to 2 percent slopes	610	0.2
156B	Fairhaven silt loam, 2 to 6 percent slopes	310	0.1
183	Dassel loam	1,735	0.6
206B	Kasota silt loam, 1 to 6 percent slopes	850	0.3
238B	Kilkenny loam, 2 to 6 percent slopes	7,905	2.8
238C2	Kilkenny clay loam, 6 to 12 percent slopes, eroded	11,550	4.1
238D2	Kilkenny clay loam, 12 to 18 percent slopes, eroded	4,330	1.5
238E	Kilkenny clay loam, 18 to 24 percent slopes	770	0.3
239B	Le Sueur clay loam, 1 to 4 percent slopes	27,163	9.9
256	Mazaska silty clay loam	8,185	2.9
271	Minneiska fine sandy loam, frequently flooded	890	0.3
317	Oshawa silt loam	2,045	0.7
323	Shields silty clay loam	2,240	0.8
327A	Dickman fine sandy loam, 0 to 2 percent slopes	310	0.1
327B	Dickman fine sandy loam, 2 to 6 percent slopes	460	0.2
329	Chaska silt loam	1,565	0.6
392	Biscay loam	910	0.3
414	Hamel clay loam	21,214	7.4
463	Minneiska fine sandy loam, occasionally flooded	1,355	0.5
468	Otter silt loam	1,325	0.5
524	Caron muck	8,170	2.9
525	Muskego muck	8,470	3.0
539	Palms muck	3,670	1.3
611C	Hawick sandy loam, 6 to 12 percent slopes	700	0.2
611D	Hawick sandy loam, 12 to 18 percent slopes	340	0.1
611F	Hawick sandy loam, 18 to 40 percent slopes	970	0.3
944B	Lester-Estherville complex, 2 to 6 percent slopes	2,125	0.8
944C	Lester-Hawick-Storden complex, 6 to 12 percent slopes	4,540	1.6
944D	Lester-Hawick-Storden complex, 12 to 18 percent slopes	2,535	0.9
944F	Lester-Hawick-Storden complex, 18 to 40 percent slopes	1,470	0.5
945B	Lester-Storden loams, 2 to 6 percent slopes	460	0.2
945C	Lester-Storden loams, 6 to 12 percent slopes	2,720	1.0
945D	Lester-Storden loams, 12 to 18 percent slopes	1,640	0.6
945F	Lester-Storden loams, 18 to 40 percent slopes	4,200	1.5
978	Cordova-Rolfe complex	3,275	1.2
1013	Pits, quarry	370	0.1
1030	Udorthents-Pits, gravel, complex	760	0.3
1057	Caron, Blue Earth, and Palms soils, ponded	4,485	1.6
1855B	Dickinson sandy loam, loamy substratum, 2 to 6 percent slopes	950	0.3
1901B	Le Sueur-Lester complex, 1 to 6 percent slopes	11,540	4.1
1962	Mazaska-Rolfe complex	730	0.3
	Water	2,900	1.0
	Total	281,600	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
27A	Dickinson sandy loam, 0 to 2 percent slopes
27B	Dickinson sandy loam, 2 to 6 percent slopes
39A	Wadena loam, 0 to 2 percent slopes
39B	Wadena loam, 2 to 6 percent slopes
86	Canisteo clay loam (where drained)
94B	Terril loam, 1 to 8 percent slopes
106B	Lester loam, 2 to 6 percent slopes
109	Cordova clay loam (where drained)
114	Glencoe clay loam (where drained)
123	Dundas loam (where drained)
129	Cylinder loam, 1 to 4 percent slopes
138B	Lerdal clay loam, 2 to 6 percent slopes (where drained)
156A	Fairhaven silt loam, 0 to 2 percent slopes
156B	Fairhaven silt loam, 2 to 6 percent slopes
206B	Kasota silt loam, 1 to 6 percent slopes
238B	Kilkenny loam, 2 to 6 percent slopes
239B	Le Sueur clay loam, 1 to 4 percent slopes
256	Mazaska silty clay loam (where drained)
323	Shields silty clay loam (where drained)
329	Chaska silt loam (where drained)
392	Biscay loam (where drained)
414	Hamel clay loam (where drained)
463	Minneiska fine sandy loam, occasionally flooded
468	Otter silt loam (where drained and either protected from flooding or not frequently flooded during the growing season)
944B	Lester-Estherville complex, 2 to 6 percent slopes
945B	Lester-Storden loams, 2 to 6 percent slopes
978	Cordova-Rolfe complex (where drained)
1855B	Dickinson sandy loam, loamy substratum, 2 to 6 percent slopes
1901B	Le Sueur-Lester complex, 1 to 6 percent slopes
1962	Mazaska-Rolfe complex (where drained)

TABLE 6.--LAND CAPABILITY CLASSES 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	Corn silage	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Tons	Tons	AUM*
8B---------- Sparta	IVs	47	15	32	6.7	1.8	3.4
8C---------- Sparta	VIs	---	---	---	---	---	3.0
27A---------- Dickinson	IIs	80	25	54	11.4	3.0	4.5
27B---------- Dickinson	IIe	78	25	53	11.1	2.9	4.5
27C---------- Dickinson	IVe	70	22	47	10.0	2.6	4.2
35---------- Blue Earth	IIIw	83	26	56	11.9	3.1	---
39A---------- Wadena	IIs	92	29	62	13.1	3.5	5.2
39B---------- Wadena	IIe	85	27	58	12.1	3.2	5.0
41B---------- Estherville	IIIs	55	17	37	7.9	2.1	4.3
86---------- Canisteo	IIw	116	34	78	16.5	4.3	5.8
94B---------- Terril	IIe	128	40	87	18.2	4.8	6.5
100B---------- Copaston	IIIe	50	16	34	7.1	1.9	4.0
106B---------- Lester	IIe	123	39	83	17.5	4.6	6.4
106C2---------- Lester	IIIe	98	31	65	14.0	3.7	6.3
106D2---------- Lester	IVe	80	25	54	11.4	3.0	5.8
106E---------- Lester	VIe	---	---	---	---	---	3.0
109---------- Cordova	IIw	123	39	83	17.5	4.6	6.4
114---------- Glencoe	IIIw	105	33	71	15.0	3.9	---
123---------- Dundas	IIw	110	35	74	15.7	4.1	5.8

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land Capability	Corn	Soybeans	Oats	Corn silage	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Tons	Tons	AUM*
129---------- Cylinder	IIs	100	32	68	14.2	3.8	5.6
138B---------- Lerdal	IIe	95	30	64	13.5	3.6	6.4
138C---------- Lerdal	IIIe	82	26	55	11.7	3.1	6.3
156A---------- Fairhaven	IIs	114	36	77	16.2	4.3	5.5
156B---------- Fairhaven	IIe	107	34	72	15.2	4.0	5.3
183---------- Dassel	IIIw	50	16	34	7.1	2.3	4.0
206B---------- Kasota	IIe	92	29	62	13.1	3.5	5.0
238B---------- Kilkenny	IIe	110	35	74	15.7	4.1	6.3
238C2---------- Kilkenny	IIIe	90	28	60	12.9	3.4	6.2
238D2---------- Kilkenny	IVe	75	24	50	10.7	2.8	5.4
238E---------- Kilkenny	VIe	---	---	---	---	---	3.0
239B---------- Le Sueur	I	133	42	90	19.0	5.0	7.0
256---------- Mazaska	IIw	105	33	71	15.0	3.9	6.0
271---------- Minneiska	Vw	---	---	---	---	---	4.0
317---------- Oshawa	VIw	---	---	---	---	---	3.5
323---------- Shields	IIIw	90	28	60	12.7	3.4	5.4
327A---------- Dickman	IIIs	68	21	46	9.7	2.5	4.0
327B---------- Dickman	IIIe	60	19	41	8.6	2.3	4.0
329---------- Chaska	IIw	88	28	60	12.6	3.3	6.0
392---------- Biscay	IIw	95	30	64	13.5	3.6	5.8

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land Capability	Corn	Soybeans	Oats	Corn silage	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Tons	Tons	AUM*
414---------- Hamel	IIw	119	38	81	17.0	4.5	6.2
463---------- Minneiska	IIw	82	26	55	11.7	3.1	5.8
468---------- Otter	Vw	---	---	---	---	---	---
524---------- Caron	IIIw	83	26	56	11.9	3.1	---
525---------- Muskego	IVw	83	26	56	11.9	3.1	3.7
539---------- Palms	IIIw	88	26	60	12.6	3.1	---
611C---------- Hawick	IVs	32	10	22	4.6	1.2	3.0
611D---------- Hawick	VIs	---	---	---	---	---	---
611F---------- Hawick	VIIs	---	---	---	---	---	---
944B---------- Lester-Estherville	IIe	82	26	55	11.7	3.1	5.8
944C---------- Lester-Hawick-Storden	IIIe	72	23	49	10.3	2.7	4.8
944D---------- Lester-Hawick-Storden	IVe	53	17	36	7.6	2.0	4.0
944F---------- Lester-Hawick-Storden	VIIe	---	---	---	---	---	---
945B---------- Lester-Storden	IIe	108	34	72	15.4	4.1	6.3
945C---------- Lester-Storden	IIIe	82	26	55	11.7	3.1	5.8
945D---------- Lester-Storden	IVe	65	21	44	9.3	2.4	5.0
945F---------- Lester-Storden	VIIe	---	---	---	---	---	---
978---------- Cordova-Rolfe	IIIw	112	35	77	16.0	3.9	6.0
1013**. Pits							

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land Capability	Corn	Soybeans	Oats	Corn silage	Alfalfa hay	Kentucky bluegrass
		Bu	Bu	Bu	Tons	Tons	AUM*
1030**. Udorthents-Pits							
1057---------- Caron, Blue Earth, and Palms	VIIIw	---	---	---	---	---	---
1855B---------- Dickinson	IIe	82	26	55	11.7	3.1	4.8
1901B---------- Le Sueur-Lester	IIe	128	40	87	18.2	4.8	6.5
1962---------- Mazaska-Rolfe	IIIw	92	29	62	13.1	3.5	5.6

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
106B, 106C2----- Lester	5A	Slight	Slight	Slight	Slight	Northern red oak----	70	66	Black walnut, northern red oak, white oak, green ash.
						American basswood---	70	66	
						Black walnut--------	60	---	
						Eastern cottonwood--	90	103	
						White oak-----------	60	51	
						Sugar maple---------	---	---	
106D2, 106E----- Lester	5R	Moderate	Moderate	Slight	Slight	Northern red oak----	70	66	Black walnut, northern red oak, white oak, silver maple.
						American basswood---	70	66	
						Black walnut--------	60	---	
						Eastern cottonwood--	90	103	
						White oak-----------	60	51	
						Sugar maple---------	---	---	
109---------- Cordova	5W	Slight	Moderate	Moderate	Slight	American basswood---	75	73	Black ash, green ash.
						Eastern cottonwood--	90	103	
						Green ash-----------	50	34	
						Sugar maple---------	55	35	
123---------- Dundas	5W	Slight	Moderate	Moderate	Moderate	American basswood---	70	66	Green ash, black ash, northern red oak.
						Green ash-----------	50	34	
						Eastern cottonwood--	85	91	
138B, 138C------ Lerdal	5A	Slight	Slight	Slight	Slight	American basswood---	70	66	Black walnut, eastern white pine, green ash, northern red oak.
						Sugar maple---------	60	38	
						Black walnut--------	60	---	
						Eastern cottonwood--	85	91	
238B, 238C2----- Kilkenny	5A	Slight	Slight	Slight	Slight	American basswood---	70	66	Black walnut, northern red oak, white oak, green ash.
						Northern red oak----	65	59	
						Black walnut--------	70	---	
						Sugar maple---------	---	---	
238D2, 238E----- Kilkenny	5R	Moderate	Moderate	Slight	Slight	American basswood---	70	66	Black walnut, northern red oak, white oak, green ash.
						Northern red oak----	65	59	
						Black walnut--------	70	---	
						Sugar maple---------	---	---	
239B---------- Le Sueur	5A	Slight	Slight	Slight	Slight	American basswood---	70	66	Black walnut, white oak, green ash, northern red oak.
						Sugar maple---------	60	38	
						Black walnut--------	55	---	
						Eastern cottonwood--	85	91	
271---------- Minneiska	9A	Slight	Slight	Slight	Slight	Eastern cottonwood--	100	128	Black walnut, green ash, white oak.
323---------- Shields	5W	Slight	Moderate	Moderate	Slight	American Basswood---	70	66	Black ash, green ash.
						Eastern cottonwood--	90	103	
						Green ash-----------	50	34	

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
414---------- Hamel	5W	Slight	Moderate	Moderate	Slight	American basswood--- Eastern cottonwood-- Green ash----------	70 85 ---	66 91 ---	Green ash, black ash.
463---------- Minneiska	9A	Slight	Slight	Slight	Slight	Eastern cottonwood--	100	128	Black walnut, green ash, white oak.
468---------- Otter	3W	Slight	Severe	Moderate	Moderate	Silver maple-------- White ash----------	94 ---	--- ---	Green ash, silver maple, eastern cottonwood.
944B**:									
Lester---------	5A	Slight	Slight	Slight	Slight	Northern red oak---- American basswood--- Black walnut-------- Eastern cottonwood-- White oak---------- Sugar maple---------	70 70 60 90 60 ---	66 66 --- 103 51 ---	Black walnut, northern red oak, white oak, silver maple.
Estherville.									
944C**:									
Lester---------	5A	Slight	Slight	Slight	Slight	Northern red oak---- American basswood--- Black walnut-------- Eastern cottonwood-- White oak---------- Sugar maple---------	70 70 60 90 60 ---	66 66 --- 103 51 ---	Black walnut, northern red oak, white oak, silver maple.
Hawick.									
Storden.									
944D**, 944F**:									
Lester---------	5R	Moderate	Moderate	Slight	Slight	Northern red oak---- American basswood--- Black walnut-------- Eastern cottonwood-- White oak---------- Sugar maple---------	70 70 60 90 60 ---	66 66 --- 103 51 ---	Black walnut, northern red oak, white oak, green ash.
Hawick.									
Storden.									
945B**, 945C**:									
Lester---------	5A	Slight	Slight	Slight	Slight	Northern red oak---- American basswood--- Black walnut-------- Eastern cottonwood-- White oak---------- Sugar maple---------	70 70 60 90 60 ---	66 66 --- 103 51 ---	Black walnut, northern red oak, white oak, green ash.
Storden.									

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
945D**, 945F**:									
Lester	5R	Moderate	Moderate	Slight	Slight	Northern red oak	70	66	Black walnut, northern red oak, white oak, green ash.
						American basswood	70	66	
						Black walnut	60	---	
						Eastern cottonwood	90	103	
						White oak	60	51	
						Sugar maple	---	---	
Storden.									
978**:									
Cordova	5W	Slight	Moderate	Moderate	Slight	American basswood	75	73	Black ash, green ash.
						Eastern cottonwood	90	103	
						Green ash	50	34	
						Sugar maple	55	35	
Rolfe.									
1901B**:									
Le Sueur	5A	Slight	Slight	Slight	Slight	American basswood	70	66	Northern red oak, white oak, black walnut, green ash.
						Sugar maple	60	38	
						Black walnut	55	---	
						Eastern cottonwood	85	91	
Lester	5A	Slight	Slight	Slight	Slight	Northern red oak	70	66	Black walnut, northern red oak, white oak, green ash.
						American basswood	70	66	
						Black walnut	60	---	
						Eastern cottonwood	90	103	
						White oak	60	51	
						Sugar maple	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not gro 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
8B, 8C---------- Sparta	Siberian peashrub	Lilac----------	Austrian pine, red pine, honeylocust, green ash, Russian-olive.	Eastern white pine	---
27A, 27B, 27C----- Dickinson	Hedge cotoneaster	Siberian peashrub, lilac.	Green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	Eastern white pine	---
35---------- Blue Earth	---	Redosier dogwood	Tamarack----------	Golden willow, white willow.	---
39A, 39B---------- Wadena	Siberian peashrub, lilac.	Russian-olive, hackberry, Manchurian crabapple.	Green ash, eastern white pine.	---	---
41B---------- Estherville	Siberian peashrub	Lilac----------	Honeylocust, green ash, Russian-olive, red pine, Austrian pine.	Eastern white pine	---
86---------- Canisteo	---	Siberian peashrub, lilac, northern white-cedar.	Hackberry, white spruce, blue spruce.	Honeylocust, green ash.	Eastern cottonwood.
94B---------- Terril	---	Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian-olive, Amur maple, blue spruce, northern white-cedar, white spruce.	Eastern white pine, green ash, Austrian pine.	---
100B. Copaston					
106B, 106C2, 106D2, 106E------ Lester	---	Redosier dogwood, Siberian peashrub, lilac.	Hackberry, northern white-cedar, Amur maple, Russian-olive, blue spruce, white spruce.	Eastern white pine, green ash.	---
109---------- Cordova	---	American plum, redosier dogwood.	Red splendor crabapple, northern white-cedar, white spruce, hackberry, Amur maple, blue spruce.	Green ash, eastern white pine, honeylocust.	Eastern cottonwood, silver maple.

TABLE 8.--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
114---------- Glencoe	---	Redosier dogwood	Black ash, tamarack.	Black willow, golden willow, white willow.	---
123---------- Dundas	---	Lilac, redosier dogwood.	Northern white-cedar, white spruce, hackberry, Amur maple, blue spruce.	Green ash, honeylocust.	Eastern cottonwood, silver maple.
129---------- Cylinder	---	Redosier dogwood, lilac.	Blue spruce, northern white-cedar, Amur maple, white spruce.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
138B, 138C-------- Lerdal	---	Northern white-cedar, Siberian peashrub, lilac.	White spruce, Austrian pine, hackberry, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
156A, 156B-------- Fairhaven	Lilac, Siberian peashrub.	Manchurian crabapple, Russian-olive.	Hackberry, green ash, eastern white pine, honeylocust.	---	---
183---------- Dassel	---	Redosier dogwood	Northern white-cedar, tamarack.	Golden willow, green ash.	Silver maple.
206B---------- Kasota	American plum, lilac, Siberian peashrub.	Hackberry, Russian-olive.	Honeylocust, green ash, Austrian pine.	---	---
238B, 238C2, 238D2, 238E------ Kilkenny	---	Redosier dogwood, Siberian peashrub, lilac.	Northern white-cedar, blue spruce, hackberry, Amur maple, white spruce, Russian-olive.	Austrian pine, eastern white pine, green ash.	---
239B---------- Le Sueur	---	Redosier dogwood, lilac, Siberian peashrub.	Northern white-cedar, white spruce, blue spruce, Amur maple, Russian-olive.	Austrian pine, eastern white pine, green ash, hackberry, Norway spruce.	Silver maple, eastern cottonwood.
256---------- Mazaska	---	Lilac, American plum, redosier dogwood, Siberian peashrub.	Northern white-cedar, white spruce, hackberry, Amur maple, blue spruce.	Green ash, eastern white pine.	Eastern cottonwood, silver maple.

TABLE 8.--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
271---------- Minneiska	---	Lilac, Siberian peashrub, redosier dogwood.	Hackberry, white spruce, northern white-cedar, blue spruce, Russian-olive.	Honeylocust, green ash, eastern white pine, Austrian pine.	Eastern cottonwood.
317. Oshawa					
323---------- Shields	---	Redosier dogwood, lilac, Tatarian honeysuckle, Siberian peashrub.	White spruce, Austrian pine, hackberry, Russian-olive, northern white-cedar, blue spruce.	Eastern white pine, green ash.	---
327A, 327B-------- Dickman	Siberian peashrub	Lilac, crabapple	Green ash, honeylocust, red pine, Austrian pine, Russian-olive.	Eastern white pine	---
329---------- Chaska	---	Siberian peashrub, lilac, northern white-cedar.	White spruce, hackberry, blue spruce, Russian-olive.	Green ash, honeylocust.	Eastern cottonwood.
392---------- Biscay	---	Redosier dogwood, American plum, Siberian peashrub.	Northern white-cedar, Amur maple, white spruce, blue spruce, hackberry.	Green ash, eastern white pine.	Eastern cottonwood, silver maple.
414---------- Hamel	---	American plum, redosier dogwood, Siberian peashrub.	Northern white-cedar, hackberry, white spruce, Amur maple, blue spruce.	Green ash, eastern white pine.	Eastern cottonwood, silver maple.
463---------- Minneiska	---	Lilac, Siberian peashrub, redosier dogwood.	Hackberry, white spruce, blue spruce, northern white-cedar, Russian-olive.	Honeylocust, green ash, eastern white pine, Austrian pine.	Eastern cottonwood.
468---------- Otter	---	Siberian peashrub, American plum, redosier dogwood.	Amur maple, white spruce, hackberry, blue spruce, northern white-cedar, Scotch pine.	Green ash, eastern white pine.	Silver maple, eastern cottonwood.
524---------- Caron	---	Redosier dogwood	Tamarack----------	Black willow, white willow, golden willow.	---
525---------- Muskego	---	Northern white-cedar, redosier dogwood, late lilac.	White spruce, tamarack.	Siberian crabapple	---

TABLE 8.--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
539---------- Palms	---	Redosier dogwood, silky dogwood.	Northern white-cedar, white spruce, tamarack.	Norway spruce, green ash.	---
611C, 611D, 611F-- Hawick	Siberian peashrub	Lilac----------	Austrian pine, red pine, green ash, honeylocust, Russian-olive.	Eastern white pine	---
944B*:					
Lester----------	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern white-cedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
Estherville------	Siberian peashrub	Eastern redcedar, lilac.	Honeylocust, green ash, Russian-olive, red pine, Austrian pine.	Eastern white pine	---
944C*, 944D*, 944F*:					
Lester----------	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern white-cedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
Hawick----------	Siberian peashrub	Lilac, eastern redcedar.	Austrian pine, red pine, green ash, honeylocust, Russian-olive.	Eastern white pine	---
Storden---------	American plum-----	Hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	---	---
945B*, 945C*, 945D*, 945F*:					
Lester----------	---	Redosier dogwood, Siberian peashrub, lilac, gray dogwood.	Hackberry, eastern redcedar, northern white-cedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
Storden---------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian-olive.	Siberian elm------	---

See footnote at end of table.

TABLE 8.--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
978*:					
Cordova	---	American plum, redosier dogwood.	Northern white-cedar, white spruce, hackberry.	Green ash, golden willow.	Eastern cottonwood, silver maple.
Rolfe	---	Redosier dogwood, American plum.	Amur maple, northern white-cedar, hackberry, white spruce.	Green ash	Silver maple, eastern cottonwood.
1013*. Pits					
1030*: Udorthents.					
Pits.					
1057*: Caron.					
Blue Earth.					
Palms.					
1855B Dickinson	Hedge cotoneaster	Siberian peashrub, lilac.	Red pine, Amur maple, Norway spruce, green ash, hackberry, honeylocust.	Eastern white pine	---
1901B*:					
Le Sueur	---	Redosier dogwood, lilac.	Northern white-cedar, white spruce, blue spruce.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
Lester	---	Redosier dogwood, Siberian peashrub, lilac.	Hackberry, eastern redcedar, northern white-cedar, Amur maple, Russian-olive, blue spruce.	Eastern white pine, green ash.	---
1962*:					
Mazaska	---	American plum, redosier dogwood, lilac, Siberian peashrub.	Blue spruce, northern white-cedar, white spruce, hackberry, Amur maple.	Green ash, eastern white pine.	Eastern cottonwood, silver maple.
Rolfe	---	Redosier dogwood, American plum.	Amur maple, northern white-cedar, hackberry, white spruce.	Green ash	Silver maple, eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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
8B Sparta	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
8C Sparta	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
27A Dickinson	Slight	Slight	Slight	Slight	Slight.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
27C Dickinson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
35 Blue Earth	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.
39A Wadena	Slight	Slight	Slight	Slight	Slight.
39B Wadena	Slight	Slight	Moderate: slope.	Slight	Slight.
41B Estherville	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
86 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
94B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
100B Copaston	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer.	Slight	Severe: thin layer, area reclaim.
106B Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
106C2 Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
106D2, 106E Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
109 Cordova	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
114 Glencoe	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
123--Dundas	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
129--Cylinder	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
138B--Lerdal	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
138C--Lerdal	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
156A--Fairhaven	Slight	Slight	Slight	Slight	Slight.
156B--Fairhaven	Slight	Slight	Moderate: slope.	Slight	Slight.
183--Dassel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
206B--Kasota	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight	Slight.
238B--Kilkenny	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
238C2--Kilkenny	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
238D2, 238E--Kilkenny	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
239B--Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
256--Mazaska	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
271--Minneiska	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
317--Oshawa	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
323--Shields	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
327A--Dickman	Slight	Slight	Slight	Slight	Moderate: droughty.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
327B---------- Dickman	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
329---------- Chaska	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
392---------- Biscay	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
414---------- Hamel	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
463---------- Minneiska	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
468---------- Otter	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
524---------- Caron	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
525---------- Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
539---------- Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
611C---------- Hawick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
611D---------- Hawick	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
611F---------- Hawick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
944B*:					
Lester----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
Estherville----------	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
944C*:					
Lester----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Hawick----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Storden----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
944D*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Hawick	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
944F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hawick	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
945B*:					
Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
Storden	Slight	Slight	Moderate: slope.	Slight	Slight.
945C*:					
Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
945D*:					
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.
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.
1013*. Pits					
1030*: Udorthents.					

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1030*: Pits.					
1057*: Caron	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Blue Earth	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.
Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1855B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
1901B*: Le Sueur	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
Lester	Slight	Slight	Moderate: slope.	Slight	Slight.
1962*: Mazaska	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Rolfe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--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
8B---------- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
8C---------- Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
27A, 27B---------- Dickinson	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
27C---------- Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
35---------- Blue Earth	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
39A, 39B---------- Wadena	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
41B---------- Estherville	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
86---------- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
94B---------- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
100B---------- Copaston	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
106B---------- Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
106C2, 106D2------- Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
106E---------- Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
109---------- Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
114---------- Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
123---------- Dundas	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
129---------- Cylinder	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
138B---------- Lerdal	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
138C---------- Lerdal	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 10.--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
156A, 156B--------- Fairhaven	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
183---------- Dassel	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
206B---------- Kasota	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
238B---------- Kilkenny	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
238C2, 238D2------- Kilkenny	Fair	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
238E---------- Kilkenny	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
239B---------- Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
256---------- Mazaska	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
271---------- Minneiska	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
317---------- Oshawa	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
323---------- Shields	Fair	Good	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
327A, 327B--------- Dickman	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
329---------- Chaska	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
392---------- Biscay	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
414---------- Hamel	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
463---------- Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
468---------- Otter	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
524---------- Caron	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
525---------- Muskego	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
539---------- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
611C, 611D--------- Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.

TABLE 10.--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
611F---------- Hawick	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
944B*:										
Lester----------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Estherville-------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
944C*, 944D*:										
Lester----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Hawick----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Storden----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
944F*:										
Lester----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hawick----------	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Storden----------	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
945B*:										
Lester----------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden----------	Good	Good	Good	Fair	Poor	Very poor.	Very poor.	Good	Fair	Very poor.
945C*, 945D*:										
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.
978*:										
Cordova----------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Rolfe----------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1013*. Pits										

See footnote at end of table.

TABLE 10.--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
1030*:										
Udorthents.										
Pits.										
1057*:										
Caron	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Poor	Good.
Blue Earth	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Poor	Good.
Palms	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Poor	Good.
1855B---------- Dickinson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.
1901B*:										
Le Sueur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1962*:										
Mazaska	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Rolfe	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--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
8B---------- Sparta	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
8C---------- Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
27A---------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
27B---------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
27C---------- Dickinson	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
35---------- Blue Earth	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
39A---------- Wadena	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
39B---------- Wadena	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
41B---------- Estherville	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
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.
100B---------- Copaston	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer, area reclaim
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.
106D2, 106E------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
109---------- Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.

TABLE 11.--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
114--- Glencoe	Severe: ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
123--- Dundas	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
129--- Cylinder	Severe: cutbanks cave, wetness.	Moderate: shrink-swell, wetness.	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: frost action.	Slight.
138B--- Lerdal	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
138C--- Lerdal	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
156A--- Fairhaven	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Moderate: frost action.	Slight.
156B--- Fairhaven	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Slight.
183--- Dassel	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
206B--- Kasota	Severe: cutbanks cave.	Severe: shrink-swell.	Slight---	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
238B--- Kilkenny	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
238C2--- Kilkenny	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
238D2, 238E--- Kilkenny	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
239B--- Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
256--- Mazaska	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
271--- Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
317---------- Oshawa	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
323---------- Shields	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
327A---------- Dickman	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
327B---------- Dickman	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
329---------- Chaska	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
392---------- Biscay	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
414---------- Hamel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
463---------- Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
468---------- Otter	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
524---------- Caron	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
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---------- Palms	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
611C---------- Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
611D, 611F--------- Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 11.--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
944B*:						
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Estherville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
944C*:						
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.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
944D*, 944F*:						
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
945B*:						
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Storden	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
945C*:						
Lester	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
945D*, 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.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
978*:						
Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Rolfe	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1013*.						
Pits						
1030*:						
Udorthents.						
Pits.						
1057*:						
Caron	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Blue Earth	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
Palms	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.
1855B--Dickinson	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
1901B*:						
Le Sueur	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
Lester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
1962*:						
Mazaska	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, 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.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--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
8B Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
8C Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
27A, 27B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
27C Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
35 Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
39A, 39B Wadena	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
41B Estherville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
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.
100B Copaston	Severe: thin layer, seepage.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
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.
106D2, 106E Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
109 Cordova	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 12.--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
114---------- Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
123---------- Dundas	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
129---------- Cylinder	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
138B---------- Lerdal	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
138C---------- Lerdal	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
156A, 156B---------- Fairhaven	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, small stones, too sandy.
183---------- Dassel	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
206B---------- Kasota	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
238B---------- Kilkenny	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Poor: hard to pack.
238C2---------- Kilkenny	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: hard to pack.
238D2, 238E--------- Kilkenny	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: hard to pack, slope.
239B---------- Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
256---------- Mazaska	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
271---------- Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.

TABLE 12.--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
317---------- Oshawa	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
323---------- Shields	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
327A, 327B---------- Dickman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
329---------- Chaska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, thin layer.
392---------- Biscay	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
414---------- Hamel	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
463---------- Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
468---------- Otter	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
524---------- Caron	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
525---------- Muskego	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
539---------- Palms	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
611C---------- Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
611D, 611F---------- Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

TABLE 12.--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*:					
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Estherville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
944C*:					
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.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
944D*, 944F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
945B*:					
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Storden	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
945C*:					
Lester	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
945D*, 945F*:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 12.--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
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.
1013*.					
Pits					
1030*:					
Udorthents.					
Pits.					
1057*:					
Caron	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
Palms	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
1855B	Severe:	Severe:	Slight	Severe:	Good.
Dickinson	poor filter.	seepage.		seepage.	
1901B*:					
Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Lester	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
1962*:					
Mazaska	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Rolfe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--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
8B, 8C Sparta	Good	Probable	Improbable: too sandy.	Poor: too sandy.
27A, 27B Dickinson	Good	Probable	Improbable: too sandy.	Good.
27C Dickinson	Good	Probable	Improbable: too sandy.	Fair: slope.
35 Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
39A, 39B Wadena	Good	Probable	Probable	Poor: small stones, area reclaim.
41B Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
86 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
94B Terril	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
100B Copaston	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
106B Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
106C2 Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
106D2, 106E Lester	Fair: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
109 Cordova	Fair: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
114 Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
123 Dundas	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
129--- Cylinder	Fair: wetness.	Probable	Probable	Fair: area reclaim, small stones, thin layer.
138B, 138C--- Lerdal	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
156A, 156B--- Fairhaven	Good	Probable	Probable	Poor: area reclaim, small stones.
183--- Dassel	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
206B--- Kasota	Good	Probable	Improbable: too sandy.	Poor: too clayey.
238B--- Kilkenny	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
238C2--- Kilkenny	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
238D2, 238E--- Kilkenny	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
239B--- Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
256--- Mazaska	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
271--- Minneiska	Good	Probable	Improbable: too sandy.	Good.
317--- Oshawa	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
323--- Shields	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
327A, 327B--- Dickman	Good	Probable	Improbable: too sandy.	Poor: thin layer.
329--- Chaska	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
392--- Biscay	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
414--- Hamel	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
463--- Minneiska	Good	Probable	Improbable: too sandy.	Good.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
468--Otter	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
524--Caron	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
525--Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
539--Palms	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
611C--Hawick	Good	Probable	Probable	Poor: small stones, area reclaim.
611D--Hawick	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
611F--Hawick	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
944B*:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Estherville	Good	Probable	Probable	Poor: small stones, area reclaim.
944C*:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Hawick	Good	Probable	Probable	Poor: small stones, area reclaim.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
944D*:				
Lester	Fair: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hawick	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
944D*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
944F*:				
Lester	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hawick	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
945B*:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
945C*:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
945D*:				
Lester	Fair: slope, low strength.	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.
978*:				
Cordova	Fair: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1013*. Pits				

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1030*: Udorthents. Pits.				
1057*: Caron	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Palms	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
1855B Dickinson	Good	Improbable: thin layer.	Improbable: excess fines.	Good.
1901B*: Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1962*: Mazaska	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--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
8B---------- Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
8C---------- Sparta	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
27A---------- Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing---	Soil blowing, too sandy.	Favorable.
27B---------- Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing, too sandy.	Favorable.
27C---------- Dickinson	Severe: slope, seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing, too sandy, slope.	Slope.
35---------- Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
39A---------- Wadena	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable------	Too sandy------	Favorable.
39B---------- Wadena	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Too sandy------	Favorable.
41B---------- Estherville	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
86---------- Canisteo	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
94B---------- Terril	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Favorable------	Favorable.
100B---------- Copaston	Severe: depth to rock, seepage.	Severe: piping, thin layer.	Deep to water	Slope, thin layer.	Depth to rock, area reclaim.	Depth to rock, area reclaim.
106B---------- Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope----------	Erodes easily	Erodes easily.
106C2, 106D2, 106E---------- Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
109---------- Cordova	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.

TABLE 14.--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
114---------- Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding--------	Ponding--------	Wetness.
123---------- Dundas	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
129---------- Cylinder	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Favorable.
138B---------- Lerdal	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easil
138C---------- Lerdal	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easil
156A---------- Fairhaven	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable------	Erodes easily, too sandy.	Erodes easily
156B---------- Fairhaven	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Erodes easily, too sandy.	Erodes easily
183---------- Dassel	Severe: seepage.	Severe: seepage, piping, wetness.	Ponding, frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
206B---------- Kasota	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Too sandy------	Favorable.
238B---------- Kilkenny	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope----------	Favorable------	Favorable.
238C2, 238D2, 238E---------- Kilkenny	Severe: slope.	Severe: hard to pack.	Deep to water	Slope----------	Slope----------	Slope.
239B---------- Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action---	Wetness, rooting depth.	Wetness--------	Rooting depth
256---------- Mazaska	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly
271---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
317---------- Oshawa	Slight---------	Severe: ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding--------	Wetness.
323---------- Shields	Moderate: seepage.	Severe: hard to pack.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easil percs slowly

TABLE 14.--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
327A---------- Dickman	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
327B---------- Dickman	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
329---------- Chaska	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness--------	Wetness.
392---------- Biscay	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
414---------- Hamel	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
463---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
468---------- Otter	Moderate: seepage.	Severe: piping, wetness.	Ponding, flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
524---------- Caron	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
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---------- Palms	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
611C, 611D, 611F-- Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
944B*:						
Lester----------	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Estherville------	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
944C*, 944D*, 944F*:						
Lester----------	Severe: slope.	Severe: thin layer.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Hawick----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Storden---------	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 14.--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
945B*:						
Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope	Erodes easily	Erodes easily
Storden	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily
945C*, 945D*, 945F*:						
Lester	Severe: slope.	Severe: thin layer.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easil
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easil
978*:						
Cordova	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
Rolfe	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding	Wetness, percs slowly
1013*. Pits						
1030*: Udorthents.						
Pits.						
1057*:						
Caron	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
Palms	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, rooting depth.	Ponding	Wetness, rooting dept
1855B Dickinson	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
1901B*:						
Le Sueur	Moderate: seepage.	Severe: thin layer.	Frost action	Wetness, rooting depth.	Wetness	Rooting depth
Lester	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope	Erodes easily	Erodes easily

See footnote at end of table.

TABLE 14.--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
1962*:						
Mazaska	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Rolfe	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--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		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticit index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
8B, 8C----------	0-18	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
Sparta	18-30	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
	30-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	85-100	85-100	50-95	2-30	---	NP
27A, 27B, 27C----	0-12	Sandy loam-------	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
Dickinson	12-24	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	24-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
35----------	0-10	Mucky silt loam	OL, ML	A-5	0	95-100	95-100	85-95	80-95	41-50	2-8
Blue Earth	10-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	95-100	80-100	80-95	80-95	41-50	2-8
39A, 39B---------	0-14	Loam----------	ML	A-4	0	95-100	90-100	75-95	50-65	25-40	2-10
Wadena	14-38	Loam, sandy loam, sandy clay loam.	SM, ML, CL, SC	A-4, A-6	0	95-100	80-100	75-95	40-60	25-40	5-12
	38-60	Stratified gravelly coarse sand to gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	45-100	35-95	10-80	2-10	---	NP
41B----------	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
Estherville	9-18	Sandy loam, loam, coarse sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	18-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
86----------	0-9	Clay loam--------	OL, CL	A-7	0	98-100	95-100	85-98	60-90	40-50	15-20
Canisteo	9-35	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	35-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
94B----------	0-28	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
Terril	28-60	Clay loam, loam	CL	A-6	0-5	95-100	90-100	85-95	65-85	25-40	10-20
100B----------	0-10	Loam----------	SM, ML	A-4	0	95-100	90-100	65-80	45-80	30-40	NP-10
Copaston	10-16	Sandy loam, gravelly loam.	SM	A-2	0-5	90-100	70-100	50-70	20-35	---	NP
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
106B, 106C2, 106D2, 106E-----	0-6	Loam----------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
Lester	6-43	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	43-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
109---------- Cordova	0-9	Clay loam--------	OL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	9-45	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	45-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
114---------- Glencoe	0-9	Clay loam--------	OL, OH, MH, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-55	10-25
	9-58	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-50	10-25
	58-60	Loam, clay loam	CL, ML	A-6, A-7	0	90-100	85-100	60-95	55-75	30-50	10-20
123---------- Dundas	0-8	Loam----------	ML, CL	A-6, A-4	0	100	95-100	85-97	60-80	30-40	6-16
	8-35	Clay loam, silty clay loam, loam.	CL, CH	A-6, A-7	0-2	97-100	90-98	85-97	50-90	35-60	15-30
	35-60	Clay loam, loam	CL, SC	A-6	0-2	95-100	90-98	80-95	35-70	30-40	10-20
129---------- Cylinder	0-12	Loam----------	CL	A-6, A-7	0	100	90-100	80-100	50-75	30-50	10-25
	12-35	Loam, clay loam, sandy loam.	CL, SC	A-6	0	95-100	80-100	80-95	45-70	30-40	10-20
	35-60	Gravelly coarse sand, loamy fine sand, fine sand.	SP-SM, SM	A-1, A-2, A-3	0-10	65-95	65-98	20-55	5-25	---	NP
138B, 138C------- Lerdal	0-8	Clay loam--------	CL, ML	A-6, A-7	0	95-100	90-100	80-95	60-90	35-50	10-20
	8-40	Silty clay, clay loam, silty clay loam.	MH, CH, CL, ML	A-7	0	95-100	90-100	80-95	70-90	45-70	20-35
	40-60	Clay loam--------	CL	A-7	0-5	90-100	85-95	75-90	60-75	40-50	15-25
156A, 156B------- Fairhaven	0-16	Silt loam--------	ML, CL	A-4, A-6	0	95-100	95-100	80-95	60-85	25-40	NP-15
	16-55	Silt loam, loam, silty clay loam.	ML, CL	A-4, A-6	0	95-100	95-100	80-95	60-85	25-40	2-15
	55-60	Stratified gravelly coarse sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	50-100	35-100	20-50	1-10	---	NP
183---------- Dassel	0-12	Loam----------	OL, ML	A-4	0	100	95-100	70-85	50-65	<30	NP-4
	12-20	Stratified fine sand to very fine sandy loam.	SM	A-4, A-2	0	100	95-100	60-75	30-40	<30	NP-4
	20-60	Stratified silt loam to coarse sand.	SM, SP-SM	A-2	0	100	80-100	50-80	10-35	---	NP
206B---------- Kasota	0-14	Silt loam--------	ML, CL	A-6, A-4, A-7	0	95-100	85-100	65-90	50-80	25-45	8-20
	14-38	Clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	85-100	80-95	65-90	45-75	20-45
	38-60	Sand, coarse sand	SP, SP-SM	A-3, A-1, A-2	0-3	85-100	65-100	20-65	2-10	<20	NP
238B---------- Kilkenny	0-9	Loam----------	ML, OH, MH, OL	A-7	0	95-100	95-100	80-95	60-75	40-60	10-20
	9-54	Clay loam, clay, silty clay loam.	MH, CH	A-7	0	95-100	90-98	80-95	65-80	50-70	25-35
	54-60	Clay loam, loam	CL, ML	A-7, A-6	0-5	95-100	90-98	75-90	60-75	35-50	10-25
238C2, 238D2----- Kilkenny	0-9	Clay loam--------	ML, MH	A-7	0	95-100	95-100	80-95	70-85	40-60	10-25
	9-53	Clay loam, clay, silty clay loam.	MH, CH	A-7	0	95-100	90-98	80-95	65-80	50-70	25-35
	53-60	Clay loam, loam	CL, ML	A-7, A-6	0-5	95-100	90-98	75-90	60-75	35-50	10-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
238E----------	0-7	Clay loam--------	ML, MH	A-7	0	95-100	95-100	80-95	70-85	40-60	10-25
Kilkenny	7-38	Clay loam, clay, silty clay loam.	MH, CH	A-7	0	95-100	90-98	80-95	65-80	50-70	25-35
	38-60	Clay loam, loam	CL, ML	A-7, A-6	0-5	95-100	90-98	75-90	60-75	35-50	10-25
239B----------	0-16	Clay loam--------	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
Le Sueur	16-45	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	45-60	Loam----------	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20
256----------	0-12	Silty clay loam	CL, CH	A-6, A-7	0	95-100	95-100	85-100	70-95	35-55	12-28
Mazaska	12-32	Clay loam, clay, silty clay loam.	CH, CL	A-7	0	90-100	85-100	75-95	60-90	40-65	15-35
	32-60	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	90-100	85-100	70-95	50-80	30-50	10-25
271----------	0-12	Fine sandy loam	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
Minneiska	12-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	20-30	NP-5
317----------	0-12	Silt loam--------	OL, ML, CL	A-4, A-6	0	95-100	95-100	90-100	85-95	30-40	5-15
Oshawa	12-60	Loam, silt loam, silty clay loam.	CL	A-6	0	95-100	95-100	90-100	85-95	30-40	10-15
323----------	0-9	Silty clay loam	OL, ML	A-7, A-6	0	98-100	95-100	90-98	85-95	35-50	10-20
Shields	9-50	Silty clay, clay	CH, MH, CL	A-7	0	95-100	95-100	90-98	85-95	45-70	20-35
	50-60	Silty clay loam, loam, clay.	CL, ML, MH	A-7, A-6	0	95-100	90-98	85-98	80-95	35-65	10-30
327A, 327B-------	0-16	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0	95-100	95-100	55-95	25-40	20-30	2-8
Dickman	16-30	Sandy loam, loamy fine sand, loamy sand.	SM, SM-SC, SC	A-2, A-4	0	95-100	85-100	55-95	25-45	15-25	2-8
	30-60	Stratified fine sand to coarse sand.	SP-SM	A-3, A-2	0	95-100	75-100	50-80	5-10	---	NP
329----------	0-8	Silt loam--------	OL, CL, ML	A-4, A-6	0	100	100	90-100	70-80	30-40	5-15
Chaska	8-60	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
392----------	0-9	Loam----------	CL, ML	A-7, A-6	0	95-100	95-100	70-95	50-80	35-50	10-25
Biscay	9-35	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
414----------	0-21	Clay loam--------	CL, CH	A-6, A-7	0	100	98-100	90-98	70-95	35-55	15-30
Hamel	21-38	Clay loam, loam, silty clay loam.	CH, CL	A-7	0	98-100	95-100	85-95	65-80	40-55	25-35
	38-60	Loam, clay loam	CL	A-6, A-7	0-5	98-100	95-100	80-95	60-80	30-45	10-25
463----------	0-9	Fine sandy loam	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
Minneiska	9-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	20-30	NP-5
468----------	0-45	Silt loam--------	CL	A-6, A-7, A-4	0	100	95-100	90-100	80-100	25-45	7-20
Otter	45-60	Silt loam, loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	80-100	30-45	10-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
524----------	0-13	Muck----------	PT	A-8	0	---	---	---	---	---	---
Caron	13-31	Hemic material---	PT	A-8	0	---	---	---	---	---	---
	31-60	Coprogenous earth	OL	A-5	0	100	95-100	90-95	70-90	40-50	5-10
525----------	0-27	Muck----------	PT	A-8	0	---	---	---	---	---	---
Muskego	27-60	Coprogenous earth	OL	A-5	0	95-100	95-100	85-100	75-96	40-50	2-8
539----------	0-34	Muck----------	PT	A-8	---	---	---	---	---	---	---
Palms	34-60	Clay loam, silt loam, loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
611C, 611D, 611F-	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
Hawick	9-14	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
944B*:											
Lester----------	0-8	Loam----------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	8-48	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	48-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
Estherville-----	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	9-18	Sandy loam, loam, coarse sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	18-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0-10	55-90	50-85	10-40	2-25	---	NP
944C*, 944D*:											
Lester----------	0-6	Loam----------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	6-43	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	43-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
Hawick----------	0-9	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	9-14	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
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
944F*:											
Lester----------	0-6	Loam----------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	6-25	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	25-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
944F*:											
Hawick----------	0-8	Sandy loam-------	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-4
	8-12	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
	12-60	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
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
945B*, 945C*, 945D*, 945F*:											
Lester----------	0-8	Loam-------------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	8-48	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	48-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
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
978*:											
Cordova----------	0-9	Clay loam--------	OL, ML, MH, OH	A-6, A-7	0	95-100	95-100	90-100	70-85	38-60	12-25
	9-45	Silty clay loam, clay loam.	CL	A-7	0	90-100	90-100	85-95	65-90	40-50	20-30
	45-60	Clay loam, loam	CL	A-6	0-5	90-100	90-100	80-95	55-70	30-40	12-20
Rolfe------------	0-20	Silt loam--------	OL, CL, ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	20-51	Clay, silty clay, clay loam.	CH	A-7	0	100	95-100	90-100	75-95	50-65	25-35
	51-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-45	10-20
1013*. Pits											
1030*: Udorthents.											
Pits.											
1057*:											
Caron------------	0-13	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
	13-31	Hemic material---	PT	A-8	0	---	---	---	---	---	---
	31-60	Coprogenous earth	OL	A-5	0	100	95-100	90-95	70-90	40-50	5-10
Blue Earth------	0-10	Mucky silt loam	OL, ML	A-5	0	95-100	95-100	85-95	80-95	41-50	2-8
	10-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	95-100	80-100	80-95	80-95	41-50	2-8
Palms------------	0-34	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	34-60	Clay loam, silt loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1855B---------- Dickinson	0-20	Sandy loam-------	SM, SC, SM-SC	A-2, A-4	0	100	100	80-95	30-50	15-30	NP-10
	20-49	Fine sandy loam, sandy loam, loamy sand.	SM, SP, SM-SC	A-2, A-3	0	100	100	80-95	3-20	10-20	NP-5
	49-60	Loam----------	CL	A-6	2-5	90-95	85-95	80-90	55-65	25-35	11-20
1901B*:											
Le Sueur---------	0-16	Clay loam--------	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-90	35-50	10-25
	16-45	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	35-50	15-25
	45-60	Loam----------	CL-ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	55-75	20-40	5-20
Lester----------	0-8	Loam----------	ML, CL	A-6, A-4	0-5	95-100	90-100	80-95	50-70	30-40	5-15
	8-48	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-50	15-25
	48-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
1962*:											
Mazaska---------	0-8	Silty clay loam	CL, CH	A-6, A-7	0	95-100	95-100	85-100	70-95	35-55	12-28
	8-32	Clay loam, clay, silty clay loam.	CH, CL	A-7	0	90-100	85-100	75-95	60-90	40-65	15-35
	32-60	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	90-100	85-100	70-95	50-80	30-50	10-25
Rolfe----------	0-20	Silt loam--------	OL, CL, ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	20-51	Clay, silty clay, clay loam.	CH	A-7	0	100	95-100	90-100	75-95	50-65	25-35
	51-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-45	10-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--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
8B, 8C----------	0-18	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low----------	0.17	5	2	1-2
Sparta	18-30	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-7.3	Low----------	0.15			
	30-60	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-7.3	Low----------	0.15			
27A, 27B, 27C----	0-12	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.20	4	3	1-2
Dickinson	12-24	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low----------	0.20			
	24-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low----------	0.15			
35----------	0-10	18-27	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	10-60	18-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Low----------	0.28			
39A, 39B---------	0-14	18-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	4	5	3-6
Wadena	14-38	18-30	1.35-1.50	0.6-2.0	0.14-0.19	5.6-7.3	Low----------	0.32			
	38-60	1-5	1.55-1.65	>20	0.02-0.04	6.6-8.4	Low----------	0.10			
41B----------	0-9	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.20	3	3	2-4
Estherville	9-18	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low----------	0.20			
	18-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low----------	0.10			
86----------	0-9	27-32	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate-----	0.24	5	4L	4-8
Canisteo	9-35	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	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			
94B----------	0-28	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
Terril	28-60	22-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
100B----------	0-10	14-20	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.28	2	5	2-5
Copaston	10-16	14-30	1.45-1.65	0.6-6.0	0.12-0.14	5.6-7.3	Low----------	0.28			
	16	---	---	---	---	---	----------	----			
106B, 106C2, 106D2, 106E-----	0-6	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-4
Lester	6-43	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	43-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	Low----------	0.37			
109----------	0-9	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	9-45	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	45-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate-----	0.28			
114----------	0-9	27-35	1.35-1.45	0.2-0.6	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	6	5-10
Glencoe	9-58	25-35	1.35-1.50	0.2-0.6	0.15-0.19	6.6-7.8	Moderate-----	0.28			
	58-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low----------	0.28			
123----------	0-8	10-27	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6	2-4
Dundas	8-35	20-35	1.50-1.65	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	35-60	15-30	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.28			
129----------	0-12	22-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.24	4	6	4-5
Cylinder	12-35	22-30	1.45-1.60	0.6-2.0	0.17-0.19	5.6-7.3	Moderate-----	0.32			
	35-60	2-12	1.60-1.70	>20	0.02-0.04	6.6-8.4	Low----------	0.10			
138B, 138C-------	0-8	27-32	1.15-1.25	0.2-2.0	0.18-0.22	5.6-6.5	Moderate-----	0.37	3	6	2-4
Lerdal	8-40	35-55	1.25-1.35	0.06-0.2	0.13-0.19	4.5-6.0	High---------	0.37			
	40-60	27-35	1.35-1.45	0.2-0.6	0.14-0.19	6.6-7.8	Moderate-----	0.37			
156A, 156B-------	0-16	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	4	6	3-6
Fairhaven	16-55	18-30	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43			
	55-60	0-5	1.55-1.65	6.0-20	0.02-0.04	6.1-8.4	Low----------	0.10			

TABLE 16.--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
183----------	0-12	10-24	1.00-1.40	2.0-6.0	0.18-0.24	5.6-7.3	Low----------	0.20	5	5	3-20
Dassel	12-20	2-6	1.40-1.60	2.0-6.0	0.12-0.17	5.6-7.3	Low----------	0.20			
	20-60	2-8	1.45-1.65	6.0-20	0.08-0.10	6.1-7.8	Low----------	0.20			
206B----------	0-14	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	4	6	3-6
Kasota	14-38	35-60	1.30-1.50	0.2-0.6	0.12-0.18	5.6-6.5	High---------	0.32			
	38-60	1-5	1.50-1.70	6.0-20	0.02-0.06	7.4-8.4	Low----------	0.15			
238B----------	0-9	20-27	1.15-1.25	0.6-2.0	0.18-0.22	5.6-6.5	Low----------	0.28	5	6	2-4
Kilkenny	9-54	35-45	1.25-1.35	0.2-0.6	0.15-0.19	4.5-6.5	Moderate-----	0.28			
	54-60	25-35	1.35-1.45	0.2-2.0	0.14-0.16	5.6-7.8	Moderate-----	0.37			
238C2, 238D2-----	0-9	27-30	1.15-1.25	0.2-0.6	0.17-0.19	5.6-6.5	Moderate-----	0.28	5	6	2-4
Kilkenny	9-53	35-45	1.25-1.35	0.2-0.6	0.15-0.19	4.5-6.5	Moderate-----	0.28			
	53-60	25-35	1.35-1.45	0.2-2.0	0.14-0.16	5.6-7.8	Moderate-----	0.37			
238E----------	0-7	27-30	1.15-1.25	0.2-0.6	0.17-0.19	5.6-6.5	Moderate-----	0.28	5	6	2-4
Kilkenny	7-38	35-45	1.25-1.35	0.2-0.6	0.15-0.19	4.5-6.5	Moderate-----	0.28			
	38-60	25-35	1.35-1.45	0.2-2.0	0.14-0.16	5.6-7.8	Moderate-----	0.37			
239B----------	0-16	28-30	1.50-1.75	0.6-2.0	0.17-0.20	5.6-7.3	Moderate-----	0.24	5	6	2-4
Le Sueur	16-45	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.32			
	45-60	20-27	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
256----------	0-12	27-40	1.15-1.30	0.2-0.6	0.17-0.22	6.1-7.3	High---------	0.28	5	4	4-7
Mazaska	12-32	35-50	1.25-1.40	0.06-0.2	0.10-0.16	4.5-6.5	High---------	0.28			
	32-60	20-35	1.40-1.60	0.2-2.0	0.14-0.16	7.4-7.8	Moderate-----	0.28			
271----------	0-12	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-8.4	Low----------	0.20	5	3	2-5
Minneiska	12-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.28			
317----------	0-12	18-27	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	8	4-10
Oshawa	12-60	18-35	1.30-1.35	0.2-0.6	0.17-0.19	7.4-8.4	Low----------	0.28			
323----------	0-9	27-40	1.15-1.25	0.6-2.0	0.18-0.22	5.6-6.5	Moderate-----	0.37	3	7	2-4
Shields	9-50	40-60	1.25-1.35	0.06-0.2	0.10-0.16	4.5-6.5	High---------	0.37			
	50-60	25-50	1.35-1.45	0.2-2.0	0.11-0.19	7.4-7.8	High---------	0.37			
327A, 327B-------	0-16	6-18	1.30-1.40	2.0-6.0	0.13-0.15	5.6-6.5	Low----------	0.20	3	3	2-4
Dickman	16-30	6-18	1.35-1.50	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20			
	30-60	1-10	1.50-1.60	6.0-20	0.02-0.07	5.6-7.8	Low----------	0.15			
329----------	0-8	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	8-60	18-27	1.40-1.65	0.6-2.0	0.17-0.19	7.4-7.8	Low----------	0.28			
392----------	0-9	18-27	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	Moderate-----	0.28	4	6	4-8
Biscay	9-35	18-30	1.25-1.35	0.6-2.0	0.17-0.19	6.1-7.8	Moderate-----	0.28			
	35-60	1-6	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
414----------	0-21	28-35	1.30-1.45	0.2-0.6	0.18-0.22	5.6-7.3	Moderate-----	0.28	5	6	5-7
Hamel	21-38	24-35	1.45-1.60	0.2-0.6	0.16-0.19	5.6-7.3	Moderate-----	0.28			
	38-60	20-30	1.55-1.75	0.6-2.0	0.14-0.18	7.4-7.8	Moderate-----	0.28			
463----------	0-9	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-8.4	Low----------	0.20	5	3	2-5
Minneiska	9-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.28			
468----------	0-45	18-27	1.10-1.25	0.6-2.0	0.22-0.24	6.1-7.8	Low----------	0.28	5	6	5-10
Otter	45-60	18-30	1.20-1.45	0.6-2.0	0.17-0.22	6.1-7.8	Moderate-----	0.43			
524----------	0-13	---	0.10-0.45	2.0-6.0	0.30-0.40	5.6-7.8	----------	----	---	2	50-90
Caron	13-31	---	0.10-0.45	2.0-20	0.40-0.50	5.6-7.8	----------	----			
	31-60	---	0.10-0.45	0.2-0.6	0.20-0.22	6.1-7.8	High---------	----			

TABLE 16.--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
525----------	0-27	0	0.10-0.21	0.6-6.0	0.35-0.45	5.6-7.3	----------	----	2	2	>50
Muskego	27-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	6.6-8.4	Moderate-----	0.28			
539----------	0-34	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	2	2	>75
Palms	34-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	----			
611C, 611D, 611F-	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	3	3	1-4
Hawick	9-14	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			
944B*:											
Lester----------	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-4
	8-48	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	48-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	Low----------	0.37			
Estherville-----	0-9	5-15	1.25-1.35	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.20	3	3	2-4
	9-18	10-18	1.35-1.60	2.0-6.0	0.09-0.14	5.6-7.3	Low----------	0.20			
	18-60	0-8	1.50-1.65	>6.0	0.02-0.04	6.6-8.4	Low----------	0.10			
944C*, 944D*:											
Lester----------	0-6	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-4
	6-43	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	43-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	Low----------	0.37			
Hawick----------	0-9	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	3	3	1-4
	9-14	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			
944F*:											
Lester----------	0-6	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Low----------	0.28	5	6	2-4
	6-25	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	25-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	Low----------	0.37			
Hawick----------	0-8	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.17	3	3	1-4
	8-12	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low----------	0.10			
	12-60	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			
945B*, 945C*, 945D*, 945F*:											
Lester----------	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-4
	8-48	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	48-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	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			
978*:											
Cordova----------	0-9	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
	9-45	28-35	1.35-1.50	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.28			
	45-60	18-30	1.45-1.70	0.6-2.0	0.14-0.16	7.4-8.4	Moderate-----	0.28			
Rolfe------------	0-20	22-27	1.35-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.28	5	6	3-5
	20-51	38-45	1.40-1.50	0.06-0.2	0.11-0.13	6.1-7.3	High----------	0.28			
	51-60	24-35	1.50-1.60	0.2-2.0	0.14-0.16	6.1-8.4	Moderate-----	0.28			

See footnote at end of table.

TABLE 16.--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
1013*. Pits											
1030*: Udorthents.											
Pits.											
1057*:											
Caron	0-13	---	0.10-0.45	2.0-6.0	0.30-0.40	5.6-7.8		---	---	3	50-90
	13-31	---	0.10-0.45	2.0-20	0.40-0.50	5.6-7.8		---			
	31-60	---	0.10-0.45	0.2-0.6	0.20-0.22	6.1-7.8	High	---			
Blue Earth	0-10	18-27	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Moderate	0.28	5	4L	10-25
	10-60	18-32	0.20-0.80	0.6-2.0	0.18-0.24	7.4-8.4	Low	0.28			
Palms	0-34	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8		---	2	8	>75
	34-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low	---			
1855B Dickinson	0-20	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.20	4	3	1-2
	20-49	5-15	1.45-1.55	6.0-20	0.08-0.10	5.1-6.0	Low	0.20			
	49-60	20-24	1.55-1.80	0.6-2.0	0.17-0.19	5.6-6.5	Low	0.37			
1901B*:											
Le Sueur	0-16	28-30	1.50-1.75	0.6-2.0	0.17-0.20	5.6-7.3	Moderate	0.24	5	6	2-4
	16-45	24-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	0.32			
	45-60	20-27	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
Lester	0-8	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
	8-48	24-35	1.45-1.55	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	0.28			
	48-60	20-30	1.55-1.75	0.6-2.0	0.14-0.19	6.6-8.4	Low	0.37			
1962*:											
Mazaska	0-8	27-40	1.15-1.30	0.2-0.6	0.17-0.22	6.1-7.3	High	0.28	5	4	4-7
	8-32	35-50	1.25-1.40	0.06-0.2	0.10-0.16	4.5-6.5	High	0.28			
	32-60	20-35	1.40-1.60	0.2-2.0	0.14-0.16	7.4-7.8	Moderate	0.28			
Rolfe	0-20	22-27	1.35-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Moderate	0.28	5	6	3-5
	20-51	38-45	1.40-1.50	0.06-0.2	0.11-0.13	6.1-7.3	High	0.28			
	51-60	24-35	1.50-1.60	0.2-2.0	0.14-0.16	6.1-8.4	Moderate	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
8B, 8C---------- Sparta	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
27A, 27B, 27C----- Dickinson	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
35---------- Blue Earth	B/D	Rare--------	---	---	+2-1.0	Apparent	Jan-Dec	---	High-----	High-----	Low.
39A, 39B---------- Wadena	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
41B---------- Estherville	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
86---------- Canisteo	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
94B---------- Terril	B	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Low.
100B---------- Copaston	D	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
106B, 106C2, 106D2, 106E------ Lester	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
109---------- Cordova	C/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
114---------- Glencoe	B/D	Rare--------	---	---	+1-1.0	Apparent	Oct-Jul	---	High-----	High-----	Low.
123---------- Dundas	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	---	High-----	High-----	Moderate.
129---------- Cylinder	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	---	High-----	Moderate	Low.
138B, 138C-------- Lerdal	C	None--------	---	---	1.0-3.0	Perched	Apr-May	---	High-----	High-----	High.
156A, 156B-------- Fairhaven	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
183---------- Dassel	B/D	None--------	---	---	0.5-3.0	Apparent	Oct-Jul	---	High-----	High-----	Low.
206B---------- Kasota	C	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Low.
238B, 238C2, 238D2, 238E------ Kilkenny	B	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
239B---------- Le Sueur	B	None--------	---	---	2.0-4.0	Apparent	Apr-May	---	High-----	High-----	Low.
256---------- Mazaska	C/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jun	---	High-----	High-----	Moderate.
271---------- Minneiska	B	Frequent----	Brief-----	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	---	Moderate	Low------	Low.
317---------- Oshawa	D	Frequent----	Long------	Mar-Jul	+1-1.0	Apparent	Nov-Jul	---	High-----	High-----	Low.
323---------- Shields	C	None--------	---	---	1.0-3.0	Perched	Apr-Jun	---	High-----	High-----	Moderate.
327A, 327B-------- Dickman	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
329---------- Chaska	B/D	Occasional	Brief-----	Mar-Jun	1.0-3.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
392---------- Biscay	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	---	High-----	Moderate	Low.
414---------- Hamel	C	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
463---------- Minneiska	B	Occasional	Brief-----	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	---	Moderate	Low------	Low.
468---------- Otter	B/D	Frequent----	Brief-----	Mar-Jun	0-2.0	Apparent	Mar-Jun	---	High-----	High-----	Low.
524---------- Caron	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Aug	40-45	High-----	High-----	Moderate.
525---------- Muskego	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Aug	35-45	High-----	Moderate	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
539---------- Palms	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Aug	25-32	High-----	High-----	Moderate.
611C, 611D, 611F-- Hawick	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
944B*:											
Lester----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Estherville------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
944C*, 944D*, 944F*:											
Lester----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Hawick----------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
Storden---------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
945B*, 945C*, 945D*, 945F*:											
Lester----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Storden---------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	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.
1013*. Pits											
1030*: Udorthents.											
Pits.											
1057*:											
Caron------------	D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	40-45	High-----	High-----	Moderate.
Blue Earth-------	B/D	Rare--------	---	---	+1-1.0	Apparent	Jan-Dec	---	High-----	High-----	Low.
Palms------------	D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	25-32	High-----	High-----	Moderate.
1855B---------- Dickinson	A	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
1901B*:											
Le Sueur----------	B	None--------	---	---	2.0-4.0	Apparent	Apr-May	---	High-----	High-----	Low.
Lester----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
1962*:											
Mazaska----------	C/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jun	---	High-----	High-----	Moderate.
Rolfe----------	C	None--------	---	---	+1-1.0	Apparent	Nov-Jul	---	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--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
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
Caron	Coprogenous, euic, mesic Limnic Medihemists
Chaska	Fine-loamy, mixed (calcareous), mesic Mollic Fluvaquents
Copaston	Loamy, mixed, mesic Lithic Hapludolls
Cordova	Fine-loamy, mixed, mesic Typic Argiaquolls
Cylinder	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Dassel	Coarse-loamy, mixed, mesic Typic Haplaquolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Dickman	Sandy, mixed, mesic Typic Hapludolls
*Dundas	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Estherville	Sandy, mixed, mesic Typic Hapludolls
*Fairhaven	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Glencoe	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Hamel	Fine-loamy, mixed, mesic Typic Argiaquolls
Hawick	Sandy, mixed, mesic Entic Hapludolls
Kasota	Clayey over sandy or sandy-skeletal, mixed, mesic Typic Argiudolls
Kilkenny	Fine, montmorillonitic, mesic Mollic Hapludalfs
Le Sueur	Fine-loamy, mixed, mesic Aquic Argiudolls
Lerdal	Fine, montmorillonitic, mesic, sloping Udollic Ochraqualfs
Lester	Fine-loamy, mixed, mesic Mollic Hapludalfs
Mazaska	Fine, montmorillonitic, mesic Typic Argiaquolls
Minneiska	Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents
Muskego	Coprogenous, euic, mesic Limnic Medisaprists
Oshawa	Fine-loamy, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Otter	Fine-silty, mixed, mesic Cumulic Haplaquolls
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Rolfe	Fine, montmorillonitic, mesic Typic Argialbolls
Shields	Fine, montmorillonitic, mesic Mollic Ochraqualfs
Sparta	Sandy, mixed, mesic Entic Hapludolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Udorthents	Udorthents
Wadena	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

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