



United States  
Department of  
Agriculture

Natural  
Resources  
Conservation  
Service

In cooperation with  
Minnesota Agricultural  
Experiment Station

# Soil Survey of Big Stone County, Minnesota



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# How To Use This Soil Survey

## General Soil Map

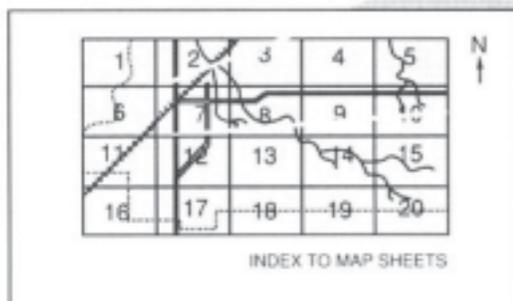
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

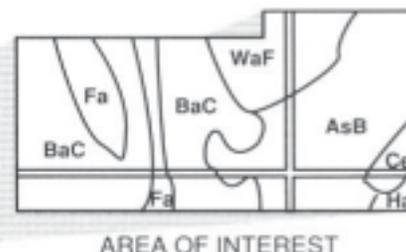
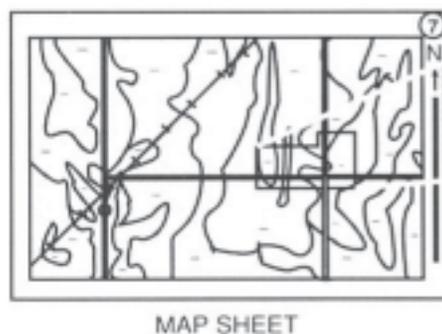
## Detailed Soil Maps

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.



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.



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.

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

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Big Stone County Soil and Water Conservation District. It was partially funded by the Legislative Committee for Minnesota Resources.

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

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

**Cover: An area of Esmond loam, 18 to 45 percent slopes, bouldery, along Big Stone Lake.**

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# Foreword

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This soil survey contains information that can be used in land-planning programs in Big Stone 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 Natural Resources Conservation Service or the Cooperative Extension Service.

Gary R. Nordstrom  
State Conservationist  
Natural Resources Conservation Service

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# Soil Survey of Big Stone County, Minnesota

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By Marc P. Diers, Natural Resources Conservation Service

Fieldwork by Marc P. Diers and Raymond C. Genrich, Natural Resources Conservation Service, and H. Gerald Floren and David H. Tufvesson, Minnesota Agricultural Experiment Station

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

BIG STONE COUNTY is in the west-central part of Minnesota, on the South Dakota border (fig. 1). It has a total area of 338,100 acres. Of this total, 20,300 acres is covered by water. The county has a population of 7,716. Ortonville, the county seat, has a population of 2,550.

Farming and businesses related to agriculture are the major industries in the county. Corn, soybeans, small grain, and hay are the most common crops. Beef cattle, dairy cattle, and swine are the main types of livestock.

The soils in Big Stone County are quite varied. They formed in several types of parent material on a variety of landscapes. The parent material in the county includes glacial till, glacial outwash, lacustrine sediments, colluvium, alluvium, and alluvium-mantled granite bedrock. Bedrock is exposed in some areas.

## General Nature of the County

This section provides general information about the survey area. It describes the climate and the physiography, relief, and drainage in the area.

### Climate

Big Stone County is cold in winter. It is generally hot in summer but has occasional cool spells. Precipitation during the winter frequently occurs as snowstorms. During the warm months it occurs mainly as showers, which are often heavy, caused by warm, moist air

moving into the area from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Artichoke Lake, Minnesota, in the period 1951 to 1984. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 14 degrees F and the average daily minimum temperature is 4 degrees. The lowest temperature on record, which occurred at Artichoke Lake on January 29, 1951, is -34 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on August 4, 1959, is 105 degrees.

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

The total annual precipitation is 23.75 inches. Of this, 17 inches, or about 74 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 14 inches. The

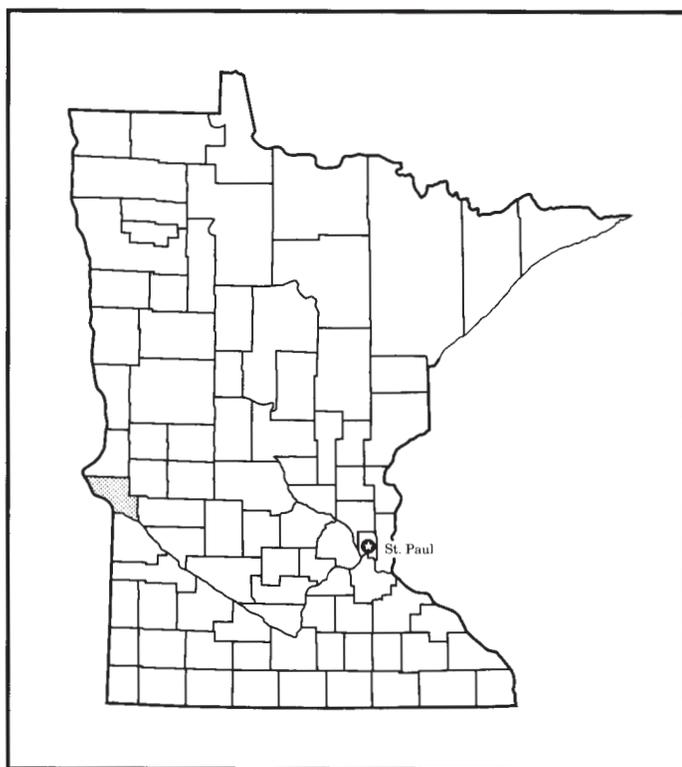


Figure 1.—Location of Big Stone County in Minnesota.

heaviest 1-day rainfall during the period of record was 3.57 inches at Artichoke Lake on August 13, 1957. Thunderstorms occur on about 36 days each year.

The average seasonal snowfall is about 37 inches. The greatest snow depth at any one time during the period of record was 31 inches. On the average, 42 days have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

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

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration. They result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

### Physiography, Relief, and Drainage

Big Stone County is generally level and has small, low rises and closed depressions. A hilly moraine,

called the Big Stone Moraine, extends from the southeastern part of the county to the northwest. This recessional moraine developed as the Des Moines Lobe of the Wisconsin glaciation retreated (6).

Several glacial lakes formed during the retreat of the Des Moines Lobe. The largest of these, Lake Agassiz and Lake Benson, had a decided influence on Big Stone County (7). A smaller proglacial lake also developed before Lake Agassiz. It was drained through the channel now known as Fish Creek. Small pockets of outwash material carried by the creek have been deposited along the existing channel.

Lake Agassiz, which developed north of Big Stone County, was fed by melting ice from the receding Des Moines Lobe. As it enlarged, the lake developed an outlet at Browns Valley, and the outlet stream became the glacial River Warren (5). This giant river dissected the landscape, creating a large valley. During that period, Lake Agassiz drained until its water level stabilized. As the lake received additional meltwater and grew larger, the river again cut into the valley, releasing more water. This cycle continued until the land area north and east of Lake Agassiz was at a lower elevation and the outlet at Browns Valley had cut to bedrock and was too high to release water.

The River Warren left outwash deposits, huge erratics, and boulder-paved till benches, which corresponded to the various breakouts from the lake. Outwash sediment is located on a large plain near Beardsley. One of the more prominent benches is near Correll and along Highway 7. This bench corresponds to the final southerly breakout from Lake Agassiz, which occurred about 9,200 years ago. The county was named "Big Stone" because of the huge boulder erratics along Highway 7 south of Ortonville.

When its water volume dropped, the River Warren could not transport the sediment brought into the valley by smaller tributary streams. The sediment carried by the Whetstone River eventually dammed the River Warren, creating Big Stone Lake. The old Warren River Valley is now the Minnesota River Valley, and Big Stone Lake is the source of the Minnesota River.

Proglacial Lake Benson developed south and east of Big Stone County, but it did not extend into the county. The lake basin is locally known as Pleasant Valley. Water from the Pomme de Terre River and the Chippewa River created the lake and carried the sediment that is now deposited in the basin.

### How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a

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

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

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

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Some of the boundaries on the soil maps of Big Stone County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. The differences are the result of improvements in the classification of soils, particularly modifications or refinements in series concepts. Also, there may be differences in the intensity of mapping or in the extent of the soils in the survey areas.

## Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other

natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes.

Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small

areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

# General Soil Map Units

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

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

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

## Soil Descriptions

### 1. Hamerly-Parnell-Lindaas Association

*Nearly level and gently undulating, very poorly drained to moderately well drained soils on till plains and moraines (fig. 2)*

#### **Setting**

*Landform and position on the landform:* Low convex rises, depressions, flats, and drainageways on till plains and moraines

*Slope range:* 0 to 6 percent

#### **Composition**

*Percent of survey area:* 25

*Extent of components in the association:*

Hamerly soils—40 percent

Parnell soils—25 percent

Lindaas soils—20 percent

Minor soils—15 percent

#### **Soil Properties and Qualities**

##### **Hamerly**

*Drainage class:* Somewhat poorly drained and moderately well drained

*Parent material:* Glacial till

*Surface texture:* Loam

##### **Parnell**

*Drainage class:* Very poorly drained

*Parent material:* Local alluvium and glacial till

*Surface texture:* Silty clay loam

##### **Lindaas**

*Drainage class:* Poorly drained

*Parent material:* Local alluvium and glacial till

*Surface texture:* Silty clay loam

#### **Minor Soils**

- The moderately well drained Aazdahl soils on low rises
- The poorly drained Vallers soils on flats and in drainageways
- The very poorly drained Bigstone soils in depressions, potholes, and large sloughs

#### **Use and Management**

*Major use:* Cropland

*Major management factors:* Soil blowing, excessive soil moisture

- Hamerly soils are suited to corn, soybeans, small grain, and alfalfa.
- Parnell and Lindaas soils are fairly suited to crops if adequate drainage is provided.

### 2. Gonvick-Lindaas Association

*Nearly level, moderately well drained and poorly drained soils on till plains and moraines*

#### **Setting**

*Landform and position on the landform:* Flats and drainageways on till plains and moraines

*Slope range:* 0 to 2 percent

#### **Composition**

*Percent of survey area:* 4

*Extent of components in the association:*

Gonvick soils—60 percent

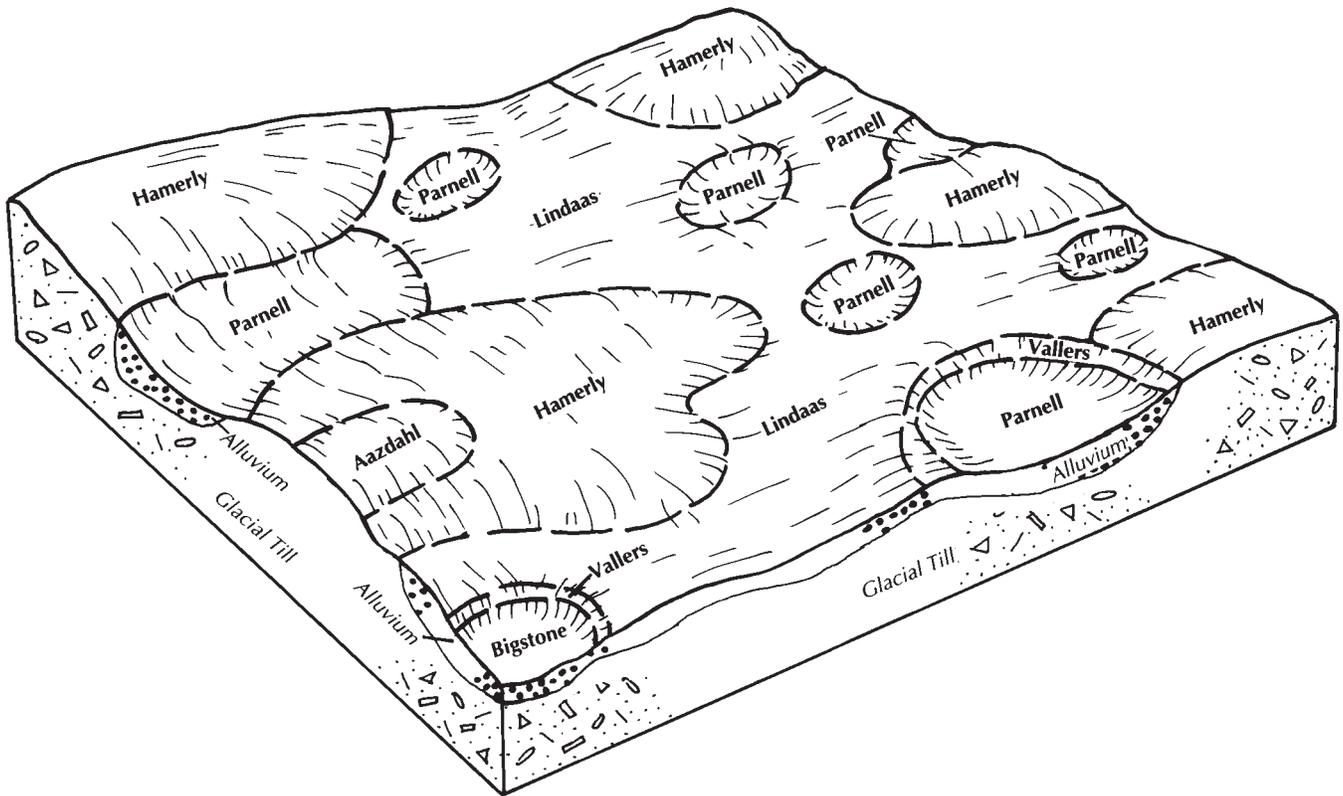


Figure 2.—Typical pattern of soils and parent material in the Hamerly-Parnell-Lindaas association.

Lindaas soils—15 percent  
 Minor soils—25 percent

### **Soil Properties and Qualities**

#### **Gonvick**

*Drainage class:* Moderately well drained  
*Parent material:* Glacial till  
*Surface texture:* Loam

#### **Lindaas**

*Drainage class:* Poorly drained  
*Parent material:* Local alluvium and glacial till  
*Surface texture:* Silty clay loam

### **Minor Soils**

- The moderately well drained Aazdahl soils on low rises and flats
- The well drained Formdale soils on plane and convex side slopes
- The somewhat poorly drained and moderately well drained Hamerly soils on low convex rises
- The poorly drained Flom soils in drainageways
- The poorly drained Vallery soils on flats

- The very poorly drained Bigstone soils in potholes and large sloughs
- The very poorly drained Parnell soils in depressions

### **Use and Management**

*Major use:* Cropland

*Major management factors:* Soil blowing, wetness

- Gonvick soils are suited to corn, soybeans, small grain, and alfalfa.
- Lindaas soils are fairly suited to crops if adequate drainage is provided.

## **3. Hattie-Fulda Association**

*Nearly level to rolling, poorly drained, moderately well drained, and well drained soils on till plains (fig. 3)*

### **Setting**

*Landform and position on the landform:* Low convex rises, side slopes, flats, and drainageways on till plains

*Slope range:* 0 to 10 percent

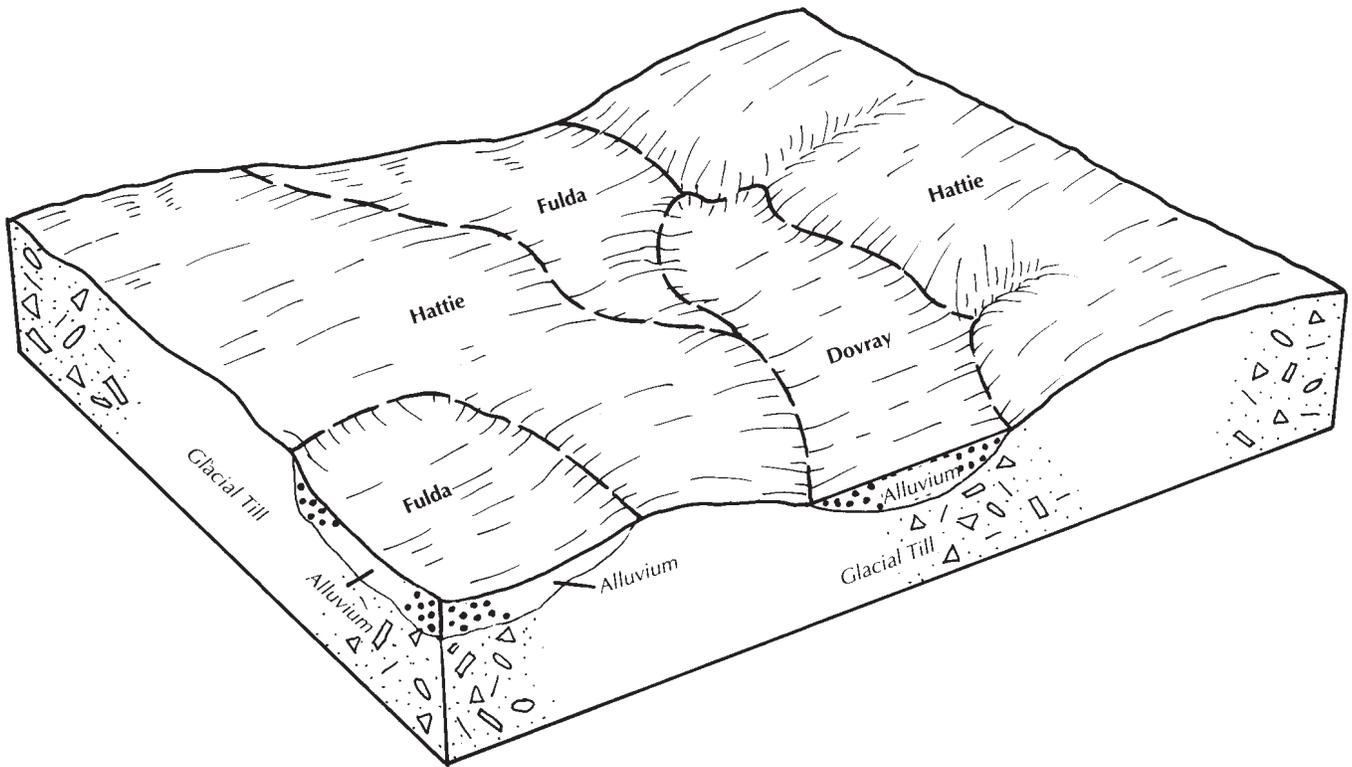


Figure 3.—Typical pattern of soils and parent material in the Hattie-Fulda association.

**Composition**

Percent of survey area: 18

Extent of components in the association:

- Hattie soils—50 percent
- Fulda soils—20 percent
- Minor soils—30 percent

**Soil Properties and Qualities**

**Hattie**

*Drainage class:* Moderately well drained and well drained

*Parent material:* Glacial till

*Surface texture:* Silty clay

**Fulda**

*Drainage class:* Poorly drained

*Parent material:* Local alluvium

*Surface texture:* Silty clay

**Minor Soils**

- The very poorly drained Dovray soils in depressions
- The very poorly drained Oldham soils in potholes and sloughs
- The very poorly drained Parnell soils in small, shallow depressions

- The well drained Formdale soils on side slopes adjacent to large potholes

**Use and Management**

*Major use:* Cropland

*Major management factors:* Soil blowing, wetness, water erosion

- Hattie soils are suited to corn, soybeans, small grain, and alfalfa.
- Fulda soils are fairly suited to crops if adequate drainage is provided.

**4. Esmond-Heimdal Association**

*Gently undulating to very steep, well drained soils on moraines (fig. 4)*

**Setting**

*Landform and position on the landform:* Side slopes and summits on moraines

*Slope range:* 2 to 45 percent

**Composition**

Percent of survey area: 29

Extent of components in the association:

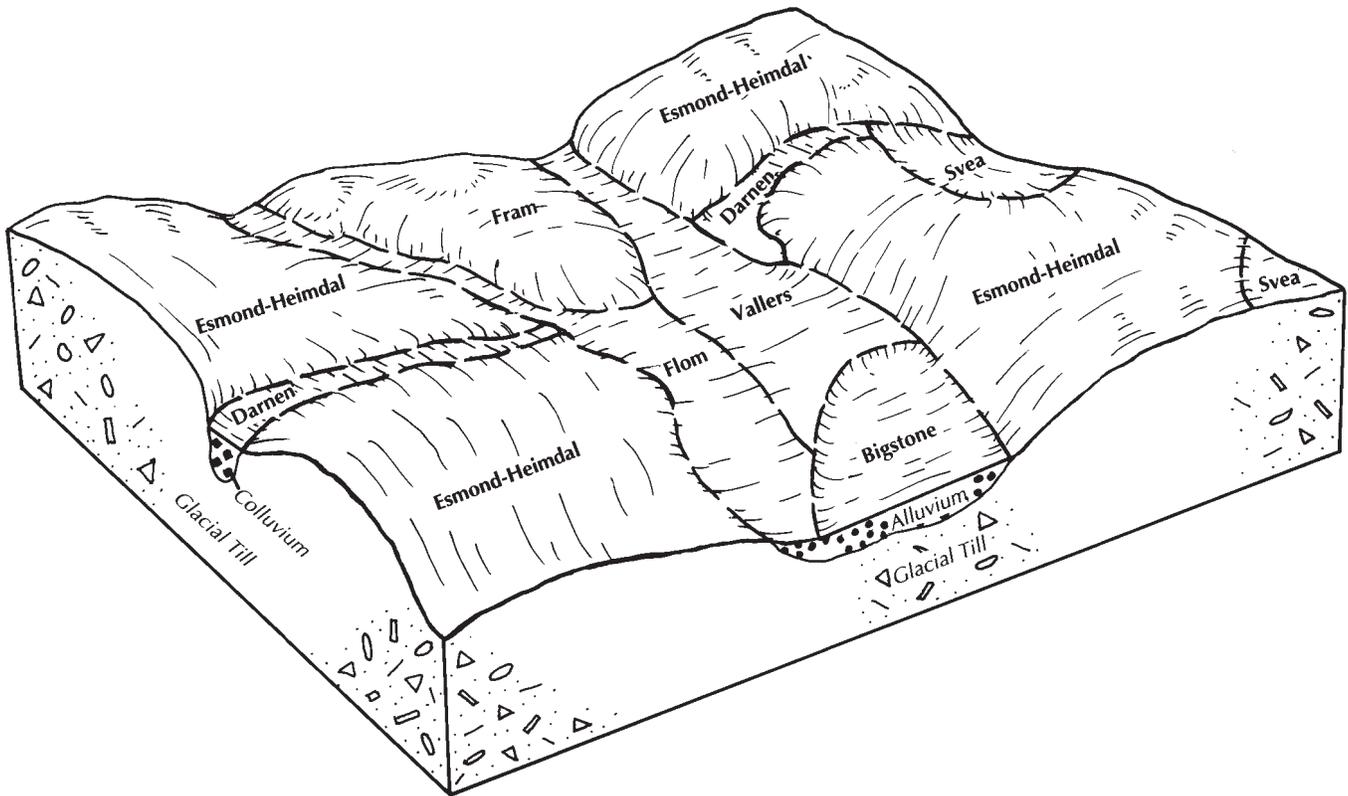


Figure 4.—Typical pattern of soils and parent material in the Esmond-Heimdal association.

Esmond soils—45 percent  
 Heimdal soils—25 percent  
 Minor soils—30 percent

### ***Soil Properties and Qualities***

#### **Esmond**

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

#### **Heimdal**

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

#### ***Minor Soils***

- The moderately well drained Darnen soils on toe slopes
- The moderately well drained Svea soils on concave side slopes, foot slopes, and hilltops
- The somewhat poorly drained and moderately well drained Fram soils on low convex rises
- The poorly drained Flom soils in drainage ways
- The poorly drained Vallery soils on flats

- The very poorly drained Bigstone soils in potholes and sloughs
- The very poorly drained Parnell soils in depressions
- The excessively drained Sioux soils on side slopes

### ***Use and Management***

*Major uses:* Cropland and pasture

*Major management factor:* Water erosion

- Areas of Esmond and Heimdal soils that have slopes of less than 12 percent are fairly suited to corn, soybeans, small grain, and alfalfa.
- Esmond and Heimdal soils are well suited to pasture.

## **5. Formdale-Buse Association**

*Gently undulating to hilly, well drained soils on moraines (fig. 5)*

### ***Setting***

*Landform and position on the landform:* Plane and convex side slopes and summits on moraines

*Slope range:* 2 to 18 percent

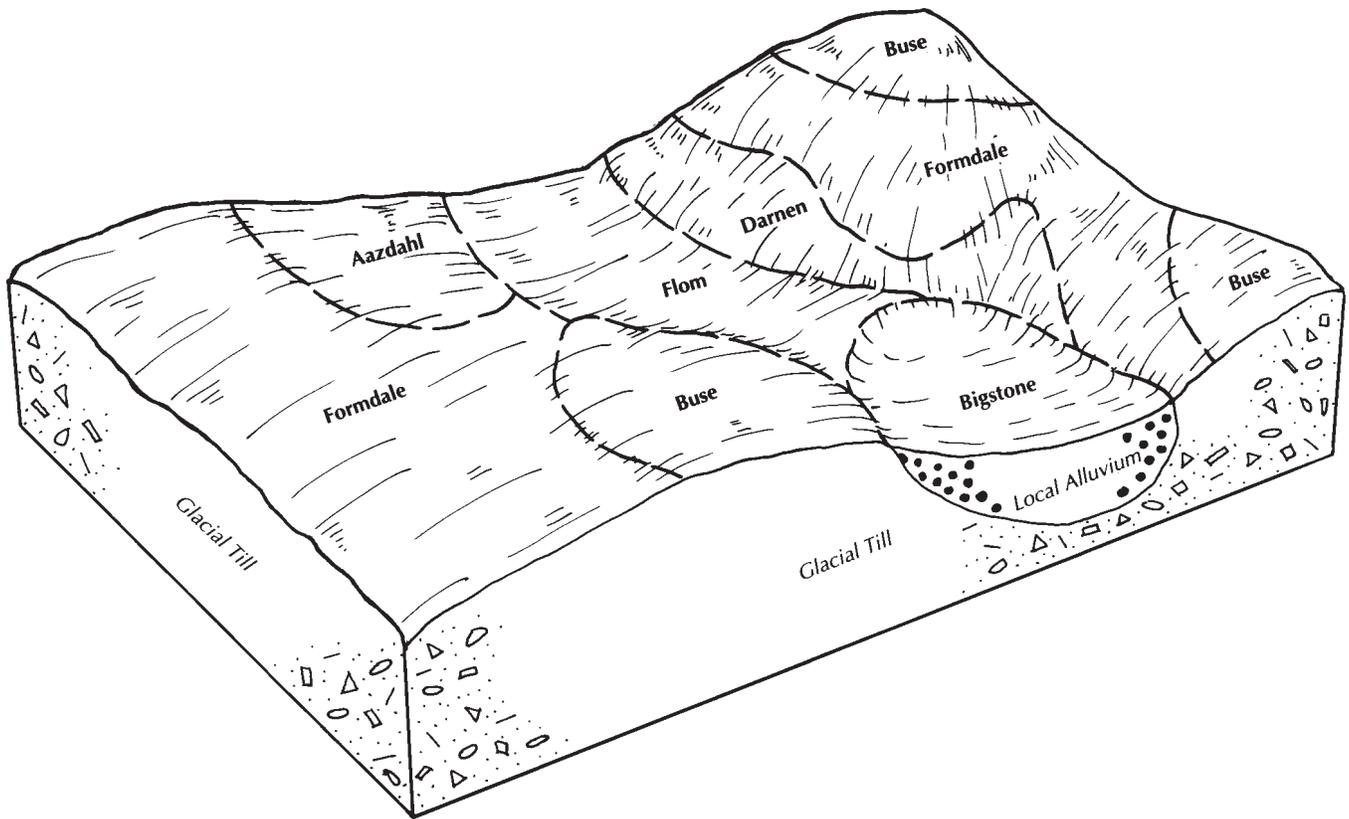


Figure 5.—Typical pattern of soils and parent material in the Formdale-Buse association.

**Composition**

Percent of survey area: 5

Extent of components in the association:

Formdale soils—45 percent

Buse soils—25 percent

Minor soils—30 percent

**Soil Properties and Qualities**

**Formdale**

Drainage class: Well drained

Parent material: Glacial till

Surface texture: Clay loam

**Buse**

Drainage class: Well drained

Parent material: Glacial till

Surface texture: Clay loam

**Minor Soils**

- The moderately well drained Aazdahl soils on plane and concave side slopes, foot slopes, and hilltops
- The moderately well drained Darnen soils on toe slopes
- The somewhat poorly drained and moderately well

drained Hamerly soils on low convex rises

- The poorly drained Flom and Lindaas soils in drainageways
- The poorly drained Vallers soils on flats
- The very poorly drained Parnell soils in depressions
- The very poorly drained Bigstone soils in potholes and sloughs

**Use and Management**

Major use: Cropland

Major management factor: Water erosion

- Formdale and Buse soils are suited to corn, soybeans, small grain, and alfalfa.

**6. Egeland-Marysland-Estelline Association**

Nearly level and gently undulating, well drained and poorly drained soils on outwash plains

**Setting**

Landform and position on the landform: Flats, low rises, side slopes, and drainageways on outwash plains  
Slope range: 0 to 6 percent

### **Composition**

*Percent of survey area:* 6

*Extent of components in the association:*

- Egeland soils—30 percent
- Marysland soils—20 percent
- Estelline soils—15 percent
- Minor soils—35 percent

### **Soil Properties and Qualities**

#### **Egeland**

*Drainage class:* Well drained

*Parent material:* Glacial outwash

*Surface texture:* Fine sandy loam

#### **Marysland**

*Drainage class:* Poorly drained

*Parent material:* Glacial outwash

*Surface texture:* Clay loam

#### **Estelline**

*Drainage class:* Well drained

*Parent material:* Lacustrine sediment over glacial outwash

*Surface texture:* Silt loam

### **Minor Soils**

- The moderately well drained Embden soils in drainageways and on concave flats
- The moderately well drained Malachy soils on convex rises
- The well drained Sverdrup soils on plane and convex side slopes and summits

### **Use and Management**

*Major uses:* Cropland and pasture

*Major management factors:* Droughtiness and soil blowing

- Egeland and Estelline soils are suited to pasture and to corn, soybeans, small grain, and alfalfa.
- Marysland soils are fairly suited to crops and pasture if adequate drainage is provided.

## **7. Fordville-Swenoda Association**

*Nearly level and gently undulating, moderately well drained and well drained soils on outwash plains and stream terraces (fig. 6)*

### **Setting**

*Landform and position on the landform:* Flats, low rises, hilltops, and side slopes on outwash plains and stream terraces

*Slope range:* 0 to 6 percent

### **Composition**

*Percent of survey area:* 5

*Extent of components in the association:*

- Fordville soils—40 percent
- Swenoda soils—25 percent
- Minor soils—35 percent

### **Soil Properties and Qualities**

#### **Fordville**

*Drainage class:* Well drained

*Parent material:* Glacial outwash

*Surface texture:* Loam

#### **Swenoda**

*Drainage class:* Moderately well drained and well drained

*Parent material:* Loamy sediment over glacial till

*Surface texture:* Sandy loam

### **Minor Soils**

- The excessively drained Sioux soils on convex side slopes and summits
- The somewhat excessively drained Arvilla and Renshaw soils on plane and convex flats and side slopes
- The moderately well drained Spottswood soils in drainageways

### **Use and Management**

*Major uses:* Cropland and pasture

*Major management factors:* Droughtiness and soil blowing

- Fordville and Swenoda soils are suited to pasture and to corn, soybeans, small grain, and alfalfa.

## **8. Gardena-Glyndon Association**

*Nearly level and gently undulating, moderately well drained soils on glacial lake plains*

### **Setting**

*Landform and position on the landform:* Flats and low rises on glacial lake plains

*Slope range:* 0 to 3 percent

### **Composition**

*Percent of survey area:* 2

*Extent of components in the association:*

- Gardena soils—40 percent
- Glyndon soils—25 percent
- Minor soils—35 percent

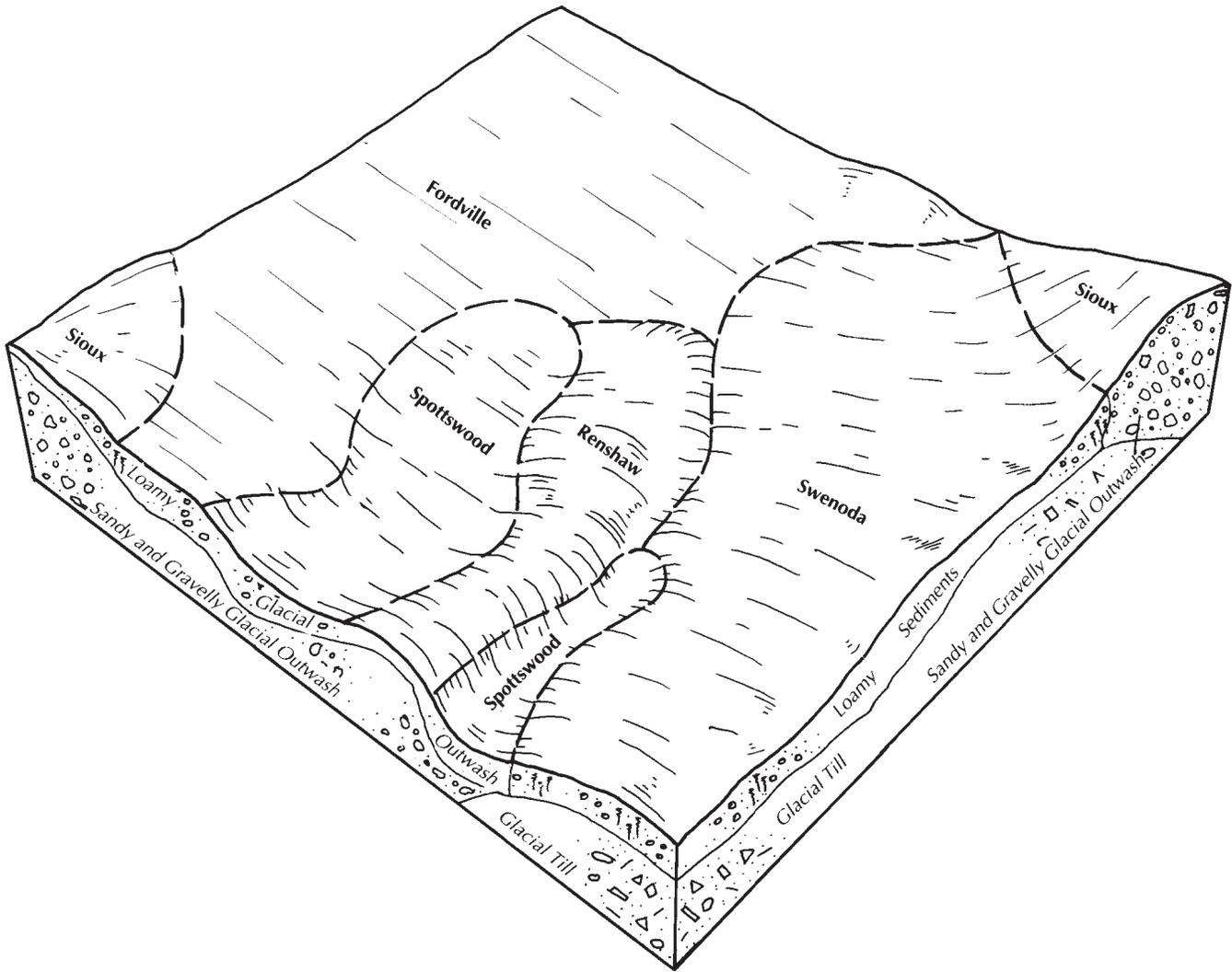


Figure 6.—Typical pattern of soils and parent material in the Fordville-Swenoda association.

**Soil Properties and Qualities**

**Gardena**

*Drainage class:* Moderately well drained  
*Parent material:* Lacustrine sediments  
*Surface texture:* Silt loam

**Glyndon**

*Drainage class:* Moderately well drained  
*Parent material:* Lacustrine sediments  
*Surface texture:* Silty clay loam

**Minor Soils**

- The well drained Zell soils on side slopes
- The moderately well drained Athelwold soils on flats
- The very poorly drained Bigstone soils in potholes, depressions, and sloughs

**Use and Management**

*Major use:* Cropland

*Major management factor:* Soil blowing

- Gardena and Glyndon soils are suited to corn, soybeans, small grain, and alfalfa.

**9. La Prairie-Lamoure Association**

*Nearly level, moderately well drained and poorly drained soils on flood plains (fig. 7)*

**Setting**

*Landform and position on the landform:* Flats on flood plains

*Slope range:* 0 to 2 percent

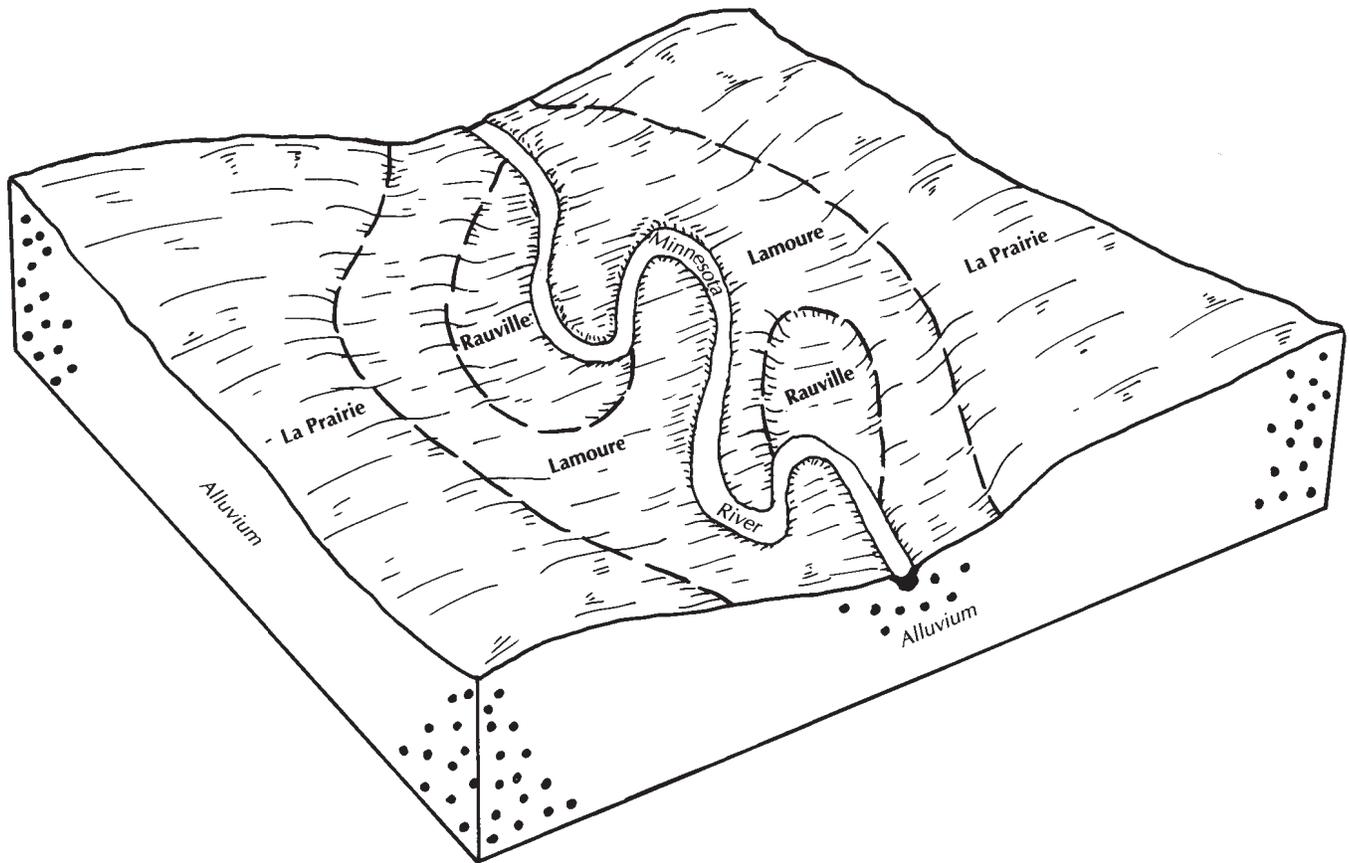


Figure 7.—Typical pattern of soils and parent material in the La Prairie-Lamoure association.

### **Composition**

*Percent of survey area:* 5

*Extent of components in the association:*

La Prairie soils—45 percent

Lamoure soils—30 percent

Minor soils—25 percent

### **Soil Properties and Qualities**

#### **La Prairie**

*Drainage class:* Moderately well drained

*Parent material:* Alluvium

*Surface texture:* Silt loam

#### **Lamoure**

*Drainage class:* Poorly drained

*Parent material:* Alluvium

*Surface texture:* Silty clay loam

### **Minor Soils**

- The very poorly drained Rauville soils in drainageways and oxbows

### **Use and Management**

*Major uses:* Cropland and pasture

*Major management factors:* Wetness and flooding

- La Prairie soils are suited to pasture and to corn, soybeans, small grain, and alfalfa.
- Lamoure soils are fairly suited to pasture and crops if adequate drainage is provided.

## **10. Copaston-Rock Outcrop Association**

*Rock outcrop and nearly level to hilly, well drained soils on bedrock-controlled benches*

### **Setting**

*Landform and position on the landform:* Flats and side slopes on bedrock-controlled benches

*Slope range:* 1 to 25 percent

### **Composition**

*Percent of survey area:* 1

*Extent of components in the association:*

Copaston soils—50 percent  
Granite bedrock outcrops—25 percent  
Minor soils—25 percent

***Soil Properties and Qualities***

**Copaston**

*Drainage class:* Well drained  
*Parent material:* Alluvium over bedrock  
*Surface texture:* Loam

***Minor Soils***

- The moderately well drained La Prairie soils on alluvial terraces
- The poorly drained Lamoure soils on flats and in drainageways
- The very poorly drained Rauville soils in drainageways and oxbows

***Use and Management***

*Major uses:* Pasture and wildlife habitat  
*Major management factor:* Bedrock outcrops

- Copaston soils are suited to pasture and wildlife habitat.

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# Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Hamerly loam, 3 to 6 percent slopes, is a phase of the Hamerly series.

Some map units are made up of two or more major soils. These map units are called soil complexes. 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. Esmond-Heimdal loams, 2 to 6 percent slopes, is an example.

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.

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

### 26—Aazdahl clay loam

#### *Composition*

Aazdahl soil and similar soils: 85 to 90 percent  
Contrasting inclusions: 10 to 15 percent

#### *Setting*

*Landform and position on the landform:* Concave side slopes, foot slopes, and low plane and convex rises on till plains and moraines

*Slope range:* 0 to 3 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

#### *Typical Profile*

0 to 8 inches—black clay loam

8 to 11 inches—very dark grayish brown clay loam

11 to 15 inches—dark grayish brown clay loam

15 to 24 inches—grayish brown and light olive brown, mottled, calcareous clay loam

24 to 60 inches—grayish brown and light olive brown, mottled, calcareous clay loam

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Flom and Lindaas soils, which are on flats and in drainageways
- The well drained Formdale soils, which are on plane and convex side slopes
- The somewhat poorly drained and moderately well drained, calcareous Hamerly soils, which are on low convex rises
- The very poorly drained Parnell soils, which are in depressions

*Similar soils:*

- Soils that have a surface layer of loam or silty clay loam
- Soils that have a dark surface layer more than 16 inches thick
- Soils that contain more clay in the subsoil

### **Use and Management**

#### **Cropland**

- This soil is well suited to crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* I

*Windbreak suitability group:* 1

## **34—Parnell silty clay loam**

### **Composition**

Parnell soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Depressions on till plains and moraines

*Slope range:* 0 to 1 percent

*Shape of areas:* Circular or irregular

*Size of areas:* 4 to 80 acres

### **Typical Profile**

0 to 8 inches—black silty clay loam

8 to 20 inches—very dark gray silty clay loam

20 to 37 inches—very dark gray silty clay

37 to 50 inches—dark grayish brown, mottled silty clay

50 to 60 inches—grayish brown, mottled, calcareous silty clay loam

### **Soil Properties and Qualities**

*Drainage class:* Very poorly drained

*Permeability:* Moderately slow in the upper part; slow in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Very slow or ponded

*Seasonal high water table:* 1 foot above to 1 foot below the surface

*Distinctive properties:* Subject to ponding

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Flom soils, which are on flats and in drainageways
- The somewhat poorly drained and moderately well drained, calcareous Fram and Hamerly soils, which are on low convex rises
- The poorly drained, calcareous Vallery soils, which are on flats and rims surrounding depressions

*Similar soils:*

- Soils that have a surface layer of silt loam
- Soils that have a surface layer of calcareous loam because of soil material washed in from adjacent areas
- Soils that contain less clay in the subsoil
- Poorly drained soils that are subject to ponding

### **Use and Management**

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* IIIw

*Windbreak suitability group:* 2W

## **36—Flom silty clay loam**

### **Composition**

Flom soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Flats and drainageways on till plains and moraines

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

**Typical Profile**

0 to 14 inches—black silty clay loam

14 to 20 inches—dark grayish brown, mottled clay loam

20 to 36 inches—grayish brown, mottled, calcareous clay loam

36 to 60 inches—olive gray, mottled, calcareous clay loam

**Soil Properties and Qualities**

*Drainage class:* Poorly drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 1 to 3 feet

**Inclusions**

*Contrasting inclusions:*

- The moderately well drained Aazdahl and Svea soils, which are on low rises, concave foot slopes, side slopes, and summits
- The moderately well drained Darnen soils, which are on concave toe slopes
- The moderately well drained and somewhat poorly drained, calcareous Fram and Hamerly soils, which are on low convex rises
- The very poorly drained Parnell soils, which are in depressions and have more clay in the subsoil than the Flom soil
- The poorly drained, calcareous Vallers soils, which are on flats and rims surrounding depressions

*Similar soils:*

- Soils that have a thick, dark surface layer
- Soils that contain more clay in the subsoil
- Soils that have a surface layer of clay loam

**Use and Management****Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

**Interpretive Groups**

*Land capability classification:* 1lw

*Windbreak suitability group:* 2W

**51—La Prairie silt loam****Composition**

La Prairie soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Flats on flood plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular or long and narrow

*Size of areas:* 10 to 200 acres

**Typical Profile**

0 to 16 inches—black silt loam

16 to 29 inches—very dark gray silt loam

29 to 60 inches—very dark grayish brown, mottled, calcareous silt loam

**Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3.5 to 6.0 feet

*Frequency of flooding:* Occasional

**Inclusions**

*Contrasting inclusions:*

- The poorly drained Lamoure soils, which are on bottom land
- The very poorly drained Rauville soils, which are on bottom land where stream and river channels actively change course

*Similar soils:*

- Soils that have a surface layer of loam or silty clay loam
- Soils that have strata containing more clay or sand

**Use and Management****Cropland**

- Seasonal flooding limits the production and harvesting of crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

**Interpretive Groups**

*Land capability classification:* 1lw

*Windbreak suitability group:* 1

## 60—Glyndon silty clay loam

### **Composition**

Glyndon soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Flats and low convex rises on glacial lake plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 400 acres

### **Typical Profile**

0 to 11 inches—black, calcareous silty clay loam

11 to 14 inches—dark grayish brown, calcareous silt loam

14 to 24 inches—brown, calcareous silt loam

24 to 32 inches—yellowish brown, mottled, calcareous very fine sandy loam

32 to 60 inches—grayish brown and yellowish brown, mottled, calcareous very fine sandy loam

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate or moderately rapid in the upper part; moderately rapid in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 2.5 to 6.0 feet

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Gardena soils, which are not calcareous

- The very poorly drained Bigstone soils, which are in depressions

- The well drained Zell soils, which are on side slopes

*Similar soils:*

- Soils that have a surface layer of silt loam

- Soils that have strata in the subsoil containing more clay or sand or both

### **Use and Management**

#### **Cropland**

- This soil has a high pH level because of a concentration of lime in the surface layer.

- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.

### **Interpretive Groups**

*Land capability classification:* IIs

*Windbreak suitability group:* 1K

## 70—Svea loam

### **Composition**

Svea soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Concave foot slopes, side slopes, and summits on till plains and moraines

*Slope range:* 0 to 3 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 200 acres

### **Typical Profile**

0 to 13 inches—black loam

13 to 17 inches—dark brown loam

17 to 60 inches—light olive brown, mottled, calcareous loam

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; moderately slow or moderate in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 4 to 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The well drained Esmond and Heimdal soils, which are on plane and convex side slopes and have a thinner dark surface layer than the Svea soil

- The poorly drained Flom soils, which are on flats and in drainageways

- The somewhat poorly drained and moderately well drained, calcareous Fram soils, which are on low convex rises

- The very poorly drained Parnell soils, which are in depressions

*Similar soils:*

- Soils that have a surface layer of silt loam or clay loam

- Soils that have a thin, dark surface layer
- Soils that contain more silt and clay in the subsoil
- Soils that have many stones or boulders on the surface

### ***Use and Management***

#### **Cropland**

- This soil is well suited to crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

#### ***Interpretive Groups***

*Land capability classification:* I

*Windbreak suitability group:* 1

### **127B—Sverdrup fine sandy loam, 1 to 6 percent slopes**

#### ***Composition***

Sverdrup soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

#### ***Setting***

*Landform and position on the landform:* Side slopes and summits on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 120 acres

#### ***Typical Profile***

0 to 8 inches—black fine sandy loam

8 to 14 inches—dark yellowish brown fine sandy loam

14 to 18 inches—dark yellowish brown loamy sand

18 to 60 inches—olive brown, calcareous loamy sand

#### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderately rapid in the upper part; rapid in the lower part

*Available water capacity:* Low

*Organic matter content:* Moderate

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

#### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Embden soils, which are on concave foot slopes and in drainageways

*Similar soils:*

- Soils that have a surface layer of loam or sandy loam
- Soils that have a light-colored, calcareous surface layer
- Soils that contain more clay in the subsoil
- Soils that have slopes of more than 6 percent

### ***Use and Management***

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

#### ***Interpretive Groups***

*Land capability classification:* IIIe

*Windbreak suitability group:* 6G

### **137—Dovray silty clay**

#### ***Composition***

Dovray soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

#### ***Setting***

*Landform and position on the landform:* Depressions, potholes, and sloughs on till plains

*Slope range:* 0 to 1 percent

*Shape of areas:* Circular or irregular

*Size of areas:* 4 to 1,200 acres

#### ***Typical Profile***

0 to 24 inches—black silty clay

24 to 36 inches—very dark grayish brown silty clay

36 to 60 inches—grayish brown, mottled, calcareous silty clay

#### ***Soil Properties and Qualities***

*Drainage class:* Very poorly drained

*Permeability:* Slow or moderately slow in the upper part; slow or very slow in the lower part

*Available water capacity:* Moderate

*Organic matter content:* High or very high

*Surface runoff:* Pondered

*Seasonal high water table:* 2 feet above to 1 foot below the surface

*Distinctive properties:* Subject to ponding

#### ***Inclusions***

*Contrasting inclusions:*

- The poorly drained Fulda soils, which are on flats and in drainageways
- The very poorly drained, calcareous Oldham soils

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that contain less clay in the surface layer

- Soils that are poorly drained
- Soils that have a surface layer of clay

### ***Use and Management***

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIIw

*Windbreak suitability group:* 2W

## **141A—Egeland fine sandy loam, 0 to 2 percent slopes**

### ***Composition***

Egeland soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### ***Setting***

*Landform and position on the landform:* Flats and low rises on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

### ***Typical Profile***

0 to 8 inches—black fine sandy loam

8 to 12 inches—very dark grayish brown sandy loam

12 to 26 inches—dark yellowish brown sandy loam

26 to 32 inches—yellowish brown sandy loam

32 to 60 inches—light olive brown, calcareous loamy fine sand

### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderately rapid

*Available water capacity:* Moderate

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Embden soils, which are in shallow drainageways
- The poorly drained, calcareous Marysland soils, which are in drainageways and on flats

*Similar soils:*

- Soils that have a surface layer of loam or sandy loam
- Soils that contain more silt and clay in the surface layer and subsoil
- Soils that contain more sand in the subsoil
- Soils that have slopes of more than 2 percent

### ***Use and Management***

#### **Cropland**

- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIIs

*Windbreak suitability group:* 5

## **141B—Egeland fine sandy loam, 2 to 6 percent slopes**

### ***Composition***

Egeland soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### ***Setting***

*Landform and position on the landform:* Side slopes on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 20 acres

### ***Typical Profile***

0 to 8 inches—very dark brown fine sandy loam

8 to 11 inches—very dark grayish brown fine sandy loam

11 to 22 inches—olive brown sandy loam

22 to 27 inches—light olive brown sandy loam

27 to 60 inches—light olive brown, calcareous loamy sand

### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderately rapid

*Available water capacity:* Moderate

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

#### *Contrasting inclusions:*

- The moderately well drained Embden soils, which are on concave foot slopes and in shallow drainageways

#### *Similar soils:*

- Soils that have a surface layer of loam or sandy loam
- Soils that contain more silt and clay in the surface layer and subsoil
- Soils that contain more sand in the subsoil
- Soils that have slopes of less than 2 percent

### ***Use and Management***

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIIe

*Windbreak suitability group:* 5

## **171B—Formdale clay loam, 2 to 4 percent slopes**

### ***Composition***

Formdale soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

### ***Setting***

*Landform and position on the landform:* Plane and convex side slopes on moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 160 acres

### ***Typical Profile***

0 to 8 inches—black clay loam

8 to 10 inches—very dark brown clay loam

10 to 14 inches—dark yellowish brown clay loam

14 to 24 inches—light olive brown, calcareous clay loam

24 to 60 inches—light olive brown, calcareous clay loam that has relict mottles

### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Medium

*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

#### *Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on concave foot slopes, side slopes, and hilltops
- The well drained, calcareous Buse soils, which are on convex side slopes and summits
- The poorly drained Flom soils, which are on flats and in drainageways
- The somewhat poorly drained and moderately well drained Hamerly soils, which are on low convex rises
- The poorly drained Lindaas soils, which are in drainageways
- The very poorly drained Parnell soils, which are in depressions

#### *Similar soils:*

- Soils that have a surface layer of silty clay loam
- Soils that contain more clay in the subsoil
- Soils that contain more sand in the surface layer
- Soils that have slopes of more than 4 percent

### ***Use and Management***

#### **Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIe

*Windbreak suitability group:* 3

## **180—Gonvick loam**

### ***Composition***

Gonvick soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Concave or convex flats on till plains

*Slope range:* 1 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 10 to 400 acres

### ***Typical Profile***

0 to 8 inches—black loam

8 to 15 inches—dark brown clay loam

15 to 25 inches—dark yellowish brown clay loam

25 to 36 inches—olive brown, mottled, calcareous clay loam

36 to 60 inches—light olive brown, mottled, calcareous clay loam

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 2.5 to 4.0 feet

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Flom soils, which are on flats and in drainageways
- The well drained Formdale soils, which are on side slopes
- The somewhat poorly drained and moderately well drained, calcareous Hamerly soils, which are on low convex rises
- The poorly drained Lindaas soils, which are in drainageways
- The very poorly drained Parnell soils, which are in depressions

*Similar soils:*

- Soils that have a surface layer of clay loam
- Soils that contain less clay in the subsoil

### **Use and Management**

#### **Cropland**

- This soil is well suited to crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* I

*Windbreak suitability group:* 1

## **184A—Hamerly loam, 1 to 3 percent slopes**

### **Composition**

Hamerly soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Low convex rises on till plains and moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### **Typical Profile**

0 to 8 inches—black, calcareous loam

8 to 16 inches—light brownish gray, calcareous clay loam

16 to 28 inches—light brownish gray, mottled, calcareous clay loam

28 to 60 inches—light olive brown, mottled, calcareous clay loam

### **Soil Properties and Qualities**

*Drainage class:* Somewhat poorly drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 2 to 4 feet

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on low rises, concave foot slopes, and side slopes and are not calcareous
- The poorly drained Flom soils, which are on flats and in drainageways
- The poorly drained Lindaas soils, which are in drainageways
- The very poorly drained Parnell soils, which are in depressions
- The poorly drained Vallers soils, which are on flats and rims surrounding depressions

*Similar soils:*

- Soils that have a surface layer of clay loam or silt loam
- Soils that contain more silt in the subsoil
- Soils that have slopes of more than 3 percent

### **Use and Management**

#### **Cropland**

- This soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.

### **Interpretive Groups**

*Land capability classification:* II<sub>s</sub>

*Windbreak suitability group:* 1K

**184B—Hamerly loam, 3 to 6 percent slopes****Composition**

Hamerly soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Convex rises on till plains and moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 20 acres

**Typical Profile**

0 to 8 inches—very dark gray, calcareous loam

8 to 20 inches—light yellowish brown, calcareous clay loam

20 to 60 inches—light olive brown, mottled, calcareous clay loam

**Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow or medium

*Depth to the seasonal high water table:* 2 to 4 feet

**Inclusions**

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on low rises, concave foot slopes, and side slopes and are not calcareous
- The well drained Buse soils, which are on convex side slopes and summits
- The poorly drained Lindaas soils, which are in drainageways

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silt loam or clay loam
- Soils that contain more silt in the subsoil
- Soils that have slopes of less than 3 percent

**Use and Management****Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of

conservation tillage help to maintain or improve fertility.

- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

**Interpretive Groups**

*Land capability classification:* IIe

*Windbreak suitability group:* 1K

**185B—Hattie silty clay, 1 to 4 percent slopes****Composition**

Hattie soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

**Setting**

*Landform and position on the landform:* Low plane and convex rises and side slopes and summits on till plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 200 acres

**Typical Profile**

0 to 8 inches—black, calcareous silty clay

8 to 15 inches—olive brown, calcareous silty clay

15 to 22 inches—olive brown, calcareous silty clay

22 to 60 inches—olive brown, mottled, calcareous silty clay

**Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Slow

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 6 feet

**Inclusions**

*Contrasting inclusions:*

- The very poorly drained Dovray, Oldham, and Parnell soils, which are in depressions
- The poorly drained Fulda soils, which are on flats and in drainageways

*Similar soils:*

- Soils that have a thick, dark surface layer
- Soils that have a surface layer of silty clay loam or clay
- Soils that have a leached surface layer
- Soils that contain less clay
- Soils that have slopes of more than 4 percent

### ***Use and Management***

#### **Cropland**

- This soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.

#### ***Interpretive Groups***

*Land capability classification:* II<sub>s</sub>

*Windbreak suitability group:* 4C

### **185C—Hattie silty clay, 4 to 10 percent slopes**

#### ***Composition***

Hattie soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

#### ***Setting***

*Landform and position on the landform:* Side slopes on till plains

*Shape of areas:* Irregular or long and narrow

*Size of areas:* 4 to 80 acres

#### ***Typical Profile***

0 to 9 inches—black, calcareous silty clay

9 to 19 inches—light olive brown, calcareous silty clay

19 to 60 inches—light brown, mottled, calcareous silty clay

#### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Slow

*Available water capacity:* Moderate

*Organic matter content:* Moderate or high

*Surface runoff:* Medium

*Depth to the seasonal high water table:* More than 6 feet

#### ***Inclusions***

*Contrasting inclusions:*

- The poorly drained Fulda soils, which are in drainageways
- The well drained Formdale soils, which are on convex side slopes and contain less clay than the Hattie soil

*Similar soils:*

- Soils that have a surface layer of silty clay loam or clay
- Soils that have slopes of less than 4 percent

### ***Use and Management***

#### **Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

#### ***Interpretive Groups***

*Land capability classification:* III<sub>e</sub>

*Windbreak suitability group:* 4C

### **192A—Estelline silt loam, 0 to 2 percent slopes**

#### ***Composition***

Estelline soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

#### ***Setting***

*Landform and position on the landform:* Flats on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

#### ***Typical Profile***

0 to 8 inches—black silt loam

8 to 11 inches—very dark grayish brown silt loam

11 to 22 inches—dark brown silt loam

22 to 28 inches—yellowish brown, calcareous silty clay loam

28 to 60 inches—yellowish brown, calcareous sand

#### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Available water capacity:* Moderate

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

**Inclusions***Contrasting inclusions:*

- The moderately well drained Athelwold soils, which are in drainageways and shallow depressions

*Similar soils:*

- Soils that have a surface layer of silty clay loam
- Soils that have a thin, dark surface layer
- Soils that contain more sand in the surface layer and subsoil
- Soils that have slopes of more than 2 percent

**Use and Management****Cropland**

- Rotating crops, establishing field windbreaks, and applying a system of conservation tillage conserve soil moisture.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

**Interpretive Groups**

*Land capability classification:* IIs

*Windbreak suitability group:* 6G

**192B—Estelline silt loam, 2 to 6 percent slopes****Composition**

Estelline soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

**Setting**

*Landform and position on the landform:* Side slopes on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 20 acres

**Typical Profile**

0 to 8 inches—very dark gray silt loam

8 to 10 inches—very dark grayish brown silt loam

10 to 18 inches—dark yellowish brown silt loam

18 to 24 inches—light olive brown, calcareous silt loam

24 to 60 inches—light olive brown, calcareous sand

**Soil Properties and Qualities**

*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Available water capacity:* Moderate

*Organic matter content:* High

*Surface runoff:* Slow or medium

*Depth to the seasonal high water table:* More than 6 feet

**Inclusions***Contrasting inclusions:*

- The moderately well drained Athelwold soils, which are in drainageways and shallow depressions
- The excessively drained, calcareous Sioux soils, which are on side slopes and contain more sand in the surface layer and subsoil than the Estelline soil

*Similar soils:*

- Soils that have a surface layer of silty clay loam
- Soils that have more sand in the surface layer and subsoil
- Soils that have slopes of less than 2 percent

**Use and Management****Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

**Interpretive Groups**

*Land capability classification:* IIe

*Windbreak suitability group:* 6G

**210—Fulda silty clay****Composition**

Fulda soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

**Setting**

*Landform and position on the landform:* Flats and drainageways on till plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

**Typical Profile**

0 to 13 inches—black silty clay

13 to 22 inches—dark grayish brown, mottled silty clay

22 to 46 inches—grayish brown, mottled, calcareous silty clay

46 to 60 inches—olive gray, mottled, calcareous silty clay

**Soil Properties and Qualities**

*Drainage class:* Poorly drained

*Permeability:* Slow or moderately slow in the upper part; moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 1 to 3 feet

*Frequency of flooding:* Rare

### **Inclusions**

*Contrasting inclusions:*

- The very poorly drained Dovray, Oldham, and Parnell soils, which are in depressions
- The moderately well drained and well drained Hattie soils, which are on low rises and side slopes

*Similar soils:*

- Soils that have a thick, dark surface layer
- Soils that have a calcareous surface layer
- Soils that have a surface layer of clay or silty clay loam

### **Use and Management**

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Seasonal flooding limits the production and harvesting of crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* 11w

*Windbreak suitability group:* 2W

## **236—Vallers clay loam**

### **Composition**

Vallers soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Flats, drainageways, and rims surrounding depressions on till plains and moraines

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### **Typical Profile**

0 to 13 inches—black, calcareous clay loam

13 to 26 inches—grayish brown, mottled, calcareous clay loam

26 to 60 inches—olive, mottled, calcareous clay loam

## **Soil Properties and Qualities**

*Drainage class:* Poorly drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 1.0 to 2.5 feet

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Flom and Lindaas soils, which are on flats and in drainageways and are not calcareous
- The moderately well drained and somewhat poorly drained Fram and Hamerly soils, which are on low convex rises
- The very poorly drained Parnell and Bigstone soils, which are in depressions

*Similar soils:*

- Soils that have a thick, dark surface layer
- Soils that have a surface layer of silty clay loam
- Soils that contain more clay

### **Use and Management**

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* 11w

*Windbreak suitability group:* 2K

## **246—Marysland clay loam**

### **Composition**

Marysland soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Flats and drainageways on outwash plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 1,000 acres

### **Typical Profile**

0 to 18 inches—black, calcareous clay loam

18 to 32 inches—dark grayish brown, mottled, calcareous loam

32 to 38 inches—grayish brown, mottled, calcareous loam

38 to 60 inches—grayish brown, mottled, calcareous sand

### **Soil Properties and Qualities**

*Drainage class:* Poorly drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Available water capacity:* Moderate

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 1.0 to 2.5 feet

*Frequency of flooding:* Rare

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Malachy soils, which are on low rises

*Similar soils:*

- Very poorly drained soils in depressions
- Soils that have a surface layer of loam, silt loam, silty clay loam, or sandy clay loam
- Soils that have coarse material at a depth of more than 40 inches
- Soils that have coarse material at a depth of less than 20 inches

### **Use and Management**

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Seasonal flooding limits the production and harvesting of crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* 1lw

*Windbreak suitability group:* 2K

### **276—Oldham silty clay**

#### **Composition**

Oldham soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

#### **Setting**

*Landform and position on the landform:* Depressions, potholes, and sloughs on till plains

*Slope range:* 0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 400 acres

#### **Typical Profile**

0 to 22 inches—black, calcareous silty clay

22 to 30 inches—very dark gray, calcareous silty clay

30 to 60 inches—olive gray, mottled, calcareous silty clay

#### **Soil Properties and Qualities**

*Drainage class:* Very poorly drained

*Permeability:* Slow in the upper part; slow or moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow to ponded

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

*Distinctive properties:* Subject to ponding

#### **Inclusions**

*Contrasting inclusions:*

- The very poorly drained Dovray soils, which are in landscape positions similar to those of the Oldham soil and are not calcareous
- The poorly drained Fulda soils, which are in drainageways and are not calcareous
- The moderately well drained and well drained Hattie soils, which are on rises and side slopes

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silty clay loam
- Soils that contain less clay
- Soils that contain as much as 2 percent rock fragments

#### **Use and Management**

##### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.

- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### ***Interpretive Groups***

*Land capability classification:* IIIw

*Windbreak suitability group:* 2W

## **288D—Esmond loam, 12 to 18 percent slopes**

### ***Composition***

Esmond soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Side slopes on moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### ***Typical Profile***

0 to 8 inches—dark brown, calcareous loam

8 to 15 inches—light yellowish brown, calcareous loam

15 to 60 inches—light olive brown, calcareous loam

### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Rapid

*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes and have a thick, dark surface layer
- The well drained Heimdal soils, which are on side slopes and are not calcareous
- The poorly drained Flom soils, which are on flats and in drainageways

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that contain more clay and silt
- Soils that have slopes of less than 12 percent or more than 18 percent

### ***Use and Management***

#### **Cropland**

• This soil has a high pH level because of a concentration of lime in the surface layer.

• Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

#### **Pasture and forage**

• This soil is suited to pasture and hay and to wildlife habitat.

• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

### ***Interpretive Groups***

*Land capability classification:* VIe

*Windbreak suitability group:* 10

## **293A—Swenoda sandy loam, 0 to 2 percent slopes**

### ***Composition***

Swenoda soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

### ***Setting***

*Landform and position on the landform:* Flats, low rises, and summits on outwash plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 300 acres

### ***Typical Profile***

0 to 14 inches—black sandy loam

14 to 28 inches—dark brown sandy loam

28 to 33 inches—olive brown fine sandy loam

33 to 60 inches—olive brown, grayish brown, and light olive brown, mottled, calcareous clay loam

### ***Soil Properties and Qualities***

*Drainage class:* Moderately well drained

*Permeability:* Moderately rapid in the upper part; moderately slow or moderate in the lower part

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 2.5 to 4.0 feet

### ***Inclusions***

*Contrasting inclusions:*

- The poorly drained Flom soils, which are in drainageways and contain less sand in the surface layer and subsoil than the Swenoda soil
- The well drained Fordville soils, which are on level flats and contain less clay in the underlying material than the Swenoda soil
- The moderately well drained Spottswood soils, which are in drainageways and contain less clay in the underlying material than the Swenoda soil

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of fine sandy loam or loam
- Soils that have slopes of more than 2 percent

### ***Use and Management***

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIc

*Windbreak suitability group:* 5

## **293B—Swenoda sandy loam, 2 to 6 percent slopes**

### ***Composition***

Swenoda soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### ***Setting***

*Landform and position on the landform:* Side slopes on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 20 acres

### ***Typical Profile***

- 0 to 13 inches—very dark gray sandy loam
- 13 to 23 inches—dark grayish brown sandy loam
- 23 to 32 inches—dark grayish brown loamy sand
- 32 to 60 inches—olive brown, mottled, calcareous loam

### ***Soil Properties and Qualities***

*Drainage class:* Well drained

*Permeability:* Moderately rapid in the upper part;

moderate or moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

*Contrasting inclusions:*

- The somewhat excessively drained Arvilla soils, which are on level flats and contain less clay in the underlying material than the Swenoda soil
- The well drained Egeland soils, which are on flats, low rises, and side slopes and contain less clay in the underlying material than the Swenoda soil

*Similar soils:*

- Soils that have a thick, dark surface layer
- Soils that have a surface layer of fine sandy loam or loam
- Soils that have slopes of less than 2 percent

### ***Use and Management***

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIc

*Windbreak suitability group:* 5

## **296B—Fram loam, 1 to 4 percent slopes**

### ***Composition***

Fram soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Low convex rises on till plains and moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### ***Typical Profile***

- 0 to 8 inches—black, calcareous loam
- 8 to 15 inches—grayish brown, calcareous loam
- 15 to 60 inches—light olive brown, mottled, calcareous loam

### **Soil Properties and Qualities**

*Drainage class:* Somewhat poorly drained and moderately well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 2 to 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Flom soils, which are in drainageways
- The moderately well drained Svea soils, which are on low rises, concave foot slopes, and side slopes and are not calcareous
- The very poorly drained Parnell soils, which are in depressions
- The poorly drained Vallers soils, which are on flats and rims surrounding depressions

*Similar soils:*

- Soils that have a surface layer of silt loam
- Soils that contain more clay in the subsoil
- Soils that have slopes of more than 4 percent

### **Use and Management**

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* IIe

*Windbreak suitability group:* 1K

## **314—Spottswood loam**

### **Composition**

Spottswood soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Flats, drainageways, and shallow depressions on outwash plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular or long and narrow

*Size of areas:* 4 to 80 acres

### **Typical Profile**

0 to 8 inches—black loam

8 to 19 inches—very dark brown loam

19 to 22 inches—dark grayish brown clay loam

22 to 32 inches—dark grayish brown, mottled loam

32 to 60 inches—grayish brown and light olive brown, calcareous gravelly sand

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Available water capacity:* Moderate

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The somewhat excessively drained Renshaw soils, which are on side slopes at the higher elevations
- The excessively drained Sioux soils, which are on side slopes at the higher elevations

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silt loam
- Soils that have coarse material at a depth of less than 20 inches
- Soils that contain more sand in the surface layer and subsoil

### **Use and Management**

#### **Cropland**

- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.

### **Interpretive Groups**

*Land capability classification:* IIs

*Windbreak suitability group:* 1

## **339—Fordville loam**

### **Composition**

Fordville soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

**Setting**

*Landform and position on the landform:* Flats on  
outwash plains and stream terraces

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 10 to 500 acres

**Typical Profile**

0 to 8 inches—black loam

8 to 19 inches—very dark brown loam

19 to 26 inches—dark yellowish brown loam

26 to 33 inches—olive brown clay loam

33 to 60 inches—light olive brown, calcareous gravelly  
loamy sand

**Soil Properties and Qualities**

*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; rapid in the  
lower part

*Available water capacity:* Moderate

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

**Inclusions**

*Contrasting inclusions:*

- The moderately well drained Spottswood soils, which are in drainageways and shallow depressions
- The moderately well drained and well drained Swenoda soils, which are on flats, low rises, summits, and side slopes and have more clay in the underlying material than the Fordville soil
- Poorly drained soils in depressions

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silt loam
- Soils that have coarse material at a depth of less than 24 inches
- Soils that contain more sand in the surface layer and subsoil

**Use and Management****Cropland**

- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks (fig. 8), and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.

**Interpretive Groups**

*Land capability classification:* IIs

*Windbreak suitability group:* 6G

**341—Arvilla loam****Composition**

Arvilla soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Flats on  
outwash plains and stream terraces

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 80 acres

**Typical Profile**

0 to 10 inches—black loam

10 to 15 inches—dark brown sandy loam

15 to 34 inches—light olive brown loamy sand

34 to 60 inches—light olive brown, calcareous gravelly  
loamy sand

**Soil Properties and Qualities**

*Drainage class:* Somewhat excessively drained

*Permeability:* Moderately rapid in the upper part; rapid in  
the lower part

*Available water capacity:* Moderately low or moderate

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

**Inclusions**

*Contrasting inclusions:*

- The moderately well drained Spottswood soils, which are in drainageways and shallow depressions
- The excessively drained, calcareous Sioux soils, which are on summits and side slopes
- The moderately well drained and well drained Swenoda soils, which are on low rises and side slopes and contain more clay in the underlying material than the Arvilla soil
- Poorly drained soils in drainageways and depressions

*Similar soils:*

- Soils that have a surface layer of sandy loam
- Soils that contain less sand in the subsoil
- Soils that have coarse material at a depth of more than 24 inches

**Use and Management****Cropland**

- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- Using a cropping system that includes grasses or



Figure 8.—This field windbreak in an area of Fordville loam helps to control soil blowing.

legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIIs

*Windbreak suitability group:* 6G

### **344—Bigstone silty clay loam**

#### ***Composition***

Bigstone soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

#### ***Setting***

*Landform and position on the landform:* Depressions, potholes, and sloughs on till plains and moraines

*Slope range:* 0 to 1 percent

*Shape of areas:* Circular or irregular

*Size of areas:* 20 to 400 acres

#### ***Typical Profile***

0 to 22 inches—black, calcareous silty clay loam

22 to 45 inches—very dark gray, calcareous silty clay loam

45 to 60 inches—olive gray, mottled, calcareous clay loam

### ***Soil Properties and Qualities***

*Drainage class:* Very poorly drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Very slow or ponded

*Seasonal high water table:* 1 foot above to 1 foot below the surface

*Distinctive properties:* Subject to ponding

### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes
- The poorly drained Vallers soils, which are on rims surrounding depressions

*Similar soils:*

- Soils that have a surface layer of silt loam
- Soils that have a surface layer of loam, clay loam, or silty clay because of soil material washed in from adjacent areas
- Soils that contain more clay in the subsoil
- Soils that contain more clay throughout

**Use and Management****Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

**Interpretive Groups**

*Land capability classification:* IIIw

*Windbreak suitability group:* 2K

**347—Malachy loam****Composition**

Malachy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Flats and low rises on outwash plains

*Slope range:* 0 to 3 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 100 acres

**Typical Profile**

0 to 13 inches—black, calcareous loam

13 to 19 inches—very dark gray, calcareous loam

19 to 24 inches—dark grayish brown, calcareous loam

24 to 33 inches—grayish brown, mottled, calcareous loam

33 to 60 inches—grayish brown and light olive brown, mottled, calcareous loamy fine sand

**Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part

*Available water capacity:* Moderate

*Organic matter content:* Moderate or high

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 5 feet

**Inclusions***Contrasting inclusions:*

- The well drained Egeland soils, which are on side slopes, low rises, and flats, are not calcareous, and have a thin, dark surface layer
- The well drained Sverdrup soils, which are on side slopes, are not calcareous, and have a thin, dark surface layer
- The poorly drained Marysland soils, which are on flats and in drainageways

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that do not have a calcareous surface layer

**Use and Management****Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

**Interpretive Groups**

*Land capability classification:* IIs

*Windbreak suitability group:* 1K

**373B—Renshaw loam, 0 to 6 percent slopes****Composition**

Renshaw soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

**Setting**

*Landform and position on the landform:* Flats, side slopes, and summits on outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 160 acres

### **Typical Profile**

0 to 10 inches—black loam  
 10 to 17 inches—dark yellowish brown loam  
 17 to 60 inches—yellowish brown, calcareous gravelly sand

### **Soil Properties and Qualities**

*Drainage class:* Somewhat excessively drained  
*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part  
*Available water capacity:* Low  
*Organic matter content:* Moderate  
*Surface runoff:* Slow  
*Depth to the seasonal high water table:* More than 6 feet

### **Inclusions**

#### *Contrasting inclusions:*

- The moderately well drained Spottswood soils, which are in drainageways and shallow depressions
- The excessively drained, calcareous Sioux soils, which are in landscape positions similar to those of the Renshaw soil and contain less clay in the surface layer and subsoil
- The moderately well drained and well drained Swenoda soils, which are in landscape positions similar to those of the Renshaw soil and contain more clay in the underlying material

#### *Similar soils:*

- Soils that have a surface layer of gravelly loam
- Soils that have coarse material at a depth of more than 24 inches
- Soils that contain more sand in the surface layer

### **Use and Management**

#### **Cropland**

- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* IVs  
*Windbreak suitability group:* 6G

## **402B—Sioux loam, 1 to 6 percent slopes**

### **Composition**

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

### **Setting**

*Landform and position on the landform:* Side slopes and summits on moraines and outwash plains  
*Shape of areas:* Irregular  
*Size of areas:* 4 to 20 acres

### **Typical Profile**

0 to 8 inches—very dark gray, calcareous loam  
 8 to 14 inches—brown, calcareous gravelly loam  
 14 to 60 inches—yellowish brown, calcareous gravelly sand

### **Soil Properties and Qualities**

*Drainage class:* Excessively drained  
*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part  
*Available water capacity:* Low  
*Organic matter content:* Moderately low or moderate  
*Surface runoff:* Slow  
*Depth to the seasonal high water table:* More than 6 feet

### **Inclusions**

#### *Contrasting inclusions:*

- The somewhat excessively drained Arvilla soils, which are on broad flats, are not calcareous, and contain less gravel in the surface layer and subsoil than the Sioux soil
- The somewhat excessively drained Renshaw soils, which are in landscape positions similar to those of the Sioux soil, are not calcareous, and contain more clay in the surface layer and subsoil
- The moderately well drained Spottswood soils, which are in drainageways and shallow depressions, are not calcareous, and contain more clay in the surface layer and subsoil than the Sioux soil

#### *Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of gravelly loam, sandy loam, or gravelly sandy loam
- Soils that have slopes of more than 6 percent

### **Use and Management**

#### **Cropland**

- In nonirrigated areas, crops that can tolerate drought are the best suited.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing and conserve moisture.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime

should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* VIs

*Windbreak suitability group:* 10

## **402E—Sioux loam, 6 to 35 percent slopes**

### **Composition**

Sioux soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Side slopes on moraines and outwash plains

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### **Typical Profile**

0 to 8 inches—very dark gray, calcareous gravelly loam

8 to 12 inches—dark brown, calcareous gravelly loam

12 to 60 inches—yellowish brown very gravelly sand

### **Soil Properties and Qualities**

*Drainage class:* Excessively drained

*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part

*Available water capacity:* Low

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Slow

*Depth to the seasonal high water table:* More than 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The somewhat excessively drained Arvilla soils, which are not calcareous and contain less gravel in the surface layer and subsoil than the Sioux soil
- The well drained Buse and Esmond soils, which are in landscape positions similar to those of the Sioux soil and contain more clay and less gravel
- The moderately well drained Darnen soils, which are on concave toe slopes, are not calcareous, and contain more clay and less gravel than the Sioux soil

*Similar soils:*

- Soils that have a surface layer of gravelly loam, sandy loam, or gravelly sandy loam
- Soils that have slopes of less than 6 percent

### **Use and Management**

#### **Cropland**

- This soil has a high pH level because of a concentration of lime in the surface layer.

- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

#### **Pasture and forage**

- This soil is suited to pasture and hay and to wildlife habitat.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

### **Interpretive Groups**

*Land capability classification:* VIIIs

*Windbreak suitability group:* 10

## **410—Athelwold silt loam**

### **Composition**

Athelwold soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Drainageways and shallow depressions on outwash plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 40 acres

### **Typical Profile**

0 to 18 inches—black silt loam

18 to 25 inches—dark brown silt loam

25 to 35 inches—grayish brown, mottled, calcareous silt loam

35 to 60 inches—grayish brown and light olive brown, calcareous gravelly sand

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Available water capacity:* Very high

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The well drained Estelline soils, which are on flats and side slopes at the higher elevations
- The moderately well drained Gardena soils, which are on flats and small rises and contain more silt and fine sand in the subsoil and underlying material than the Athelwold soil

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silty clay loam
- Soils that have strata in the subsoil containing more clay
- Soils that contain more sand in the surface layer and subsoil
- Soils that have coarse material at a depth of less than 20 inches

***Use and Management*****Cropland**

- This soil is well suited to crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

***Interpretive Groups****Land capability classification:* 1*Windbreak suitability group:* 1**418—Lamoure silty clay loam*****Composition***

Lamoure soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

***Setting****Landform and position on the landform:* Flats on flood plains*Slope range:* 0 to 1 percent*Shape of areas:* Irregular or long and narrow*Size of areas:* 10 to 500 acres***Typical Profile***

0 to 36 inches—black, calcareous silty clay loam

36 to 45 inches—dark gray, calcareous silty clay loam

45 to 60 inches—grayish brown, mottled, calcareous silty clay loam

***Soil Properties and Qualities****Drainage class:* Poorly drained*Permeability:* Moderate or moderately slow*Available water capacity:* High*Organic matter content:* High*Surface runoff:* Slow*Seasonal high water table:* At the surface to 2 feet below the surface*Frequency of flooding:* Occasional***Inclusions****Contrasting inclusions:*

- The moderately well drained La Prairie soils, which are on terraces and flats and contain more sand than the Lamoure soil

- The moderately well drained Darnen soils, which are on concave toe slopes and contain more sand than the Lamoure soil

- The very poorly drained Rauville soils, which are on bottom land where streams and rivers continually change course

*Similar soils:*

- Soils that have a surface layer of silt loam
- Soils that have strata in the subsoil containing more sand or clay
- Soils that contain 0 to 2 percent rock fragments throughout

***Use and Management*****Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- Seasonal flooding limits the production and harvesting of crops.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

***Interpretive Groups****Land capability classification:* 11w*Windbreak suitability group:* 2**437D—Buse clay loam, 12 to 18 percent slopes*****Composition***

Buse soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

***Setting****Landform and position on the landform:* Side slopes and summits on moraines*Shape of areas:* Irregular or long and narrow*Size of areas:* 4 to 40 acres***Typical Profile***

0 to 8 inches—very dark gray, calcareous clay loam

8 to 13 inches—grayish brown, calcareous clay loam

13 to 60 inches—light olive brown, mottled, calcareous clay loam

### **Soil Properties and Qualities**

*Drainage class:* Well drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Rapid

*Depth to the seasonal high water table:* More than 6 feet

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes, are not calcareous, and have a thick, dark surface layer
- The well drained Formdale soils, which are on the less sloping side slopes and are not calcareous

*Similar soils:*

- Soils that have a surface layer of loam
- Soils that have a thin surface layer
- Soils that contain less clay in the subsoil
- Soils that have slopes of less than 12 percent

### **Use and Management**

#### **Cropland**

- This soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

#### **Pasture and forage**

- This soil is suited to pasture and hay and to wildlife habitat.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

### **Interpretive Groups**

*Land capability classification:* IVe

*Windbreak suitability group:* 8

## **450—Rauville silty clay loam**

### **Composition**

Rauville soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Flats on flood plains

*Slope range:* 0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 10 to 240 acres

### **Typical Profile**

0 to 21 inches—black, calcareous silty clay loam

21 to 34 inches—very dark gray, calcareous silty clay loam

34 to 60 inches—grayish brown, mottled, calcareous silt loam

### **Soil Properties and Qualities**

*Drainage class:* Very poorly drained

*Permeability:* Moderate or moderately slow

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Very slow

*Seasonal high water table:* 1 foot above to 2 feet below the surface

*Frequency of flooding:* Frequent

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Lamoure soils, which are on bottom land
- The moderately well drained La Prairie soils, which are on terraces and flats

*Similar soils:*

- Soils that have a surface layer of silt loam
- Soils that have strata in the subsoil containing more sand or clay

### **Use and Management**

#### **Wildlife habitat**

- This soil is suited to wildlife habitat.
- Providing drainage is difficult because most areas have poor outlets and are subject to seasonal flooding.

### **Interpretive Groups**

*Land capability classification:* VIw

*Windbreak suitability group:* 10

## **494B—Darnen loam, 1 to 6 percent slopes**

### **Composition**

Darnen soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Concave toe slopes on moraines

*Shape of areas:* Irregular or long and narrow

*Size of areas:* 4 to 40 acres

### **Typical Profile**

0 to 8 inches—very dark brown loam

8 to 16 inches—black loam  
 16 to 26 inches—very dark grayish brown loam  
 26 to 34 inches—dark yellowish brown, mottled loam  
 34 to 60 inches—light olive brown, mottled, calcareous loam

### **Soil Properties and Qualities**

*Drainage class:* Moderately well drained  
*Permeability:* Moderate  
*Available water capacity:* High  
*Organic matter content:* High or very high  
*Surface runoff:* Slow or medium  
*Depth to the seasonal high water table:* 2.5 to 6.0 feet

### **Inclusions**

#### *Contrasting inclusions:*

- The well drained Buse, Esmond, Formdale, and Heimdal soils, which are on side slopes and have a thinner dark surface layer than the Darnen soil
- The poorly drained Flom and Lindaas soils, which are in drainageways
- The very poorly drained Parnell and Bigstone soils, which are in depressions, potholes, and sloughs
- The poorly drained, calcareous Vallerys soils, which are on flats and rims surrounding depressions

#### *Similar soils:*

- Soils that have a surface layer of silt loam or clay loam
- Soils that have a thin surface layer
- Soils that have a regular decrease in organic matter content with increasing depth

### **Use and Management**

#### **Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### **Interpretive Groups**

*Land capability classification:* IIe

*Windbreak suitability group:* 3

## **694B—Zell silt loam, 2 to 8 percent slopes**

### **Composition**

Zell soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Side slopes and

summits on glacial lake plains

*Shape of areas:* Long and narrow

*Size of areas:* 4 to 100 acres

### **Typical Profile**

0 to 8 inches—black, calcareous silt loam

8 to 16 inches—olive brown, calcareous silt loam

16 to 30 inches—light olive brown, calcareous very fine sandy loam that has relict mottles

30 to 60 inches—light yellowish brown, calcareous very fine sandy loam

### **Soil Properties and Qualities**

*Drainage class:* Well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Moderate or high

*Surface runoff:* Medium

*Depth to the seasonal high water table:* More than 6 feet

### **Inclusions**

#### *Contrasting inclusions:*

- The moderately well drained Gardena soils, which are on flats and in shallow drainageways, are not calcareous, and have a thick, dark surface layer
- The moderately well drained Glyndon soils, which are on low convex rises and flats and have a thick, dark surface layer
- The very poorly drained Bigstone soils, which are in depressions

#### *Similar soils:*

- Soils that contain as much as 2 percent rock fragments
- Soils that have a surface layer of loam
- Soils that have a leached surface layer
- Soils that have slopes of more than 8 percent

### **Use and Management**

#### **Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* IIIe

*Windbreak suitability group:* 8

## 698—Doran clay loam

### **Composition**

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

### **Setting**

*Landform and position on the landform:* Flats and plane and concave summits on till plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 240 acres

### **Typical Profile**

0 to 8 inches—black clay loam

8 to 14 inches—very dark grayish brown clay loam

14 to 20 inches—dark brown, mottled clay loam

20 to 32 inches—grayish brown, mottled, calcareous clay loam

32 to 60 inches—olive brown, mottled, calcareous clay loam

### **Soil Properties and Qualities**

*Drainage class:* Somewhat poorly drained

*Permeability:* Slow or moderately slow in the upper part; moderately slow or moderate in the lower part

*Available water capacity:* High

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 3 to 5 feet

### **Inclusions**

*Contrasting inclusions:*

- The well drained Formdale soils, which are on side slopes

*Similar soils:*

- Soils that have a surface layer of silty clay loam
- Soils that contain less clay in the subsoil
- Soils that are poorly drained

### **Use and Management**

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Open ditches or tile drains help to remove water on or near the surface.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

## **Interpretive Groups**

*Land capability classification:* 1lw

*Windbreak suitability group:* 1

## 787—Fram-Vallers-Parnell complex

### **Composition**

Fram soil and similar soils: 35 to 60 percent

Vallers soil and similar soils: 20 to 40 percent

Parnell soil and similar soils: 15 to 30 percent

Contrasting inclusions: 10 to 15 percent

### **Setting**

*Landform and position on the landform:* Fram—low convex rises on till plains and moraines; Vallers—flats and rims surrounding depressions on till plains and moraines; Parnell—depressions on till plains and moraines (fig. 9)

*Slope range:* Fram—1 to 4 percent; Vallers—0 to 2 percent; Parnell—0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 20 to several hundred acres

### **Typical Profile**

#### **Fram**

0 to 8 inches—black, calcareous loam

8 to 15 inches—grayish brown, calcareous loam

15 to 60 inches—light olive brown, mottled, calcareous loam

#### **Vallers**

0 to 13 inches—black, calcareous clay loam

13 to 26 inches—grayish brown, mottled, calcareous clay loam

26 to 60 inches—olive, mottled, calcareous clay loam

#### **Parnell**

0 to 8 inches—black silty clay loam

8 to 20 inches—very dark gray silty clay loam

20 to 37 inches—very dark gray silty clay

37 to 50 inches—dark grayish brown, mottled silty clay

50 to 60 inches—grayish brown, mottled, calcareous silty clay loam

### **Soil Properties and Qualities**

*Drainage class:* Fram—somewhat poorly drained and moderately well drained; Vallers—poorly drained; Parnell—very poorly drained

*Permeability:* Fram—moderate; Vallers—moderately slow; Parnell—moderately slow in the upper part, slow in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow

*Seasonal high water table:* Fram—at a depth of 2 to 6



Figure 9.—A nearly level area of Fram-Vallers-Parnell complex. The Fram soil is on the light-colored, low convex rises, the Vallers soil is on the rims surrounding depressions, and the Parnell soil is in the depressions.

feet; Vallers—at a depth of 1.0 to 2.5 feet; Parnell—1 foot above to 1 foot below the surface

*Distinctive properties:* Ponding on the Parnell soil

### ***Inclusions***

*Contrasting inclusions:*

- The poorly drained Flom soils, which are in drainageways and are not calcareous
- The well drained Heimdal soils, which are on side slopes
- The moderately well drained Svea soils, which are on low rises and concave foot slopes and are not calcareous

*Similar soils:*

- Somewhat poorly drained and moderately well drained soils that have a surface layer of silt loam
- Somewhat poorly drained and moderately well drained soils that contain more silt in the subsoil
- Soils that have slopes of more than 4 percent
- Poorly drained soils that have a surface layer of silty clay loam

- Poorly drained soils that have a thick, dark surface layer
- Very poorly drained soils that contain less clay in the subsoil
- Very poorly drained soils that have a surface layer of silt loam

### ***Use and Management***

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If they are worked when too wet, the soils become severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.

- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### ***Interpretive Groups***

*Land capability classification:* Fram—IIs; Vallers—IIw; Parnell—IIIw  
*Windbreak suitability group:* Fram—1K; Vallers—2K; Parnell—2W

## **814—Hamerly-Lindaas complex**

### ***Composition***

Hamerly soil and similar soils: 50 to 70 percent  
 Lindaas soil and similar soils: 25 to 40 percent  
 Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Hamerly—low convex rises on till plains and moraines; Lindaas—flats and drainageways on till plains and moraines  
*Slope range:* Hamerly—1 to 3 percent; Lindaas—0 to 1 percent  
*Shape of areas:* Irregular  
*Size of areas:* 20 to several thousand acres

### ***Typical Profile***

#### **Hamerly**

0 to 8 inches—black, calcareous loam  
 8 to 16 inches—light brownish gray, calcareous clay loam  
 16 to 28 inches—light brownish gray, mottled, calcareous clay loam  
 28 to 60 inches—light olive brown, mottled, calcareous clay loam

#### **Lindaas**

0 to 12 inches—black silty clay loam  
 12 to 20 inches—very dark gray silty clay  
 20 to 26 inches—dark grayish brown, mottled silty clay  
 26 to 36 inches—grayish brown, mottled, calcareous silty clay loam  
 36 to 60 inches—olive gray and light olive brown, mottled, calcareous silty clay loam

### ***Soil Properties and Qualities***

*Drainage class:* Hamerly—somewhat poorly drained and moderately well drained; Lindaas—poorly drained  
*Permeability:* Hamerly—moderate in the upper part, moderately slow in the lower part; Lindaas—moderate to slow in the upper part, moderately slow

or moderate in the lower part  
*Available water capacity:* High  
*Organic matter content:* High or very high  
*Surface runoff:* Slow  
*Seasonal high water table:* Hamerly—at a depth of 2 to 4 feet; Lindaas—1 foot above to 2 feet below the surface  
*Distinctive properties:* Ponding on the Lindaas soil

### ***Inclusions***

#### *Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on low rises and concave foot slopes and are not calcareous
- The poorly drained, calcareous Vallers soils, which are on flats and rims adjacent to drainageways and depressions

#### *Similar soils:*

- Poorly drained soils that have a thin, dark surface layer
- Very poorly drained soils
- Poorly drained soils that contain less clay in the subsoil
- Soils that have a surface layer of clay loam
- Somewhat poorly drained and moderately well drained soils that have a surface layer of silt loam
- Somewhat poorly drained and moderately well drained soils that contain more silt in the subsoil

### ***Use and Management***

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If they are worked when too wet, the soils become severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### ***Interpretive Groups***

*Land capability classification:* Hamerly—IIs; Lindaas—IIw  
*Windbreak suitability group:* Hamerly—1K; Lindaas—2W

## 827B—Esmond-Heimdal loams, 2 to 6 percent slopes

### Composition

Esmond soil and similar soils: 50 to 75 percent  
 Heimdal soil and similar soils: 15 to 30 percent  
 Contrasting inclusions: 10 to 15 percent

### Setting

*Landform and position on the landform:* Side slopes and summits on moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 160 acres

### Typical Profile

#### Esmond

0 to 8 inches—very dark grayish brown, calcareous loam

8 to 17 inches—grayish brown, calcareous loam

17 to 60 inches—light olive brown, calcareous loam

#### Heimdal

0 to 8 inches—black loam

8 to 13 inches—dark brown loam

13 to 16 inches—olive brown, calcareous loam

16 to 60 inches—light olive brown, calcareous loam

### Soil Properties and Qualities

*Drainage class:* Well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Esmond—moderately low or moderate; Heimdal—moderate or high

*Surface runoff:* Medium

*Depth to the seasonal high water table:* More than 6 feet

### Inclusions

*Contrasting inclusions:*

- The poorly drained Flom soils, which are on flats and in drainageways
- The somewhat poorly drained and moderately well drained Fram soils, which are on low convex rises
- The very poorly drained Parnell soils, which are in depressions
- The moderately well drained Svea soils, which are on concave foot slopes, side slopes, and summits and have a thick, dark surface layer
- The poorly drained Vallers soils, which are on flats and rims adjacent to drainageways and depressions

*Similar soils:*

- Soils that have a surface layer of silt loam or sandy loam
- Soils that have more clay in the subsoil
- Soils that have slopes of more than 6 percent

## Use and Management

### Cropland

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### Interpretive Groups

*Land capability classification:* IIe

*Windbreak suitability group:* Esmond—8; Heimdal—3

## 827C2—Esmond-Heimdal loams, 6 to 12 percent slopes, eroded

### Composition

Esmond soil and similar soils: 60 to 80 percent (fig. 10)

Heimdal soil and similar soils: 10 to 20 percent

Contrasting inclusions: 5 to 15 percent

### Setting

*Landform and position on the landform:* Side slopes and summits on moraines

*Slope range:* Esmond—6 to 12 percent; Heimdal—6 to 8 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 120 acres

### Typical Profile

#### Esmond

0 to 8 inches—dark brown, calcareous loam

8 to 15 inches—light yellowish brown, calcareous loam

15 to 60 inches—light olive brown, calcareous loam

#### Heimdal

0 to 8 inches—very dark grayish brown loam

8 to 10 inches—olive brown loam

10 to 60 inches—light olive brown, calcareous loam

### Soil Properties and Qualities

*Drainage class:* Well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Esmond—moderately low or moderate; Heimdal—moderate or high

*Surface runoff:* Medium or rapid



Figure 10.—The light-colored Esmond soil dominates this area of Esmond-Heimdal loams, 6 to 12 percent slopes, eroded.

*Depth to the seasonal high water table:* More than 6 feet

*Distinctive properties:* Esmond—areas where the subsoil has been exposed by erosion

#### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes and have a thick, dark surface layer
- The poorly drained Flom soils, which are in drainageways
- The moderately well drained Svea soils, which are on concave foot slopes and summits and have a thick, dark surface layer

*Similar soils:*

- Soils that have a surface layer of silt loam or sandy loam
- Soils that have more clay in the subsoil
- Soils that have slopes of more than 12 percent or less than 6 percent

#### ***Use and Management***

##### **Cropland**

- Farming across the slope, establishing terraces or

grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.

- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

#### ***Interpretive Groups***

*Land capability classification:* IIIe

*Windbreak suitability group:* Esmond—10; Heimdal—3

#### **900—Hamerly-Aazdahl-Lindaas complex**

##### ***Composition***

Hamerly soil and similar soils: 35 to 60 percent

Aazdahl soil and similar soils: 20 to 40 percent

Lindaas soil and similar soils: 20 to 40 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Hamerly—low convex rises on till plains and moraines; Aazdahl—low rises on till plains and moraines; Lindaas—flats and drainageways on till plains and moraines

*Slope range:* Hamerly—1 to 3 percent; Aazdahl—0 to 3 percent; Lindaas—0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 20 to several thousand acres

### **Typical Profile**

#### **Hamerly**

0 to 8 inches—black, calcareous loam

8 to 16 inches—light brownish gray, calcareous clay loam

16 to 28 inches—light brownish gray, mottled, calcareous clay loam

28 to 60 inches—light olive brown, mottled, calcareous clay loam

#### **Aazdahl**

0 to 8 inches—black clay loam

8 to 11 inches—very dark grayish brown clay loam

11 to 15 inches—dark grayish brown clay loam

15 to 60 inches—grayish brown and light olive brown, mottled, calcareous clay loam

#### **Lindaas**

0 to 12 inches—black silty clay loam

12 to 20 inches—very dark gray silty clay

20 to 26 inches—dark grayish brown, mottled silty clay

26 to 36 inches—grayish brown, mottled, calcareous silty clay loam

36 to 60 inches—olive gray and light olive brown, mottled, calcareous silty clay loam

### **Soil Properties and Qualities**

*Drainage class:* Hamerly—somewhat poorly drained and moderately well drained; Aazdahl—moderately well drained; Lindaas—poorly drained

*Permeability:* Hamerly—moderate in the upper part, moderately slow in the lower part; Aazdahl—moderate in the upper part, moderately slow in the lower part; Lindaas—moderate to slow in the upper part, moderately slow or moderate in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow

*Seasonal high water table:* Hamerly—at a depth of 2 to 4 feet; Aazdahl—at a depth of 3 to 6 feet;

Lindaas—1 foot above to 2 feet below the surface

*Distinctive properties:* Ponding on the Lindaas soil

### **Inclusions**

*Contrasting inclusions:*

- The poorly drained Vallers soils, which are on flats and rims adjacent to drainageways and depressions

*Similar soils:*

- Poorly drained soils that have a thin, dark surface layer
- Very poorly drained soils
- Poorly drained soils that contain less clay in the subsoil
- Moderately well drained soils that have a surface layer of silty clay loam
- Moderately well drained soils that contain more clay in the subsoil
- Somewhat poorly drained and moderately well drained soils that have a surface layer of silt loam and clay loam
- Somewhat poorly drained and moderately well drained soils that contain more silt in the subsoil
- Poorly drained soils that have a surface layer of clay loam

### **Use and Management**

#### **Cropland**

- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### **Interpretive Groups**

*Land capability classification:* Hamerly—IIs; Aazdahl—I; Lindaas—Ilw

*Windbreak suitability group:* Hamerly—1K; Aazdahl—1; Lindaas—2W

### **915B—Formdale-Buse clay loams, 4 to 6 percent slopes**

#### **Composition**

Formdale soil and similar soils: 50 to 75 percent

Buse soil and similar soils: 20 to 40 percent

Contrasting inclusions: 10 to 15 percent

### Setting

*Landform and position on the landform:* Side slopes and summits on moraines

*Shape of areas:* Irregular

*Size of areas:* 10 to 160 acres

### Typical Profile

#### Formdale

0 to 8 inches—very dark brown clay loam

8 to 14 inches—dark yellowish brown clay loam

14 to 25 inches—light olive brown, calcareous clay loam

25 to 60 inches—light olive brown, mottled, calcareous clay loam

#### Buse

0 to 8 inches—very dark gray, calcareous clay loam

8 to 17 inches—grayish brown, calcareous clay loam

17 to 60 inches—light olive brown, calcareous clay loam

### Soil Properties and Qualities

*Drainage class:* Well drained

*Permeability:* Formdale—moderate in the upper part, moderately slow in the lower part; Buse—moderately slow

*Available water capacity:* High

*Organic matter content:* Formdale—moderate or high; Buse—moderately low or moderate

*Surface runoff:* Medium

*Depth to the seasonal high water table:* More than 6 feet

### Inclusions

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on concave foot slopes, side slopes, and summits
- The poorly drained Flom and Lindaas soils, which are on flats and in drainageways
- The somewhat poorly drained and moderately well drained Hamerly soils, which are on low convex rises

*Similar soils:*

- Soils that have a surface layer of silty clay loam and loam
- Soils that contain more sand
- Soils that contain more clay in the subsoil
- Soils that have slopes of more than 6 percent

### Use and Management

#### Cropland

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soils have a high pH level because of a

concentration of lime in the surface layer.

- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### Interpretive Groups

*Land capability classification:* IIe

*Windbreak suitability group:* Formdale—3; Buse—8

### 915C2—Buse-Formdale clay loams, 6 to 12 percent slopes, eroded

#### Composition

Buse soil and similar soils: 40 to 60 percent

Formdale soil and similar soils: 30 to 40 percent

Contrasting inclusions: 5 to 15 percent

#### Setting

*Landform and position on the landform:* Side slopes and summits on moraines

*Shape of areas:* Irregular

*Size of areas:* 4 to 160 acres

### Typical Profile

#### Buse

0 to 8 inches—dark brown, calcareous clay loam

8 to 27 inches—olive brown, calcareous clay loam

27 to 60 inches—grayish brown and light olive brown, calcareous clay loam

#### Formdale

0 to 8 inches—very dark brown clay loam

8 to 11 inches—dark yellowish brown clay loam

11 to 18 inches—olive brown, calcareous clay loam

18 to 60 inches—light olive brown, calcareous clay loam

### Soil Properties and Qualities

*Drainage class:* Well drained

*Permeability:* Buse—moderately slow; Formdale—moderate in the upper part, moderately slow in the lower part

*Available water capacity:* High

*Organic matter content:* Buse—moderately low or moderate; Formdale—moderate or high

*Surface runoff:* Medium or rapid

*Depth to the seasonal high water table:* More than 6 feet

*Distinctive properties:* Buse—areas where the subsoil has been exposed by erosion

### Inclusions

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on concave foot slopes, side slopes, and summits
- The moderately well drained Darnen soils, which are

on concave toe slopes and have a thick, dark surface layer

- The poorly drained Flom and Lindaas soils, which are on flats and in drainageways

*Similar soils:*

- Soils that have a surface layer of silty clay loam or loam
- Soils that contain more sand
- Soils that contain more clay in the subsoil
- Soils that have slopes of more than 12 percent or less than 6 percent

### ***Use and Management***

#### **Cropland**

- Farming across the slope, establishing terraces or grassed waterways, including high-residue crops in the rotation, and applying a system of conservation tillage reduce the hazard of water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### ***Interpretive Groups***

*Land capability classification:* IIIe

*Windbreak suitability group:* Buse—8; Formdale—3

## **922—Hamerly-Parnell complex**

### ***Composition***

Hamerly soil and similar soils: 50 to 70 percent

Parnell soil and similar soils: 20 to 40 percent

Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Hamerly—low convex rises on till plains and moraines; Parnell—depressions on till plains and moraines

*Slope range:* Hamerly—1 to 3 percent; Parnell—0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 20 to several thousand acres

### ***Typical Profile***

#### **Hamerly**

0 to 8 inches—black, calcareous loam

8 to 16 inches—light brownish gray, calcareous clay loam

16 to 28 inches—light brownish gray, mottled, calcareous clay loam

28 to 60 inches—light olive brown, mottled, calcareous clay loam

#### **Parnell**

0 to 8 inches—black silty clay loam

8 to 20 inches—very dark gray silty clay loam

20 to 37 inches—very dark gray silty clay

37 to 50 inches—dark grayish brown, mottled silty clay

50 to 60 inches—grayish brown, mottled, calcareous silty clay loam

### ***Soil Properties and Qualities***

*Drainage class:* Hamerly—somewhat poorly drained and moderately well drained; Parnell—very poorly drained

*Permeability:* Hamerly—moderate in the upper part, moderately slow in the lower part; Parnell—moderately slow in the upper part, slow in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow

*Seasonal high water table:* Hamerly—at a depth of 2 to 4 feet; Parnell—1 foot above to 1 foot below the surface

*Distinctive properties:* Ponding on the Parnell soil

### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on low rises and concave foot slopes and are not calcareous
- The poorly drained Flom soils, which are on flats and in drainageways
- The poorly drained, calcareous Vallery soils, which are on flats and rims adjacent to drainageways and depressions

*Similar soils:*

- Soils that have a surface layer of silt loam
- Poorly drained soils that contain more clay in the subsoil
- Soils that have a surface layer of clay loam
- Somewhat poorly drained and moderately well drained soils that contain more silt in the subsoil

### ***Use and Management***

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If they are worked when too wet, the soils become severely compacted and cloddy.

- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.
- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- The soils have a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soils should be considered if fertilizer or chemicals are applied.

### ***Interpretive Groups***

*Land capability classification:* Hamerly—II<sub>s</sub>; Parnell—III<sub>w</sub>  
*Windbreak suitability group:* Hamerly—1K; Parnell—2W

## **923C—Copaston-Rock outcrop complex, 1 to 25 percent slopes**

### ***Composition***

Copaston soil and similar soils: 50 to 70 percent  
 Rock outcrop: 20 to 40 percent  
 Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Flats and side slopes on bedrock-controlled benches  
*Shape of areas:* Irregular  
*Size of areas:* 10 to 160 acres

### ***Typical Profile***

#### **Copaston**

0 to 9 inches—black loam  
 9 to 14 inches—very dark grayish brown loam  
 14 to 60 inches—granite bedrock

### ***Soil Properties and Qualities***

#### **Copaston**

*Drainage class:* Well drained  
*Permeability:* Moderately rapid or moderate  
*Available water capacity:* Very low  
*Organic matter content:* Moderate or high  
*Surface runoff:* Slow or medium  
*Depth to the seasonal high water table:* More than 6 feet

### ***Inclusions***

#### *Contrasting inclusions:*

- The poorly drained Lamoure soils, which are on bottom land and do not have bedrock within a depth of 20 inches
- The moderately well drained La Prairie soils, which are on terraces and do not have bedrock within a depth of 20 inches

- Well drained soils that do not have bedrock within a depth of 20 inches
- Soils that have strata in the subsoil containing more sand and gravel

#### *Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silt loam or sandy loam
- Soils that have bedrock within a depth of 10 inches

### ***Use and Management***

#### **Pasture and forage**

- The Copaston soil is suited to pasture and hay and to wildlife habitat.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

### ***Interpretive Groups***

*Land capability classification:* Copaston—VII<sub>s</sub>  
*Windbreak suitability group:* 10

## **1013—Pits, quarry**

### ***Setting***

*Shape of areas:* Irregular  
*Size of areas:* 10 to 70 acres

### ***Inclusions***

#### *Contrasting inclusions:*

- The well drained Copaston soils, which are on flats and side slopes
- Interpretive groups:* Not assigned

## **1030—Udorthents-Pits, gravel, complex**

### ***Setting***

*Shape of areas:* Irregular  
*Size of areas:* 4 to 160 acres  
*Interpretive groups:* Not assigned

## **1817F—Esmond loam, 18 to 45 percent slopes, bouldery**

### ***Composition***

Esmond soil and similar soils: 85 to 90 percent  
 Contrasting inclusions: 10 to 15 percent

### ***Setting***

*Landform and position on the landform:* Side slopes on moraines

*Shape of areas:* Long and narrow

*Size of areas:* 20 to several hundred acres

### **Typical Profile**

0 to 10 inches—very dark gray, calcareous loam

10 to 60 inches—light olive brown, calcareous loam

### **Soil Properties and Qualities**

*Drainage class:* Well drained

*Permeability:* Moderate

*Available water capacity:* High

*Organic matter content:* Moderately low or moderate

*Surface runoff:* Rapid

*Depth to the seasonal high water table:* More than 6 feet

*Distinctive properties:* Large boulders covering 0.01 to 0.1 percent of the surface

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes and have a thick, dark surface layer
- The poorly drained Flom soils, which are in drainageways
- The poorly drained Lamoure soils, which are on bottom land
- The excessively drained Sioux soils, which contain more sand and gravel and less clay than the Esmond soil

*Similar soils:*

- Soils that have more silt and clay in the subsoil
- Soils that have slopes of less than 18 percent
- Soils that have a surface layer of silt loam or sandy loam

### **Use and Management**

#### **Cropland**

- The soil has a high pH level because of a concentration of lime in the surface layer.
- Crop varieties that can tolerate a high content of lime should be selected, and the high pH level of the soil should be considered if fertilizer or chemicals are applied.

#### **Pasture and forage**

- This soil is suited to pasture and hay and to wildlife habitat.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

### **Interpretive Groups**

*Land capability classification:* VIIe

*Windbreak suitability group:* 10

## **1916—Lindaas silty clay loam**

### **Composition**

Lindaas soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

### **Setting**

*Landform and position on the landform:* Flats and drainageways on till plains and moraines

*Slope range:* 0 to 1 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 120 acres

### **Typical Profile**

0 to 12 inches—black silty clay loam

12 to 20 inches—very dark gray silty clay

20 to 26 inches—dark grayish brown, mottled silty clay

26 to 36 inches—grayish brown, mottled, calcareous silty clay loam

36 to 60 inches—olive gray and light olive brown, mottled, calcareous silty clay loam

### **Soil Properties and Qualities**

*Drainage class:* Poorly drained

*Permeability:* Moderate to slow in the upper part; moderately slow or moderate in the lower part

*Available water capacity:* High

*Organic matter content:* High or very high

*Surface runoff:* Slow or very slow

*Seasonal high water table:* 1 foot above to 2 feet below the surface

*Distinctive properties:* Subject to ponding

### **Inclusions**

*Contrasting inclusions:*

- The moderately well drained Aazdahl soils, which are on low rises, concave foot slopes, side slopes, and summits
- The moderately well drained Darnen soils, which are on concave toe slopes
- The moderately well drained Gonvick soils, which are on flats
- The somewhat poorly drained and moderately well drained, calcareous Hamerly soils, which are on low convex rises
- The poorly drained, calcareous Vallery soils, which are on flats and rims adjacent to drainageways and depressions

*Similar soils:*

- Soils that have a surface layer of clay loam
- Soils that contain less clay in the subsoil
- Soils that are very poorly drained

### ***Use and Management***

#### **Cropland**

- Most suitable crops can be grown if adequate drainage is provided.
- Using open ditches or tile drains to remove water on or near the surface helps to overcome the ponding.
- If it is worked when too wet, the soil becomes severely compacted and cloddy.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

#### ***Interpretive Groups***

*Land capability classification:* 1lw

*Windbreak suitability group:* 2W

### **1940—Bigstone silty clay loam, ponded**

#### ***Composition***

Bigstone soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

#### ***Setting***

*Landform and position on the landform:* Depressions, large potholes, and sloughs on till plains and moraines

*Slope range:* 0 to 1 percent

*Shape of areas:* Irregular or circular

*Size of areas:* 10 to 200 acres

#### ***Typical Profile***

0 to 30 inches—black, calcareous silty clay loam

30 to 36 inches—olive gray, mottled, calcareous silty clay loam

36 to 60 inches—gray and light olive brown, calcareous clay loam

#### ***Soil Properties and Qualities***

*Drainage class:* Very poorly drained

*Permeability:* Moderately slow

*Available water capacity:* High

*Organic matter content:* Very high or high

*Surface runoff:* Very slow or ponded

*Seasonal high water table:* At the surface to 3 feet above the surface

*Distinctive properties:* Subject to ponding

#### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Darnen soils, which are on concave toe slopes
- The poorly drained Vallers soils, which are on rims surrounding depressions

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of silt loam, loam, clay loam, or silty clay
- Soils that contain more clay in the subsoil
- Soils that contain more clay throughout

### ***Use and Management***

#### **Wildlife habitat**

- This soil is suited to wildlife habitat (fig. 11).
- Providing drainage is difficult because most areas have poor outlets and are ponded.

#### ***Interpretive Groups***

*Land capability classification:* VIIIw

*Windbreak suitability group:* 10

### **1949—Gardena silt loam**

#### ***Composition***

Gardena soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

#### ***Setting***

*Landform and position on the landform:* Flats and small rises on glacial lake plains

*Slope range:* 1 to 3 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 500 acres

#### ***Typical Profile***

0 to 15 inches—black silt loam

15 to 21 inches—very dark grayish brown silt loam

21 to 30 inches—grayish brown, calcareous silt loam

30 to 48 inches—olive brown, mottled, calcareous very fine sandy loam

48 to 60 inches—olive brown, mottled, calcareous silt loam

#### ***Soil Properties and Qualities***

*Drainage class:* Moderately well drained

*Permeability:* Moderate

*Available water capacity:* Very high

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 4 to 6 feet

#### ***Inclusions***

*Contrasting inclusions:*

- The moderately well drained Embden soils, which contain more sand and less silt than the Gardena soil
- The moderately well drained, calcareous Glyndon soils, which are in landscape positions similar to those of the Gardena soil



Figure 11.—An area of Bigstone silty clay loam, ponded, used for wildlife habitat.

- The very poorly drained Bigstone soils, which are in depressions
- The well drained, calcareous Zell soils, which are on side slopes and have a thin, dark surface layer
- Poorly drained soils in drainageways

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a surface layer of loam
- Soils that have strata in the subsoil containing more clay
- Soils that have as much as 1 percent rock fragments throughout

***Use and Management***

**Cropland**

- This soil is well suited to crops.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

***Interpretive Groups***

*Land capability classification:* 1

*Windbreak suitability group:* 1

**1994—Embden loam**

***Composition***

Embden soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

***Setting***

*Landform and position on the landform:* Drainageways and concave foot slopes on outwash plains

*Slope range:* 0 to 2 percent

*Shape of areas:* Irregular

*Size of areas:* 4 to 80 acres

***Typical Profile***

0 to 8 inches—black loam

8 to 20 inches—very dark grayish brown sandy loam

20 to 30 inches—dark yellowish brown sandy loam

30 to 40 inches—olive brown, mottled fine sandy loam

40 to 60 inches—grayish brown and light olive brown, mottled, calcareous loamy fine sand

***Soil Properties and Qualities***

*Drainage class:* Moderately well drained

*Permeability:* Moderately rapid

*Available water capacity:* Moderate

*Organic matter content:* High

*Surface runoff:* Slow

*Depth to the seasonal high water table:* 4 to 6 feet

### ***Inclusions***

*Contrasting inclusions:*

- The well drained Egeland and Sverdrup soils, which are on side slopes and have a thin, dark surface layer
- The poorly drained, calcareous Marysland soils, which are on flats and in drainageways and contain more clay in the surface layer and subsoil than the Embden soil

*Similar soils:*

- Soils that have a thin, dark surface layer
- Soils that have a calcareous surface layer
- Soils that have a surface layer of fine sandy loam or sandy loam
- Soils that contain less clay in the subsoil

### ***Use and Management***

#### **Cropland**

- Maintaining crop residue on the surface, establishing field windbreaks, and applying a system of conservation tillage reduce the hazard of soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and applying a system of conservation tillage help to maintain or improve fertility.

### ***Interpretive Groups***

*Land capability classification:* IIs

*Windbreak suitability group:* 1

## **Prime Farmland**

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be

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

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

About 255,000 acres in the survey area, or nearly 80 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county. Most areas of prime farmland are used for crops. The main crops grown on this land are corn and soybeans.

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."

Soils that have limitations, such as a seasonal high water table, frequent flooding during the growing season, or inadequate rainfall, qualify as prime farmland only in areas where these limitations have been overcome by such measures as drainage, flood control, or irrigation. 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

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

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

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

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

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

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

## Crops and Pasture

Steve Woltjer, district conservationist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants

best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

In 1988, about 230,000 acres in Big Stone County was used as cropland (10). The major crops in the county are soybeans, corn, and small grain. Wheat is the main small grain crop. Fruits, vegetables, sugar beets, and other specialty crops are grown in a few areas.

Most of the soils in Big Stone County are well suited to crops. The main management concerns are water erosion, soil blowing, droughtiness, wetness, fertility, and tith. Productivity can be increased or maintained on most of the soils by selecting improved crop varieties, using soil conservation practices, and maintaining proper fertility levels.

*Water erosion* is the major management concern on the more sloping soils, such as Buse, Esmond, Formdale, Hattie, Heimdal, and Zell soils. Measures that control erosion include using a system of conservation tillage that leaves crop residue on the surface, farming on the contour, and establishing terraces and grassed waterways.

*Soil blowing* can be a major problem on most of the soils in Big Stone County. Most soil blowing occurs in the winter and spring. It is especially damaging if the soil is dry and bare during periods of high wind. Measures that help to control soil blowing include using a system of conservation tillage that leaves crop residue on the surface, establishing field windbreaks, and planting cover crops, such as hay.

*Droughtiness* is a major problem in areas of Arvilla, Egeland, Renshaw, Sioux, and Sverdrup soils. Measures that conserve moisture include establishing

field windbreaks, planting cover crops, and using a system of conservation tillage that leaves crop residue on the surface.

*Wetness* can be a problem on poorly drained and very poorly drained soils. These soils can become compacted if they are tilled when too wet. Properly timed tillage can increase productivity on these soils. Using a system of surface ditches can improve drainage. Drainage systems should be designed so that they are in compliance with Federal, State, and local regulations.

*Fertility* is affected by soil reaction and the content of plant nutrients. Generally, the soils in Big Stone County have a high pH level. Selecting suitable crop varieties and properly applying fertilizer help to overcome this limitation.

The soils in the county generally have a low content of phosphorus and a high content of potash and lime. Crops respond to applications of most kinds of fertilizer. The amount to be applied depends on past and present management, the kind of crop to be grown, and the anticipated yields. A soil fertility test is needed.

*Tilth* is an important factor affecting the germination of seeds and the infiltration of water into the soil. Maintaining good soil structure and tilth is generally more difficult in poorly drained soils. Tilling at the proper moisture content is critical. If the soil is tilled when it is too wet, it becomes compacted and cloddy. The compaction reduces the ability of water and air to infiltrate the soil, and the cloddiness results in a poor seedbed.

Practices that improve tilth include installing a good drainage system, tilling at the proper time, minimizing tillage, using crop rotations that include grasses and legumes, and incorporating organic matter, such as manure, crop residue, and straw, into the upper layer of the soil.

Pasture makes up about 20,000 acres in the county. Most areas of pasture are along the western and southern sides of the county. They border Big Stone Lake in the west and the Minnesota River in the south. Most pastures are steep or are affected by some other limiting factor, such as droughtiness, flooding, very poor drainage, a stony surface, or depth to bedrock.

Overgrazing and poor management practices can result in pastures of poor quality. Production from pastures can be increased by deferring or rotating grazing, applying fertilizer, and controlling weeds. Interseeding or reseeding can greatly improve pastures that have poor stands of grasses.

Further information about the management practices described in this section can be obtained from local offices of the Cooperative Extension Service and the Natural Resources Conservation Service.

### **Yields per Acre**

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

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents (4). Available yield data from nearby counties and results of field trials and demonstrations are also considered.

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

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

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

### **Land Capability Classification**

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

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit.

Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

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

## Windbreaks and Environmental Plantings

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

trees and shrubs provide the most protection. Maximum growth and survival rates can be obtained by controlling weeds around new plantings.

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

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

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

At the end of each description under the heading "Detailed Soil Map Units," the soil has been assigned to a windbreak suitability group. These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the "Technical Guide," which is available in the local office of the Natural Resources Conservation Service.

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

## Recreation

Steve Woltjer, district conservationist, Natural Resources Conservation Service, helped prepare this section.

Opportunities for outdoor recreation in Big Stone County are provided by Big Stone Lake State Park, city parks, a county park, numerous lakes and marshes, and the Big Stone Wildlife Refuge.

Big Stone Lake State Park offers facilities for overnight camping, hiking, fishing, picnicking, and swimming. Big Stone County Park, which is located on Toqua Lake near Graceville, offers facilities for fishing, swimming, and picnicking. Ortonville and Graceville both have golf courses available to the public. Big Stone, Artichoke, Long Tom, and Toqua Lakes provide opportunities for boating and fishing. Big Stone Wildlife Refuge has public land available for hunting, fishing, hiking, biking, and horseback riding. Areas along the

Minnesota River provide scenic views and opportunities for viewing wildlife.

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

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

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

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild 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

Dave Soehren, area wildlife manager, Minnesota Department of Natural Resources, David Zappetillo, area fisheries supervisor, Minnesota Department of Natural Resources, and Steve Woltjer, district conservationist, Natural Resources Conservation Service, helped prepare this section.

Land use directly affects the wildlife in Big Stone County. Wildlife species need cover, food, and water to survive. The county has large areas of managed wildlife habitat. These areas include the Big Stone Wildlife Refuge, Big Stone Lake State Park, 15 State wildlife management areas, and more than 45 U.S. Fish and Wildlife Service waterfowl production areas.

Wetland wildlife, especially waterfowl, are an important resource in Big Stone County. Giant Canada geese and ducks, such as mallard, blue-winged teal, wood duck, northern shoveler, pintail, ruddy duck, widgeon, redhead, and canvasback, nest and rear their young in the county. A wide variety of other waterfowl species use the abundant water resources of the county as staging and resting areas during migration. Also, furbearers, such as mink, muskrat, and beaver, benefit from the large amount of wetlands in the county.

Upland wildlife, especially game birds, are attracted to Big Stone County. Extensive acreages of native grasses, on public and private lands, help to maintain populations of ring-necked pheasant. Hungarian partridge and a variety of nongame species, such as the chestnut-collared longspur, marbled godwit, and upland plover, also inhabit the county.

White-tailed deer are abundant throughout the county. The deer winter in the Minnesota River Valley,

in wooded areas along the shores of Big Stone Lake, and in extensive stands of cattails or large wooded tracts in areas of wetlands.

The lakes in Big Stone County provide abundant opportunities for fishing. The major lakes are Big Stone, Artichoke, Long Tom, East Toqua, and Oliver Lakes. The most popular fish species are walleye, northern pike, yellow perch, black crappie, white crappie, white bass, catfish, bullheads, bluegill, and carp. The fish commonly caught in county lakes by commercial fishermen include white sucker, buffalo, redhorse, carp, and bullheads. The Minnesota River and numerous streams provide additional angling opportunities. Commercial fishing operations use county streams as a source of bait minnows.

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

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

*Grain and seed crops* are domestic grains and seed-

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

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, quackgrass, indiagrass, and switchgrass.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, hackberry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, 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, fir, 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, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, reed canarygrass, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are 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. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

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

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed

performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

## Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies

may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

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

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

## Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold

the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of groundwater pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover

for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

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

### Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a

plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an

appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

### Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, 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, organic matter, or salts or sodium. 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 the potential for 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 control 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 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.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 12). "Loam," for example, is soil that is

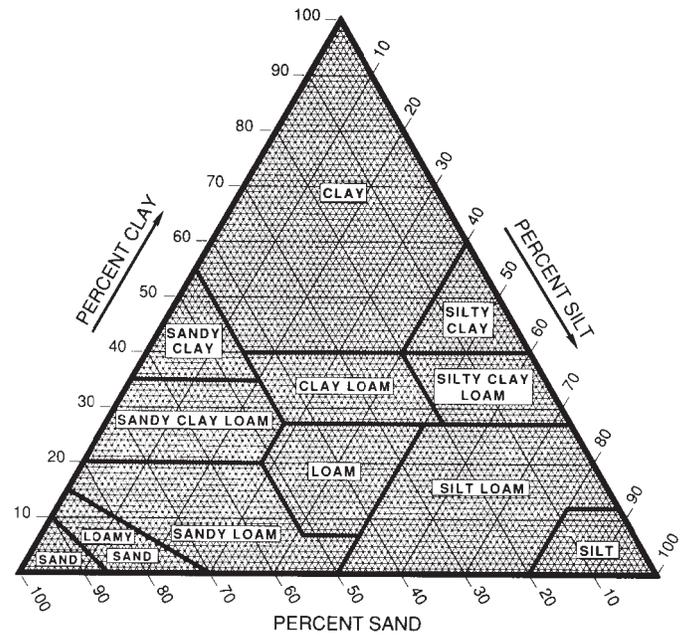


Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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 oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

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

## Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil

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

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at  $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy

loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Tables 16 and 17 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

The following paragraphs are an explanation of the columns in table 16.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low

runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

The following paragraphs are an explanation of the columns in table 17.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more

susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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# Classification of the Soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (8). 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.** Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, frigid Typic Haplaquolls.

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

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (9). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (8). 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."

### **Aazdahl Series**

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part  
*Landform:* Till plains and moraines  
*Parent material:* Glacial till  
*Slope range:* 0 to 3 percent  
*Taxonomic class:* Fine-loamy, mixed Aquic Haploborolls

#### Typical Pedon

Aazdahl clay loam, 1,800 feet north and 1,650 feet east of the southwest corner of sec. 17, T. 123 N., R. 47 W.

- Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.
- Bw1—8 to 11 inches; very dark grayish brown (2.5Y 3/2) clay loam, dark grayish brown (2.5Y 4/2) dry; weak fine and very fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear wavy boundary.
- Bw2—11 to 15 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine prismatic structure parting to weak fine and very fine subangular blocky; friable; about 4 percent gravel; neutral; gradual smooth boundary.
- Bk—15 to 24 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) clay loam; common fine and medium distinct light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure; friable; about 5 percent gravel; common concretions of lime; strong effervescence; moderately alkaline; gradual wavy boundary.
- C—24 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 and 5/6) clay loam; massive; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 14 to 20 inches  
*Thickness of the mollic epipedon:* 10 to 16 inches  
*Content of rock fragments:* 2 to 8 percent

#### Ap horizon:

Hue—10YR  
 Value—2 or 3; 3 or 4 dry  
 Chroma—1  
 Texture—clay loam

#### Bw horizon:

Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 to 4  
 Texture—clay loam or silty clay loam

#### Bk horizon:

Hue—2.5Y or 5Y  
 Value—5 or 6  
 Chroma—2 to 4

Texture—clay loam or silty clay loam

#### C horizon:

Hue—2.5Y or 5Y  
 Value—5 or 6  
 Chroma—2 to 6  
 Texture—clay loam, silty clay loam, or loam

### Arvilla Series

*Depth class:* Very deep  
*Drainage class:* Somewhat excessively drained  
*Permeability:* Moderately rapid in the upper part; rapid in the lower part  
*Landform:* Outwash plains and stream terraces  
*Parent material:* Glacial outwash  
*Slope range:* 0 to 2 percent  
*Taxonomic class:* Sandy, mixed Udic Haploborolls

#### Typical Pedon

Arvilla loam, 800 feet south and 800 feet west of the northeast corner of sec. 25, T. 124 N., R. 49 W.

- Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 3 percent gravel; neutral; abrupt smooth boundary.
- Bw1—10 to 15 inches; dark brown (10YR 4/3) sandy loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; about 3 percent gravel; neutral; gradual wavy boundary.
- 2Bw2—15 to 34 inches; light olive brown (2.5Y 5/4) loamy sand; weak medium prismatic structure; friable; about 3 percent gravel; neutral; gradual smooth boundary.
- 2C—34 to 60 inches; light olive brown (2.5Y 5/4) gravelly loamy sand; single grained; loose; about 20 percent gravel; slight effervescence.

#### Range in Characteristics

*Depth to carbonates:* 16 to 34 inches  
*Thickness of the mollic epipedon:* 8 to 17 inches

#### Ap horizon:

Hue—10YR  
 Value—2 or 3; 3 or 4 dry  
 Chroma—1  
 Texture—loam  
 Content of rock fragments—0 to 5 percent

#### Bw horizon:

Hue—2.5Y or 10YR  
 Value—2 to 4  
 Chroma—2 to 4  
 Texture—sandy loam  
 Content of rock fragments—0 to 5 percent

**2Bw horizon:**

Hue—2.5Y or 10YR  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—loamy sand or gravelly loamy sand  
 Content of rock fragments—1 to 35 percent

**2C horizon:**

Hue—2.5Y or 10YR  
 Value—4 or 5  
 Chroma—2 to 6  
 Texture—loamy sand, sand, or the gravelly analogs of those textures  
 Content of rock fragments—1 to 35 percent

**Athelwold Series**

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Landform:* Outwash plains

*Parent material:* Silty material overlying glacial outwash

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine-silty over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

**Typical Pedon**

Athelwold silt loam, 900 feet north and 3,100 feet east of the southwest corner of sec. 19, R. 121 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 18 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw—18 to 25 inches; dark brown (10YR 4/3) silt loam; weak fine prismatic structure parting to weak very fine subangular blocky; friable; neutral; gradual smooth boundary.

Bk—25 to 35 inches; grayish brown (2.5Y 5/2) silt loam; few fine prominent light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to weak fine and very fine subangular blocky; friable; strong effervescence; moderately alkaline; clear smooth boundary.

2C—35 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 and 5/6) gravelly sand; single grained; loose; about 20 percent gravel; slight effervescence; slightly alkaline.

**Range in Characteristics**

*Depth to carbonates:* 16 to 34 inches

*Thickness of the mollic epipedon:* 16 to 27 inches

**Ap horizon:**

Hue—10YR  
 Value—2 or 3; 3 or 4 dry  
 Chroma—1 or 2  
 Texture—silt loam

**A horizon:**

Hue—10YR  
 Value—2 or 3; 3 or 4 dry  
 Chroma—1 or 2  
 Texture—silt loam or silty clay loam

**Bw horizon:**

Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 to 4  
 Texture—silt loam or silty clay loam

**Bk horizon:**

Hue—2.5Y or 5Y  
 Value—5 or 6  
 Chroma—2 to 4  
 Texture—silt loam or silty clay loam  
 Content of rock fragments—0 to 1 percent

**2C horizon:**

Hue—10YR or 2.5Y  
 Value—4 to 6  
 Chroma—2 to 6  
 Texture—gravelly sand or very gravelly sand  
 Content of rock fragments—20 to 55 percent

**Bigstone Series**

*Depth class:* Very deep

*Drainage class:* Very poorly drained

*Permeability:* Moderately slow

*Landform:* Till plains and moraines

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls

**Typical Pedon**

Bigstone silty clay loam, 1,200 feet north and 1,400 feet east of the southwest corner of sec. 15, T. 124 N., R. 47 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A1—8 to 22 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; gradual smooth boundary.

A2—22 to 45 inches; very dark gray (N 3/0) silty clay loam, dark gray (N 4/0) dry; weak fine subangular

blocky structure; friable; strong effervescence; slightly alkaline; clear smooth boundary.

2Cg—45 to 60 inches; olive gray (5Y 5/2) clay loam; few fine and medium faint and distinct olive (5Y 5/3 and 5/4) and common fine and medium distinct olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Thickness of the mollic epipedon:* 24 to 60 inches

*Content of rock fragments:* 0 to 8 percent

*Ap horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

*A horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

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

*2Cg horizon:*

Hue—5Y or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam or loam

### Buse Series

*Depth class:* Very deep

*Drainage class:* Well drained

*Permeability:* Moderately slow

*Landform:* Moraines

*Parent material:* Glacial till

*Slope range:* 4 to 18 percent

*Taxonomic class:* Fine-loamy, mixed Udorthentic Haploborolls

#### Typical Pedon

Buse clay loam, in an area of Formdale-Buse clay loams, 4 to 6 percent slopes; 500 feet north and 500 feet east of the southwest corner of sec. 17, T. 124 N., R. 46 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk—8 to 17 inches; grayish brown (2.5Y 5/2) clay loam; weak fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout;

strong effervescence; moderately alkaline; gradual wavy boundary.

C—17 to 60 inches; light olive brown (2.5Y 5/4 and 5/6) clay loam; weak medium and fine subangular blocky structure; about 5 percent gravel; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Thickness of the mollic epipedon:* 7 to 10 inches

*Content of rock fragments:* 2 to 8 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—clay loam

*Bk horizon:*

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

*C horizon:*

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 6

Texture—loam or clay loam

### Copaston Series

*Depth class:* Very shallow and shallow

*Drainage class:* Well drained

*Permeability:* Moderately rapid or moderate

*Landform:* Bedrock-controlled benches

*Parent material:* Alluvium overlying bedrock

*Slope range:* 1 to 25 percent

*Taxonomic class:* Loamy, mixed, mesic Lithic Hapludolls

The Copaston soils in Big Stone County are in a colder temperature regime than is typical for the series. This difference, however, does not alter the use and management of the soils.

#### Typical Pedon

Copaston loam, in an area of Copaston-Rock outcrop complex, 1 to 25 percent slopes; 1,000 feet south and 150 feet east of the northwest corner of sec. 26, T. 121 N., R. 46 W.

A—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; neutral; gradual smooth boundary.

Bw—9 to 14 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

2R—14 inches; granite bedrock.

**Range in Characteristics**

*Thickness of the mollic epipedon:* 8 to 18 inches

*Content of rock fragments:* 0 to 15 percent

*Depth to bedrock:* 8 to 20 inches

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

*Bw horizon:*

Hue—10YR

Value—3 or 4

Chroma—1 to 4

Texture—loam

**Darnen Series**

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderate

*Landform:* Moraines

*Parent material:* Colluvium and glacial till

*Slope range:* 1 to 6 percent

*Taxonomic class:* Fine-loamy, mixed Pachic Udic  
Haploborolls

**Typical Pedon**

Darnen loam, 1 to 6 percent slopes, 500 feet north and 950 feet west of the southeast corner of sec. 32, T. 123 N., R. 46 W.

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

A—8 to 16 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw1—16 to 26 inches; very dark grayish brown (10YR 3/2) loam; weak fine subangular blocky structure; friable; neutral; gradual wavy boundary.

Bw2—26 to 34 inches; dark yellowish brown (10YR 4/4) loam; few fine prominent yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine distinct grayish brown (2.5Y 5/2) and few fine distinct yellowish brown (10YR 5/8) mottles; massive; friable; slight effervescence; slightly alkaline.

**Range in Characteristics**

*Depth to carbonates:* 20 to 60 inches

*Thickness of the mollic epipedon:* 20 to 48 inches

*Content of rock fragments:* 0 to 5 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam, clay loam, or silt loam

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—clay loam or loam

*C horizon:*

Hue—2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—clay loam or loam

**Doran Series**

*Depth class:* Very deep

*Drainage class:* Somewhat poorly drained

*Permeability:* Slow or moderately slow in the upper part; moderately slow or moderate in the lower part

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine, mixed Aquic Argiborolls

**Typical Pedon**

Doran clay loam, 600 feet south and 1,400 feet east of the northwest corner of sec. 1, T. 124 N., R. 49 W.

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

Bt1—8 to 14 inches; very dark grayish brown (10YR 3/2) clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; friable; many distinct very dark brown (10YR 2/2) clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

Bt2—14 to 20 inches; dark brown (10YR 4/3) clay loam; few fine distinct and prominent grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; moderate fine prismatic structure parting to moderate fine angular blocky; friable; common distinct dark grayish brown (2.5YR 4/2) clay films on

faces of peds; about 2 percent gravel; neutral; clear smooth boundary.

Bk—20 to 32 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few lime concretions; about 3 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

C—32 to 60 inches; olive brown (2.5Y 4/4) clay loam; common medium prominent grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; about 3 percent gravel; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 18 to 24 inches

*Thickness of the mollic epipedon:* 8 to 16 inches

*Content of rock fragments:* 0 to 8 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam

*Bt horizon:*

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 or 3

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

*Bk horizon:*

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—2 or 3

Texture—clay loam

*C horizon:*

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay loam

### Dovray Series

*Depth class:* Very deep

*Drainage class:* Very poorly drained

*Permeability:* Slow or moderately slow in the upper part; slow or very slow in the lower part

*Landform:* Till plains

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine, montmorillonitic, frigid Cumulic Haplaquolls

### Typical Pedon

Dovray silty clay, 800 feet south and 2,800 feet east of the northwest corner of sec. 6, T. 123 N., R. 45 W.

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

A—8 to 24 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; firm; neutral; clear wavy boundary.

Bg—24 to 36 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; weak very fine subangular blocky structure; firm; neutral; clear smooth boundary.

Cg—36 to 60 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent light olive brown (2.5Y 5/6) mottles; massive; firm; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 30 to 60 inches

*Thickness of the mollic epipedon:* 24 to 54 inches

*Content of rock fragments:* 0 to 3 percent

*Ap horizon:*

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

*A horizon:*

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay or clay

*Bg horizon:*

Hue—2.5Y or 5Y

Value—3 to 6

Chroma—1 or 2

Texture—silty clay or clay

*Cg horizon:*

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—silty clay or clay

### Egeland Series

*Depth class:* Very deep

*Drainage class:* Well drained

*Permeability:* Moderately rapid

*Landform:* Outwash plains

*Parent material:* Glacial outwash

*Slope range:* 0 to 6 percent

*Taxonomic class:* Coarse-loamy, mixed Udic  
Haploborolls

### Typical Pedon

Egeland fine sandy loam, 0 to 2 percent slopes, 1,200 feet north and 500 feet west of the southeast corner of sec. 35, T. 121 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

Bw1—8 to 12 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

Bw2—12 to 26 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium prismatic structure parting to weak medium and fine subangular blocky; very friable; neutral; gradual wavy boundary.

Bw3—26 to 32 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; neutral; clear smooth boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) loamy fine sand; single grained; very friable; slight effervescence; slightly alkaline.

### Range in Characteristics

*Depth to carbonates:* 25 to 35 inches

*Thickness of the mollic epipedon:* 8 to 16 inches

*Content of rock fragments:* 0 to 8 percent

#### A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—fine sandy loam

#### Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—sandy loam or fine sandy loam

#### C horizon:

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—2 to 4

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

### Embden Series

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderately rapid

*Landform:* Outwash plains

*Parent material:* Glacial outwash

*Slope range:* 0 to 2 percent

*Taxonomic class:* Coarse-loamy, mixed Pachic Udic  
Haploborolls

### Typical Pedon

Embden loam, 2,200 feet north and 350 feet west of the southeast corner of sec. 24, T. 121 N., R. 45 W.

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

Bw1—8 to 20 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

Bw2—20 to 30 inches; dark yellowish brown (10YR 3/4) sandy loam; weak medium prismatic structure parting to weak fine subangular blocky; very friable; neutral; gradual wavy boundary.

Bw3—30 to 40 inches; olive brown (2.5Y 4/4) fine sandy loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium and fine subangular blocky structure; very friable; neutral; gradual irregular boundary.

C—40 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) loamy fine sand; few fine distinct light olive brown (2.5Y 5/6) mottles; single grained; loose; slight effervescence; slightly alkaline.

### Range in Characteristics

*Depth to carbonates:* 25 to 60 inches

*Thickness of the mollic epipedon:* 16 to 40 inches

*Content of rock fragments:* 0 to 1 percent

#### Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

#### Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—sandy loam or fine sandy loam

#### C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 4

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

**Esmond Series**

*Depth class:* Very deep  
*Drainage class:* Well drained  
*Permeability:* Moderate  
*Landform:* Moraines  
*Parent material:* Glacial till  
*Slope range:* 2 to 45 percent  
*Taxonomic class:* Coarse-loamy, mixed Udorthentic Haploborolls

**Typical Pedon**

Esmond loam, in an area of Esmond-Heimdal loams, 2 to 6 percent slopes; 900 feet north and 1,200 feet west of the southeast corner of sec. 33, T. 122 N., R. 46 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; about 10 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk—8 to 17 inches; grayish brown (2.5Y 5/2) loam; weak fine subangular blocky structure; friable; about 5 percent gravel; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C—17 to 60 inches; light olive brown (2.5Y 5/4 and 5/6) loam; massive; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

**Range in Characteristics**

*Thickness of the mollic epipedon:* 7 to 10 inches  
*Content of rock fragments:* 1 to 10 percent; 0.01 to 0.1 percent surface boulders

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

*Bk horizon:*  
 Hue—10YR or 2.5Y  
 Value—4 to 6  
 Chroma—2 to 4  
 Texture—loam, sandy loam, or silt loam

*C horizon:*  
 Hue—10YR or 2.5Y  
 Value—4 or 5  
 Chroma—2 to 6  
 Texture—loam or silt loam

**Estelline Series**

*Depth class:* Very deep  
*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Landform:* Outwash plains

*Parent material:* Lacustrine sediments over glacial outwash

*Slope range:* 0 to 6 percent

*Taxonomic class:* Fine-silty over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

**Typical Pedon**

Estelline silt loam, 0 to 2 percent slopes, 2,400 feet north and 200 feet west of the southeast corner of sec. 20, T. 121 N., R. 45 W.

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

Bw1—8 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak fine subangular blocky; friable; neutral; gradual smooth boundary.

Bw2—11 to 22 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; neutral; clear smooth boundary.

Bk—22 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium subangular blocky structure; friable; common accumulations of lime; strong effervescence; moderately alkaline; clear smooth boundary.

2C—28 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; about 10 percent gravel; slight effervescence; slightly alkaline.

**Range in Characteristics**

*Depth to carbonates:* 22 to 26 inches  
*Thickness of the mollic epipedon:* 16 to 25 inches

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

*Bw horizon:*  
 Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 or 3  
 Texture—silt loam or silty clay loam

*Bk horizon:*  
 Hue—10YR or 2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—silty clay loam or silt loam

**2C horizon:**

Hue—10YR or 2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—sand, loamy sand, or gravelly sand  
 Content of rock fragments—10 to 35 percent

Taxadjunct features: The Estelline soil in map unit 192B has a thinner mollic epipedon than is typical for the series. This difference, however, does not alter the use and management of the soil.

**Flom Series**

*Depth class:* Very deep  
*Drainage class:* Poorly drained  
*Permeability:* Moderately slow  
*Landform:* Till plains and moraines  
*Parent material:* Local alluvium and glacial till  
*Slope range:* 0 to 2 percent  
*Taxonomic class:* Fine-loamy, mixed, frigid Typic Haplaquolls

**Typical Pedon**

Flom silty clay loam, 800 feet north and 500 feet west of the southeast corner of sec. 29, T. 123 N., R. 47 W.

- Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; neutral; abrupt smooth boundary.
- A—8 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky structure; friable; about 1 percent gravel; neutral; clear smooth boundary.
- Bg—14 to 20 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (10YR 5/2) dry; few fine prominent light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; about 2 percent gravel; slightly alkaline; clear smooth boundary.
- Cg1—20 to 36 inches; grayish brown (2.5Y 5/2) clay loam; common fine prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 5 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.
- Cg2—36 to 60 inches; olive gray (5Y 5/2) clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; massive; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

**Range in Characteristics**

*Depth to carbonates:* 14 to 48 inches  
*Thickness of the mollic epipedon:* 10 to 24 inches  
*Content of rock fragments:* 1 to 7 percent

**Ap horizon:**

Hue—10YR or 2.5Y  
 Value—2 or 3  
 Chroma—1  
 Texture—silty clay loam

**A horizon:**

Hue—10YR or 2.5Y  
 Value—2 or 3  
 Chroma—1  
 Texture—silty clay loam or clay loam

**Bg horizon:**

Hue—2.5Y or 5Y  
 Value—4 or 5  
 Chroma—1 or 2  
 Texture—clay loam or silty clay loam

**Cg horizon:**

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

**Fordville Series**

*Depth class:* Very deep  
*Drainage class:* Well drained  
*Permeability:* Moderate in the upper part; rapid in the lower part  
*Landform:* Outwash plains and stream terraces  
*Parent material:* Glacial outwash  
*Slope range:* 0 to 2 percent  
*Taxonomic class:* Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

**Typical Pedon**

Fordville loam, 150 feet south and 200 feet east of the northwest corner of sec. 19, T. 124 N., R. 48 W.

- Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
- Bw1—8 to 19 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
- Bw2—19 to 26 inches; dark yellowish brown (10YR 4/4) loam; weak coarse prismatic structure parting to weak medium and fine subangular blocky; friable; neutral; gradual wavy boundary.
- BC—26 to 33 inches; olive brown (2.5Y 4/3) clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; slightly alkaline; clear smooth boundary.
- 2C—33 to 60 inches; light olive brown (2.5Y 5/4) gravelly loamy sand; single grained; loose; about 30

percent gravel; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 24 to 40 inches

*Thickness of the mollic epipedon:* 16 to 30 inches

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 5 percent

*Bw horizon:*

Hue—10YR

Value—2 to 4

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—0 to 5 percent

*BC horizon:*

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—2 or 3

Texture—clay loam or loam

Content of rock fragments—0 to 5 percent

*2C horizon:*

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—gravelly loamy sand or gravelly sand

Content of rock fragments—20 to 35 percent

### Formdale Series

*Depth class:* Very deep

*Drainage class:* Well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Landform:* Moraines

*Parent material:* Glacial till

*Slope range:* 2 to 12 percent

*Taxonomic class:* Fine-loamy, mixed Udic Haploborolls

#### Typical Pedon

Formdale clay loam, 2 to 4 percent slopes, 1,000 feet south and 1,000 feet west of the northeast corner of sec. 8, T. 124 N., R. 48 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A—8 to 10 inches; very dark brown (10YR 2/2) clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 2 percent gravel;

neutral; clear smooth boundary.

Bw—10 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to weak fine and very fine subangular blocky; friable; about 4 percent gravel; slightly alkaline; clear smooth boundary.

Bk—14 to 24 inches; light olive brown (2.5Y 5/4) clay loam; weak fine subangular blocky structure; friable; about 5 percent gravel; common soft masses of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common fine and medium distinct light olive brown (2.5Y 5/6) relict mottles; massive; friable; about 5 percent gravel; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 10 to 18 inches

*Thickness of the mollic epipedon:* 8 to 13 inches

*Content of rock fragments:* 2 to 8 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam or silty clay loam

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—3 or 4

Texture—clay loam or silty clay loam

*Bk horizon:*

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 or 4

Texture—clay loam or silty clay loam

*C horizon:*

Hue—2.5Y

Value—5 or 6

Chroma—3 to 6

Texture—clay loam, silty clay loam, or loam

### Fram Series

*Depth class:* Very deep

*Drainage class:* Somewhat poorly drained and moderately well drained

*Permeability:* Moderate

*Landform:* Till plains and moraines

*Parent material:* Glacial till

*Slope range:* 1 to 4 percent

*Taxonomic class:* Coarse-loamy, frigid Aeric  
Calciaquolls

#### Typical Pedon

Fram loam, in an area of Fram-Vallers-Parnell complex; 1,375 feet north and 2,500 feet east of the southwest corner of sec. 11, T. 121 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 15 inches; grayish brown (2.5Y 5/2) loam; weak fine and very fine subangular blocky structure; friable; about 5 percent gravel; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—15 to 24 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish brown (10YR 5/8) and grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout; few lime concretions; violent effervescence; moderately alkaline; gradual wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine prominent yellowish brown (10YR 5/8) and few fine distinct brownish gray (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; about 4 percent gravel; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Thickness of the mollic epipedon:* 8 to 14 inches

*Content of rock fragments:* 0 to 5 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

*Bk horizon:*

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or sandy loam

*C horizon:*

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or sandy loam

### Fulda Series

*Depth class:* Very deep

*Drainage class:* Poorly drained

*Permeability:* Slow or moderately slow in the upper part; moderately slow in the lower part

*Landform:* Till plains

*Parent material:* Local alluvium

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine, montmorillonitic, frigid Typic  
Haplaquolls

#### Typical Pedon

Fulda silty clay, 1,500 feet north and 800 feet east of the southwest corner of sec. 2, T. 122 N., R. 45 W.

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

A—8 to 13 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak very fine angular blocky structure; friable; neutral; clear irregular boundary.

Bg—13 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; firm; slightly alkaline; gradual wavy boundary.

Cg1—22 to 46 inches; grayish brown (2.5Y 5/2) silty clay; few fine distinct olive brown (2.5Y 4/4) mottles; weak very fine angular blocky structure; firm; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—46 to 60 inches; olive gray (5Y 5/2) silty clay; common fine prominent light olive brown (2.5Y 5/6) mottles; massive; firm; about 1 percent gravel; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 20 to 42 inches

*Thickness of the mollic epipedon:* 12 to 24 inches

*Content of rock fragments:* 0 to 5 percent

*Ap horizon:*

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

*A horizon:*

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay, clay, or silty clay loam

*Bg horizon:*

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—silty clay or clay

*Cg horizon:*

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—silty clay or silty clay loam

**Gardena Series***Depth class:* Very deep*Drainage class:* Moderately well drained*Permeability:* Moderate*Landform:* Glacial lake plains*Parent material:* Lacustrine sediments*Slope range:* 1 to 3 percent*Taxonomic class:* Coarse-silty, mixed Pachic Udic  
Haploborolls**Typical Pedon**

Gardena silt loam, 1,300 feet north and 350 feet west of the southeast corner of sec. 5, T. 121 N., R. 44 W.

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

A—8 to 15 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; slightly alkaline; gradual smooth boundary.

Bw—15 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak fine and very fine subangular blocky; friable; slightly alkaline; clear smooth boundary.

Bk—21 to 30 inches; grayish brown (2.5Y 5/2) silt loam; weak fine and very fine subangular blocky structure; friable; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—30 to 48 inches; olive brown (2.5Y 4/4) very fine sandy loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak fine and very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—48 to 60 inches; olive brown (2.5Y 4/4) silt loam; common fine distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; massive; friable; slight effervescence; slightly alkaline.

**Range in Characteristics***Depth to carbonates:* 14 to 30 inches*Thickness of the mollic epipedon:* 16 to 25 inches*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam or loam

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 or 3

Texture—silt loam, very fine sandy loam, or loam

*Bk horizon:*

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—2 to 4

Texture—silt loam or very fine sandy loam

*C horizon:*

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—2 to 4

Texture—silt loam or very fine sandy loam

**Glyndon Series***Depth class:* Very deep*Drainage class:* Moderately well drained*Permeability:* Moderate or moderately rapid in the upper part; moderately rapid in the lower part*Landform:* Glacial lake plains*Parent material:* Lacustrine sediments*Slope range:* 0 to 2 percent*Taxonomic class:* Coarse-silty, frigid Aeric Calciaquolls**Typical Pedon**

Glyndon silty clay loam, 1,800 feet south and 100 feet east of the northwest corner of sec. 17, T. 121 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—8 to 11 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; clear smooth boundary.

Bk1—11 to 14 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and very fine subangular blocky structure; friable; disseminated lime throughout; strong effervescence; moderately alkaline; clear smooth boundary.

Bk2—14 to 24 inches; brown (10YR 5/3) silt loam; weak fine and very fine subangular blocky structure;

friable; disseminated lime throughout; few soft masses of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—24 to 32 inches; yellowish brown (10YR 5/4) very fine sandy loam; common fine prominent grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; very friable; strong effervescence; moderately alkaline; gradual irregular boundary.

C2—32 to 60 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) very fine sandy loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive; very friable; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Thickness of the mollic epipedon:* 8 to 16 inches

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam or silt loam

*Bk horizon:*

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—silt loam, silty clay loam, or very fine sandy loam

*C horizon:*

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

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

### Gonvick Series

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderately slow

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 1 to 2 percent

*Taxonomic class:* Fine-loamy, mixed Aquic Argiborolls

#### Typical Pedon

Gonvick loam, 2,250 feet south and 275 feet east of the northwest corner of sec. 17, T. 123 N., R. 47 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark

gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—8 to 15 inches; dark brown (10YR 4/3) clay loam; weak fine and very fine subangular blocky structure; friable; many prominent very dark brown (10YR 2/2) clay films on faces of ped; about 2 percent gravel; neutral; gradual wavy boundary.

Bt2—15 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine and very fine subangular blocky structure; friable; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of ped; about 2 percent gravel; neutral; clear smooth boundary.

Bk—25 to 36 inches; olive brown (2.5Y 4/4) clay loam; few fine distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; weak fine and very fine subangular blocky structure; friable; about 3 percent gravel; common lime concretions; strong effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 22 to 30 inches

*Thickness of the mollic epipedon:* 8 to 16 inches

*Content of rock fragments:* 2 to 8 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

*Bt horizon:*

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay loam

*Bk horizon:*

Hue—2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay loam or loam

*C horizon:*

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—clay loam or loam

## Hamerly Series

*Depth class:* Very deep

*Drainage class:* Somewhat poorly drained and moderately well drained

*Permeability:* Moderate in the upper part; moderately slow in the lower part

*Landform:* Till plains and moraines

*Parent material:* Glacial till

*Slope range:* 1 to 6 percent

*Taxonomic class:* Fine-loamy, frigid Aeric Calcicquolls

### Typical Pedon

Hamerly loam, in an area of Hamerly-Parnell complex; 1,800 feet north and 2,500 feet east of the southwest corner of sec. 25, T. 124 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; about 5 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 16 inches; light brownish gray (10YR 6/2) clay loam; weak fine and very fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—16 to 28 inches; light brownish gray (10YR 6/2) clay loam; few fine faint light gray (10YR 7/1) and few fine prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout; few lime concretions; violent effervescence; moderately alkaline; gradual wavy boundary.

C—28 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct yellowish brown (10YR 5/6) and few medium prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; about 4 percent gravel; strong effervescence; moderately alkaline.

### Range in Characteristics

*Thickness of the mollic epipedon:* 8 to 14 inches

*Content of rock fragments:* 1 to 8 percent

*Ap horizon:*

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—loam

*Bk horizon:*

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

*C horizon:*

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

## Hattie Series

*Depth class:* Very deep

*Drainage class:* Moderately well drained and well drained

*Permeability:* Slow

*Landform:* Till plains

*Parent material:* Glacial till

*Slope range:* 1 to 10 percent

*Taxonomic class:* Fine, montmorillonitic Udertic Haploborolls

### Typical Pedon

Hattie silty clay, 1 to 4 percent slopes, 2,000 feet south and 2,200 feet west of the northeast corner of sec. 6, T. 123 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; about 3 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bw—8 to 15 inches; olive brown (2.5Y 4/4) silty clay; moderate fine subangular blocky structure; few black (10YR 2/1) vertical tongues ¼ to ¾ inch wide; firm; about 3 percent gravel; slight effervescence; slightly alkaline; abrupt irregular boundary.

Bk—15 to 22 inches; olive brown (2.5Y 4/4) silty clay; weak medium prismatic structure parting to moderate fine subangular blocky; firm; about 3 percent gravel; disseminated lime throughout; few lime concretions; strong effervescence; moderately alkaline; clear smooth boundary.

C—22 to 60 inches; olive brown (2.5Y 4/4) silty clay; common fine and medium distinct grayish brown (2.5Y 5/2) and olive (5Y 5/3) mottles; weak fine prismatic structure; firm; about 3 percent gravel; slight effervescence; slightly alkaline.

### Range in Characteristics

*Thickness of the mollic epipedon:* 8 to 15 percent

*Content of rock fragments:* 2 to 8 percent

*Ap horizon:*

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1

Texture—silty clay

*Bw horizon:*

Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 to 4  
 Texture—silty clay or clay

*Bk horizon:*

Hue—2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—silty clay or clay

*C horizon:*

Hue—2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—silty clay or clay

**Heimdal Series**

*Depth class:* Very deep

*Drainage class:* Well drained

*Permeability:* Moderate

*Landform:* Moraines

*Parent material:* Glacial till

*Slope range:* 2 to 8 percent

*Taxonomic class:* Coarse-loamy, mixed Udic  
 Haploborolls

**Typical Pedon**

Heimdal loam, in an area of Esmond-Heimdal loams, 2 to 6 percent slopes; 700 feet north and 2,200 feet east of the southwest corner of sec. 8, T. 122 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

Bw—8 to 13 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; friable; about 3 percent gravel; slightly alkaline; gradual smooth boundary.

Bk1—13 to 16 inches; olive brown (2.5Y 4/4) loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; about 3 percent gravel; few concretions of lime; strong effervescence; slightly alkaline; clear smooth boundary.

Bk2—16 to 25 inches; light olive brown (2.5Y 5/4) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; about 3 percent gravel; few concretions of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—25 to 60 inches; light olive brown (2.5Y 5/4) loam;

massive; friable; about 3 percent gravel; strong effervescence; moderately alkaline.

**Range in Characteristics**

*Depth to carbonates:* 12 to 18 inches

*Thickness of the mollic epipedon:* 8 to 16 inches

*Content of rock fragments:* 1 to 8 percent

*Ap horizon:*

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

*Bw horizon:*

Hue—10YR or 2.5Y  
 Value—3 to 5  
 Chroma—2 to 4  
 Texture—loam or silt loam

*Bk horizon:*

Hue—2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—loam or silt loam

*C horizon:*

Hue—2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—loam or silt loam

**Lamoure Series**

*Depth class:* Very deep

*Drainage class:* Poorly drained

*Permeability:* Moderate or moderately slow

*Landform:* Flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine-silty, mixed (calcareous), frigid  
 Cumulic Haplaquolls

**Typical Pedon**

Lamoure silty clay loam, 1,000 feet south and 50 feet west of the northeast corner of sec. 3, T. 120 N., R. 45 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—8 to 36 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; clear smooth boundary.

Cg1—36 to 45 inches; dark gray (N 4/0) silty clay loam; weak medium and fine subangular blocky structure;

friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 0 to 10 inches

*Thickness of the mollic epipedon:* 24 to 40 inches

*Ap horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

*A horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam or silt loam

*Cg horizon:*

Hue—2.5Y, 5Y, or neutral

Value—3 to 5

Chroma—0 to 2

Texture—silty clay loam or silt loam

### La Prairie Series

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderate

*Landform:* Flood plains

*Parent material:* Alluvium

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine-loamy, mixed Cumulic Udic Haploborolls

#### Typical Pedon

La Prairie silt loam, 1,700 feet south and 200 feet east of the northwest corner of sec. 16, T. 121 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 16 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky structure; friable; slightly alkaline; gradual wavy boundary.

Bw—16 to 29 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak fine and medium subangular blocky; friable; neutral; gradual wavy boundary.

C—29 to 60 inches; very dark grayish brown (10YR 3/2)

silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 0 to 30 inches

*Thickness of the mollic epipedon:* 20 to 40 inches

*Content of rock fragments:* 0 to 2 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam, loam, or silty clay loam

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—1 to 3

Texture—silt loam or loam

*C horizon:*

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—1 to 3

Texture—silt loam or loam

### Lindaas Series

*Depth class:* Very deep

*Drainage class:* Poorly drained

*Permeability:* Moderate to slow in the upper part; moderately slow or moderate in the lower part

*Landform:* Till plains and moraines

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine, montmorillonitic, frigid Typic Argiaquolls

#### Typical Pedon

Lindaas silty clay loam, in an area of Hamerly-Lindaas complex; 1,050 feet north and 225 feet west of the southeast corner of sec. 22, T. 124 N., R. 45 W.

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

A—8 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

- Bt1**—12 to 20 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine prismatic structure parting to moderate fine and very fine subangular blocky; firm; common faint black (10YR 2/1) clay films on faces of peds; slightly alkaline; gradual wavy boundary.
- Bt2**—20 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine and medium prominent yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; many faint very dark grayish brown (10YR 3/2) clay films on faces of peds; slightly alkaline; clear wavy boundary.
- Bk**—26 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.
- Cg**—36 to 60 inches; olive gray (5Y 5/2) and light olive brown (2.5Y 5/4) silty clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 24 to 35 inches

*Thickness of the mollic epipedon:* 16 to 32 inches

#### *Ap horizon:*

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam

#### *A horizon:*

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam or clay loam

#### *Bt horizon:*

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay or clay

#### *Bk horizon:*

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—silty clay loam or silt loam

#### *Cg horizon:*

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 4

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

## Malachy Series

*Depth class:* Very deep

*Drainage class:* Moderately well drained

*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part

*Landform:* Outwash plains

*Parent material:* Glacial outwash

*Slope range:* 0 to 3 percent

*Taxonomic class:* Coarse-loamy, mixed Pachic Udic Haploborolls

#### Typical Pedon

Malachy loam, 100 feet south and 2,500 feet east of the northwest corner of sec. 27, T. 121 N., R. 44 W.

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

**A1**—8 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

**A2**—13 to 19 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual smooth boundary.

**Bw**—19 to 24 inches; dark grayish brown (2.5Y 4/2) loam; weak fine and very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

**Bk**—24 to 33 inches; grayish brown (2.5Y 5/2) loam; common fine prominent and faint light olive brown (2.5Y 5/6) and light brownish gray (2.5Y 6/2) mottles; weak fine and very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; disseminated lime throughout; clear smooth boundary.

**2C**—33 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) loamy fine sand; few fine distinct light olive brown (2.5Y 5/6) mottles; single grained; loose; slight effervescence; moderately alkaline.

#### Range in Characteristics

*Thickness of the mollic epipedon:* 16 to 24 inches

*Content of rock fragments:* 0 to 8 percent

#### *Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

**A horizon:**

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

**Bw horizon:**

Hue—2.5Y or 10YR  
 Value—3 to 5  
 Chroma—2 to 4  
 Texture—loam, sandy loam, or fine sandy loam

**Bk horizon:**

Hue—2.5Y or 10YR  
 Value—3 to 5  
 Chroma—2 to 4  
 Texture—loam, sandy loam, or fine sandy loam

**2C horizon:**

Hue—2.5Y or 10YR  
 Value—4 or 5  
 Chroma—2 to 6  
 Texture—loamy fine sand, loamy sand, or sand

**Marysland Series**

*Depth class:* Very deep

*Drainage class:* Poorly drained

*Permeability:* Moderate in the upper part; rapid in the lower part

*Landform:* Outwash plains

*Parent material:* Glacial outwash

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls

**Typical Pedon**

Marysland clay loam, 2,200 feet south and 200 feet west of the northeast corner of sec. 30, T. 121 N., R. 44 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

Ak—8 to 18 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; friable; disseminated lime throughout; strong effervescence; moderately alkaline; gradual smooth boundary.

Bkg—18 to 32 inches; dark grayish brown (2.5Y 4/2) loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; strong effervescence; moderately alkaline; disseminated lime throughout; gradual wavy boundary.

Cg1—32 to 38 inches; grayish brown (2.5Y 5/2) loam;

common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; slight effervescence; moderately alkaline; clear smooth boundary.

2Cg2—38 to 60 inches; grayish brown (2.5Y 5/2) sand; common medium and fine prominent yellowish brown (10YR 5/6) mottles; single grained; loose; about 10 percent gravel; slight effervescence; moderately alkaline.

**Range in Characteristics**

*Depth to coarse textured material:* 20 to 40 inches

*Thickness of the mollic epipedon:* 8 to 30 inches

**Ap horizon:**

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

Content of rock fragments—0 to 3 percent

**Ak horizon:**

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam, loam, silt loam, or sandy clay loam

Content of rock fragments—0 to 3 percent

**Bk horizon:**

Hue—2.5Y, 5Y, or neutral

Value—3 to 5

Chroma—0 to 2

Texture—loam, clay loam, or sandy clay loam

Content of rock fragments—0 to 10 percent

**Cg horizon:**

Hue—2.5Y, 5Y, or neutral

Value—3 to 5

Chroma—0 to 2

Texture—loam, clay loam, or sandy clay loam

Content of rock fragments—0 to 10 percent

**2Cg horizon:**

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—sand, fine sand, coarse sand, or gravelly coarse sand

Content of rock fragments—7 to 35 percent

**Oldham Series**

*Depth class:* Very deep

*Drainage class:* Very poorly drained

*Permeability:* Slow in the upper part; slow or moderately slow in the lower part

*Landform:* Till plains

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls

#### Typical Pedon

Oldham silty clay, 300 feet north and 600 feet east of the southwest corner of sec. 10, T. 122 N., R. 45 W.

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

A—8 to 22 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak fine and very fine subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Bg—22 to 30 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; weak fine and very fine subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual irregular boundary.

Cg1—30 to 44 inches; olive gray (5Y 5/2) silty clay; common fine prominent light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—44 to 60 inches; olive gray (5Y 5/2) silty clay; common fine prominent light olive brown (2.5Y 5/6) and few fine distinct gray (N 5/0) mottles; moderate very fine subangular blocky structure; friable; strong effervescence; moderately alkaline.

#### Range in Characteristics

*Depth to carbonates:* 0 to 10 inches

*Thickness of the mollic epipedon:* 24 to 40 inches

*Ap horizon:*

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay

*A horizon:*

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay or silty clay loam

*Bg horizon:*

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 or 4

Chroma—0 or 1

Texture—silty clay or silty clay loam

*Cg horizon:*

Hue—2.5Y or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay or silty clay loam

### Parnell Series

*Depth class:* Very deep

*Drainage class:* Very poorly drained

*Permeability:* Moderately slow in the upper part; slow in the lower part

*Landform:* Till plains and moraines

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 1 percent

*Taxonomic class:* Fine, montmorillonitic, frigid Typic Argiaquolls

#### Typical Pedon

Parnell silty clay loam, in an area of Hamerly-Parnell complex; 2,200 feet north and 1,250 feet west of the southeast corner of sec. 18, T. 124 N., R. 45 W.

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

A—8 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; gray (10YR 6/1), bleached sand grains on faces of peds; weak thin platy structure parting to weak very fine subangular blocky; friable; neutral; clear smooth boundary.

Btg1—20 to 37 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium and fine subangular blocky structure; firm; common faint black (10YR 2/1) clay films on faces of peds; neutral; gradual smooth boundary.

Btg2—37 to 50 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to strong fine and very fine subangular blocky; firm; many distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; slightly alkaline; diffuse wavy boundary.

Cg—50 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine and medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; friable; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 35 to 60 inches

*Thickness of the mollic epipedon:* 24 to 60 inches

*Ap horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

*A horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3  
 Chroma—0 or 1  
 Texture—silty clay loam or silt loam

**Btg horizon:**

Hue—10YR, 2.5Y, or 5Y  
 Value—2 to 4  
 Chroma—1 or 2  
 Texture—silty clay or silty clay loam  
 Content of rock fragments—0 to 3 percent in the lower part

**Cg horizon:**

Hue—2.5Y or 5Y  
 Value—3 to 5  
 Chroma—1 or 2  
 Texture—silty clay loam or clay loam  
 Content of rock fragments—0 to 7 percent

**Rauville Series**

*Depth class:* Very deep  
*Drainage class:* Very poorly drained  
*Permeability:* Moderate or moderately slow  
*Landform:* Flood plains  
*Parent material:* Alluvium  
*Slope range:* 0 to 1 percent  
*Taxonomic class:* Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls

**Typical Pedon**

Rauville silty clay loam, 1,000 feet north and 50 feet east of the southwest corner of sec. 1, T. 120 N., R. 45 W.

- A1—0 to 21 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and very fine subangular blocky structure; friable; slight effervescence; slightly alkaline; clear smooth boundary.
- A2—21 to 34 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium and fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.
- Cg—34 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; massive; friable; strong effervescence; moderately alkaline.

**Range in Characteristics**

*Thickness of the mollic epipedon:* 24 to 40 inches

**A horizon:**

Hue—10YR, 2.5Y, or neutral  
 Value—2 or 3  
 Chroma—0 or 1

Texture—silty clay loam or silt loam

**Cg horizon:**

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

**Renshaw Series**

*Depth class:* Very deep  
*Drainage class:* Somewhat excessively drained  
*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part  
*Landform:* Outwash plains  
*Parent material:* Glacial outwash  
*Slope range:* 0 to 6 percent  
*Taxonomic class:* Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls

**Typical Pedon**

Renshaw loam, 0 to 6 percent slopes, 1,800 feet south and 500 feet west of the northeast corner of sec. 6, T. 123 N., R. 48 W.

- A—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 10 percent gravel; slightly acid; clear smooth boundary.
- Bw—10 to 17 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; about 10 percent gravel; neutral; abrupt smooth boundary.
- 2C—17 to 60 inches; varicolored gravelly sand; single grained; loose; about 30 percent gravel; slight effervescence; slightly alkaline.

**Range in Characteristics**

*Depth to carbonates:* 14 to 20 inches  
*Thickness of the mollic epipedon:* 10 to 15 inches

**A horizon:**

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

**Bw horizon:**

Hue—10YR  
 Value—3 or 4  
 Chroma—1 to 4  
 Texture—loam or gravelly loam  
 Content of rock fragments—0 to 35 percent

**2C horizon:**

Hue—10YR or 2.5Y  
 Value—3 to 5

Chroma—2 to 6  
 Texture—gravelly sand, very gravelly sand, gravelly loamy sand, or very gravelly loamy sand  
 Content of rock fragments—30 to 55 percent

### **Sioux Series**

*Depth class:* Very deep  
*Drainage class:* Excessively drained  
*Permeability:* Moderate or moderately rapid in the upper part; rapid in the lower part  
*Landform:* Moraines and outwash plains  
*Parent material:* Glacial outwash  
*Slope range:* 1 to 35 percent  
*Taxonomic class:* Sandy-skeletal, mixed Udorthentic Haploborolls

#### **Typical Pedon**

Sioux loam, 1 to 6 percent slopes, 50 feet south and 1,900 feet east of the northwest corner of sec. 5, T. 123 N., R. 48 W.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 10 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.
- AC—8 to 14 inches; brown (10YR 4/3) gravelly loam; weak coarse subangular blocky structure; very friable; about 20 percent gravel; slight effervescence; slightly alkaline; gradual irregular boundary.
- C—14 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grained; loose; about 40 percent gravel; slight effervescence; slightly alkaline.

#### **Range in Characteristics**

*Depth to carbonates:* 0 to 8 inches  
*Thickness of the mollic epipedon:* 7 to 14 inches  
*Ap horizon:*  
 Hue—10YR  
 Value—2 or 3  
 Chroma—1  
 Texture—loam  
 Content of rock fragments—1 to 12 percent

*AC horizon:*  
 Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 or 3  
 Texture—loam, gravelly loam, sandy loam, or gravelly sandy loam  
 Content of rock fragments—10 to 35 percent

*C horizon:*  
 Hue—10YR or 2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—gravelly sand, very gravelly sand, gravelly loamy sand, or very gravelly loamy sand  
 Content of rock fragments—30 to 70 percent

### **Spottswood Series**

*Depth class:* Very deep  
*Drainage class:* Moderately well drained  
*Permeability:* Moderate in the upper part; rapid in the lower part  
*Landform:* Outwash plains  
*Parent material:* Glacial outwash  
*Slope range:* 0 to 2 percent  
*Taxonomic class:* Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

#### **Typical Pedon**

- Spottswood loam, 50 feet south and 1,400 feet east of the northwest corner of sec. 19, T. 124 N., R. 48 W.
- Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure; friable; neutral; abrupt smooth boundary.
- Bw1—8 to 19 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; neutral; gradual smooth boundary.
- Bw2—19 to 22 inches; dark grayish brown (10YR 4/2) clay loam; weak coarse prismatic structure parting to weak medium and fine subangular blocky; friable; neutral; gradual wavy boundary.
- Bw3—22 to 32 inches; dark grayish brown (2.5Y 4/2) loam; common fine and medium prominent light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure; friable; neutral; clear smooth boundary.
- 2C—32 to 60 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) gravelly sand; single grained; loose; about 30 percent gravel; slight effervescence; slightly alkaline.

#### **Range in Characteristics**

*Depth to carbonates:* 20 to 34 inches  
*Thickness of the mollic epipedon:* 16 to 30 inches  
*Ap horizon:*  
 Hue—10YR  
 Value—2 or 3  
 Chroma—1  
 Texture—loam  
 Content of rock fragments—0 to 3 percent

**Bw horizon:**

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

**2C horizon:**

Hue—2.5Y or 10YR  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—gravelly loam, very gravelly loam, gravelly sandy loam, very gravelly sandy loam, gravelly sand, or very gravelly sand  
 Content of rock fragments—15 to 65 percent

**Svea Series**

*Depth class:* Very deep  
*Drainage class:* Moderately well drained  
*Permeability:* Moderate in the upper part; moderately slow or moderate in the lower part  
*Landform:* Till plains and moraines  
*Parent material:* Glacial till  
*Slope range:* 0 to 3 percent  
*Taxonomic class:* Fine-loamy, mixed Pachic Udic Haploborolls

**Typical Pedon**

Svea loam, 1,200 feet north and 900 feet west of the southeast corner of sec. 26, T. 122 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 4 percent gravel; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; neutral; gradual wavy boundary.

Bw—13 to 17 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak medium prismatic structure parting to weak fine subangular blocky; friable; about 2 percent gravel; neutral; clear smooth boundary.

Bk—17 to 27 inches; light olive brown (2.5Y 5/4) loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout; few soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—27 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine and medium distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; massive; friable; about 2 percent gravel; strong

effervescence; moderately alkaline.

**Range in Characteristics**

*Depth to carbonates:* 16 to 24 inches  
*Thickness of the mollic epipedon:* 16 to 25 inches  
*Content of rock fragments:* 1 to 10 percent

**Ap horizon:**

Hue—10YR or 2.5Y  
 Value—2 or 3  
 Chroma—1  
 Texture—loam

**A horizon:**

Hue—10YR or 2.5Y  
 Value—2 or 3  
 Chroma—1  
 Texture—loam, silt loam, or clay loam

**Bw horizon:**

Hue—10YR or 2.5Y  
 Value—3 or 4  
 Chroma—2 to 4  
 Texture—loam, silt loam, or clay loam

**Bk horizon:**

Hue—2.5Y or 10YR  
 Value—4 to 6  
 Chroma—2 to 4  
 Texture—loam or clay loam

**C horizon:**

Hue—2.5Y  
 Value—4 or 5  
 Chroma—2 to 4  
 Texture—loam or clay loam

**Sverdrup Series**

*Depth class:* Very deep  
*Drainage class:* Well drained  
*Permeability:* Moderately rapid in the upper part; rapid in the lower part  
*Landform:* Outwash plains  
*Parent material:* Glacial outwash  
*Slope range:* 1 to 6 percent  
*Taxonomic class:* Sandy, mixed Udic Haploborolls

**Typical Pedon**

Sverdrup fine sandy loam, 1 to 6 percent slopes, 1,200 feet south and 200 feet east of the northwest corner of sec. 30, T. 121 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

Bw1—8 to 14 inches; dark yellowish brown (10YR 3/4) fine sandy loam; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

**Bw2**—14 to 18 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium prismatic structure parting to weak fine subangular blocky; very friable; neutral; clear wavy boundary.

**C**—18 to 60 inches; olive brown (2.5Y 4/4) loamy sand; single grained; very friable; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 15 to 30 inches

*Thickness of the mollic epipedon:* 8 to 16 inches

*Content of rock fragments:* 0 to 3 percent

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—3 or 4

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

*C horizon:*

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—loamy sand, sand, or loamy fine sand

### **Swenoda Series**

*Depth class:* Very deep

*Drainage class:* Moderately well drained and well drained

*Permeability:* Moderately rapid in the upper part; moderately slow or moderate in the lower part

*Landform:* Outwash plains

*Parent material:* Loamy sediment over glacial till

*Slope range:* 0 to 6 percent

*Taxonomic class:* Coarse-loamy, mixed Pachic Udic Haploborolls

#### Typical Pedon

Swenoda sandy loam, 0 to 2 percent slopes, 1,500 feet north and 200 feet east of the southwest corner of sec. 20, T. 124 N., R. 48 W.

**Ap**—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

**A**—8 to 14 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

**Bw1**—14 to 28 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak medium and fine subangular blocky structure; friable; neutral; gradual wavy boundary.

**Bw2**—28 to 33 inches; olive brown (2.5Y 4/4) fine sandy loam; weak medium prismatic structure parting to weak medium and fine subangular blocky; friable; neutral; abrupt smooth boundary.

**2Bk**—33 to 39 inches; olive brown (2.5Y 4/4) clay loam; common fine distinct grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; about 3 percent gravel; strong effervescence; few lime concretions; moderately alkaline; gradual wavy boundary.

**2C**—39 to 60 inches; grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/4), and olive brown (2.5Y 4/4) clay loam; massive; friable; about 3 percent gravel; slight effervescence; slightly alkaline.

#### Range in Characteristics

*Depth to carbonates:* 20 to 40 inches

*Thickness of the mollic epipedon:* 16 to 30 inches

*Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—sandy loam

Content of rock fragments—0 to 5 percent

*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—0 to 3 percent

*Bw horizon:*

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

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

Content of rock fragments—0 to 3 percent

*2Bk horizon:*

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay loam or loam

Content of rock fragments—1 to 7 percent

*2C horizon:*

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—clay loam or loam

Content of rock fragments—1 to 7 percent

Taxadjunct features: The Swenoda soil in map unit 293B has a thinner mollic epipedon than is typical for the series. This difference, however, does not alter the use and management of the soil.

### **Vallers Series**

*Depth class:* Very deep

*Drainage class:* Poorly drained

*Permeability:* Moderately slow

*Landform:* Till plains and moraines

*Parent material:* Local alluvium and glacial till

*Slope range:* 0 to 2 percent

*Taxonomic class:* Fine-loamy, frigid Typic Calciaquolls

#### **Typical Pedon**

Vallers clay loam, 850 feet north and 250 feet west of the southeast corner of sec. 22, T. 124 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Bkg1—13 to 21 inches; grayish brown (2.5Y 5/2) clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak very fine subangular blocky structure; friable; about 2 percent gravel; disseminated lime throughout; strong effervescence; moderately alkaline; gradual smooth boundary.

Bkg2—21 to 26 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; about 2 percent gravel; few soft masses of lime; few lime concretions; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—26 to 60 inches; olive (5Y 5/3) clay loam; common medium distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 and 5/6) mottles; massive; friable; about 4 percent gravel; slight effervescence; slightly alkaline.

#### **Range in Characteristics**

*Thickness of the mollic epipedon:* 10 to 25 inches

*Content of rock fragments:* 2 to 8 percent

*Ap horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

*A horizon:*

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam or silty clay loam

*Bkg horizon:*

Hue—10YR, 2.5Y, or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—clay loam or silty clay loam

*Cg horizon:*

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—1 to 3

Texture—clay loam or loam

### **Zell Series**

*Depth class:* Very deep

*Drainage class:* Well drained

*Permeability:* Moderate

*Landform:* Glacial lake plains

*Parent material:* Silty lacustrine sediments

*Slope range:* 2 to 8 percent

*Taxonomic class:* Coarse-silty, mixed Udorthentic Haploborolls

#### **Typical Pedon**

Zell silt loam, 2 to 8 percent slopes, 300 feet north and 1,800 feet east of the southwest corner of sec. 5, T. 121 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk—8 to 16 inches; olive brown (2.5Y 4/4) silt loam; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—16 to 30 inches; light olive brown (2.5Y 5/4) very fine sandy loam; common fine and medium distinct light olive brown (2.5Y 5/6) relict mottles; massive; very friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—30 to 60 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; massive; very friable; slight effervescence; slightly alkaline.

#### **Range in Characteristics**

*Thickness of the mollic epipedon:* 7 to 10 inches

*Ap horizon:*

Hue—10YR

Value—2 or 3  
Chroma—1  
Texture—silt loam

*Bk horizon:*

Hue—10YR or 2.5Y  
Value—4 or 5  
Chroma—2 to 4

Texture—silt loam or very fine sandy loam

*C horizon:*

Hue—10YR or 2.5Y  
Value—4 to 6  
Chroma—2 to 4  
Texture—very fine sandy loam or silt loam

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# Formation of the Soils

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Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of a soil are determined by the interaction of five major factors. These factors are the physical and mineralogical composition of the parent material; the climate under which the soil formed; 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.

## Parent Material

Parent material is the physical medium in which a soil develops. Geologic events are responsible for the types of parent material in Big Stone County. Most of the soils in the county formed in glacial till, lacustrine sediments, alluvium, colluvial sediments, or sandy or gravelly outwash.

The New Ulm phase of the Des Moines Lobe of the Wisconsin Glaciation was the last glacier to cover the survey area. It retreated from the area about 12,000 years ago. The glacial till that was left behind covers most of the county. It is calcareous loam, clay loam, or clay. Esmond, Fram, Hamerly, Hattie, Lindaas, and Parnell soils formed in till.

The southeast corner of the county has lacustrine deposits from Lake Benson, a glacial lake that formed from meltwater (3). The lacustrine sediments are silt loam or very fine sandy loam. Zell and Gardena soils formed in lacustrine sediments.

Glacial outwash is on outwash plains and terraces and in meltwater channels. It is mostly along rivers and streams. Sverdrup, Egeland, Renshaw, and Sioux soils formed in sand and gravel outwash sediments.

The entire county is underlain by crystalline Precambrian bedrock. Some of the bedrock crops out as ledges of granite in the Minnesota River Valley south of Ortonville. Copaston soils formed in a mantle of alluvium overlying this bedrock.

Alluvial material is on the bottom land along rivers and streams. This material is mostly dark-colored silt loam and silty clay loam and is several feet thick. La Prairie, Lamoure, and Rauville soils formed in alluvium.

Colluvial material is at the base of many of the steeper slopes. It is mostly dark-colored loam. Darnen soils formed in colluvium.

## Climate

Big Stone County has a subhumid, continental climate characterized by cold winters and hot summers. Temperature and precipitation help to determine the kind of vegetation on the soil, the length of the growing season, the soil moisture regime, and the cycles of freezing and thawing.

Temperature affects the soil in several important ways. It determines the rate of chemical reactions in the soil, which result from the decaying of organic matter and other biological activity and the weathering of mineral components. It significantly influences the type of plant and animal life on and in the soil by limiting the growing season and affecting the metabolic rate of micro-organisms. Alternate periods of freezing and thawing play a part in the formation of soil structure and the physical weathering of soil minerals. Frost action helps to mix the soil material.

Precipitation affects the soil in many ways. All biological activity in the soil depends on water. Water dissolves minerals and transports mineral salts to the surface. The minerals are deposited as water evaporates, or they are leached to lower horizons. As water moves through the soil, it transports plant nutrients, which are absorbed by plants or soil colloids or are leached from the root zone. The native vegetation of a region is, to a large extent, attributable to the climate. Prairie vegetation and cold winters promote the accumulation of organic matter in soils. Most of the soils in Big Stone County have a high content of organic matter, which results in a dark surface layer.

## Plant and Animal Life

The soils in Big Stone County formed under tall prairie grasses. Although the soils supported hundreds of plant species, the tall grasses were dominant. They

provided the organic matter necessary for the formation of the thick, dark surface layer that is typical of the soils in the county.

Micro-organisms play a significant role in the processes of soil formation. Soil micro-organisms are largely responsible for the decomposition of fresh organic matter and the recycling of plant nutrients.

Earthworms and larger burrowing animals mix soil layers. Their burrows provide channels for air and water movement.

Human activities also have affected soil formation. Prairie fires, many of which were started by humans, rejuvenated the prairie ecosystem. Intensive agriculture has resulted in an accelerated sequence of erosion and deposition and a loss of granular structure and organic matter in the plow layer. Conversely, various soil conservation practices have restored beneficial soil properties.

## Relief

Relief in Big Stone County ranges from nearly level to very steep. In areas of uniform parent material, relief plays a major role in the formation of different soils. Soil drainage is directly related to relief. A typical drainage sequence is represented by the Esmond, Fram, Vallers, and Parnell soils. Each of these soils is on a distinctive part of the landscape. The well drained Esmond soils are on convex side slopes. The somewhat poorly drained or moderately well drained Fram soils are on low convex rises. The poorly drained Vallers soils are in drainageways and on the rims of depressions. The very

poorly drained Parnell soils are in depressions.

Slope affects the rate of water erosion. As slope gradient increases, the rate of runoff and the hazard of erosion increase and the rate of soil profile development decreases. The increased runoff rate reduces the amount of moisture available to plants. The resulting decrease in plant growth reduces the amount of organic matter that accumulates in the soil. Increased runoff also reduces the extent to which carbonates are leached from the soil and the rate of soil profile development.

## Time

Time is an important factor in the processes of soil formation. Older soils are more developed than younger ones. From a geologic perspective, the soils in Big Stone County are very young. They formed in material deposited during the latter part of the Wisconsin Glaciation and are about 10,000 to 14,000 years old. The length of time has been sufficient for all of the soils to show some evidence of development.

In areas that are stable and not subject to frequent changes in parent material, conditions are favorable for soil development and mature profiles have developed. In unstable areas, such as the steeper slopes, conditions for soil development are less favorable and the soils are weakly developed. Soils that formed in relatively recent deposits of alluvial or colluvial sediments are less well developed than other soils in the county.

## References

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- (1) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.
- (2) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.
- (3) Diedrick, R., and R. Rust. 1975. Glacial lake evidence in western Minnesota. *Minn. Acad. of Sci.* 41: 9-12.
- (4) Minnesota Agricultural Statistics Service. 1977-1985. Big Stone County crop yields.
- (5) Minnesota Geological Survey. 1956. The geology and underground waters of southern Minnesota. *Minn. Geol. Surv. Bull.* 31, pp. 97-105.
- (6) Minnesota Geological Survey. 1972. Quaternary history of Minnesota. *In* *Geology of Minnesota: A centennial volume.*
- (7) Ojakangas, Richard W., and Charles L. Matsch. 1982. Minnesota geology.
- (8) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. *Soil Conserv. Serv., U.S. Dep. Agric. Handb.* 436.
- (9) United States Department of Agriculture. 1993. Soil survey manual. *U.S. Dep. Agric. Handb.* 18.
- (10) United States Department of Agriculture, National Agricultural Statistics Service (in cooperation with the Minnesota Agricultural Statistics Service). 1988. Minnesota agricultural statistics.

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# Glossary

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**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

|                 |              |
|-----------------|--------------|
| Very low .....  | 0 to 3       |
| Low .....       | 3 to 6       |
| Moderate .....  | 6 to 9       |
| High .....      | 9 to 12      |
| Very high ..... | more than 12 |

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Catena.** A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

**Chiseling.** Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil 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.

**Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or

establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**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.

**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.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Depth, soil.** The total thickness of weathered soil

material over bedrock. In this soil survey the classes of soil depth are:

|                      |                        |
|----------------------|------------------------|
| Very deep .....      | greater than 60 inches |
| Deep .....           | 40 to 60 inches        |
| Moderately deep..... | 20 to 40 inches        |
| Shallow .....        | 10 to 20 inches        |
| Very shallow.....    | less than 10 inches    |

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—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 human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines (in tables).** Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained

away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

**Fine textured soil.** Sandy clay, silty clay, or clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Frost action (in tables).** Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial 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.

**Ground water (geology).** Water filling all the unblocked pores of the material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a

gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon.*—Soft, consolidated bedrock beneath the soil.

*R layer.*—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

**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.

**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 rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Lacustrine deposit** (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**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, or fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition. In this soil survey the ratings for organic matter content of the Ap horizon or of the upper 10 inches are:

|                      |                       |
|----------------------|-----------------------|
| Very low .....       | less than 0.5 percent |
| Low .....            | 0.5 to 1.0 percent    |
| Moderately low ..... | 1.0 to 2.0 percent    |
| Moderate .....       | 2.0 to 4.0 percent    |
| High .....           | 4.0 to 8.0 percent    |
| Very high .....      | 8.0 to 16.0 percent   |

**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.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percolates slowly** (in tables). The slow movement of water through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

|                        |                        |
|------------------------|------------------------|
| Very slow .....        | less than 0.06 inch    |
| Slow .....             | 0.06 to 0.2 inch       |
| Moderately slow .....  | 0.2 to 0.6 inch        |
| Moderate .....         | 0.6 inch to 2.0 inches |
| Moderately rapid ..... | 2.0 to 6.0 inches      |
| Rapid .....            | 6.0 to 20 inches       |
| Very rapid .....       | more than 20 inches    |

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

**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 |
| Moderately acid .....    | 5.6 to 6.0 |
| Slightly acid .....      | 6.1 to 6.5 |
| Neutral .....            | 6.6 to 7.3 |

|                              |                |
|------------------------------|----------------|
| Slightly alkaline .....      | 7.4 to 7.8     |
| Moderately alkaline.....     | 7.9 to 8.4     |
| Strongly alkaline .....      | 8.5 to 9.0     |
| Very strongly alkaline ..... | 9.1 and higher |

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**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.

**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.

**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.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this soil survey the slope classes are as follows:

|                         |                  |
|-------------------------|------------------|
| Nearly level.....       | 0 to 2 percent   |
| Gently undulating ..... | 2 to 6 percent   |
| Rolling .....           | 6 to 12 percent  |
| Hilly .....             | 12 to 18 percent |
| Steep .....             | 18 to 25 percent |
| Very steep .....        | 25 to 45 percent |

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slow intake** (in tables). The slow movement of water into the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

|                       |                 |
|-----------------------|-----------------|
| Very coarse sand..... | 2.0 to 1.0      |
| Coarse sand .....     | 1.0 to 0.5      |
| Medium sand .....     | 0.5 to 0.25     |
| Fine sand .....       | 0.25 to 0.10    |
| Very fine sand .....  | 0.10 to 0.05    |
| Silt .....            | 0.05 to 0.002   |
| Clay .....            | less than 0.002 |

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

**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 grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**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.”

**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.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and

clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

**Thin layer** (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

**Till plain.** An extensive area of nearly level to undulating soils underlain by glacial till.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Toe slope.** The outermost inclined surface at the base of a hill; part of a foot slope.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth’s surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

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# Tables

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TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-84 at Artichoke Lake, Minnesota)

| Month         | Temperature                 |                             |         |  |   |  | Precipitation |                              |                |   |      |
|---------------|-----------------------------|-----------------------------|---------|--|---|--|---------------|------------------------------|----------------|---|------|
|               | Average<br>daily<br>maximum | Average<br>daily<br>minimum | Average | 2 years in<br>10 will have--               |   | Average<br>number of<br>growing<br>degree<br>days* | Average       | 2 years in 10<br>will have-- |                | Average<br>number of<br>days with<br>snowfall<br>0.10 inch<br>or more |      |
|               |                             |                             |         | Maximum<br>temperature<br>higher<br>than-- | Minimum<br>temperature<br>lower<br>than-- |  |               | Less<br>than--               | More<br>than-- |   |      |
| °<br>F        | °<br>F                      | °<br>F                      | °<br>F  | °<br>F                                     | Units                                     | In   | In            | In                           | In             |   |      |
| January-----  | 19.1                        | -1.3                        | 8.9     | 45   | -29                                       | 0  | 0.66          | 0.13                         | 1.03           | 3   | 7.9  |
| February----- | 26.2                        | 5.9                         | 16.1    | 50   | -26                                       | 0  | .67           | .25                          | 1.01           | 2   | 7.1  |
| March-----    | 36.6                        | 17.5                        | 27.1    | 64   | -15                                       | 16   | 1.20          | .47                          | 1.76           | 4   | 8.4  |
| April-----    | 55.3                        | 33.4                        | 44.4    | 85   | 11  | 53   | 2.21          | .99                          | 3.16           | 5   | 2.7  |
| May-----      | 69.4                        | 45.6                        | 57.5    | 90   | 25  | 255  | 2.87          | 1.16                         | 4.20           | 7   | .1   |
| June-----     | 78.1                        | 55.4                        | 66.8    | 95   | 39  | 504  | 4.19          | 2.09                         | 5.80           | 8   | .0   |
| July-----     | 84.2                        | 60.5                        | 72.4    | 98   | 46  | 694  | 3.26          | 1.68                         | 4.44           | 6   | .0   |
| August-----   | 82.2                        | 58.3                        | 70.3    | 98   | 42  | 629  | 3.08          | 1.24                         | 4.48           | 6   | .0   |
| September---  | 71.9                        | 47.7                        | 59.8    | 95   | 29  | 300  | 1.85          | .64                          | 2.83           | 5   | .0   |
| October-----  | 59.9                        | 37.5                        | 48.7    | 86   | 17  | 99   | 2.13          | .43                          | 3.39           | 4   | .9   |
| November----- | 40.5                        | 22.2                        | 31.4    | 68   | -6  | 0  | 1.01          | .20                          | 1.54           | 2   | 4.2  |
| December----- | 25.0                        | 6.9                         | 16.0    | 50   | -25                                       | 0  | .62           | .16                          | 1.00           | 2   | 6.0  |
| Yearly:       |                             |                             |         |  |   |  |               |                              |                |   |      |
| Average---    | 54.0                        | 32.6                        | 43.3    | ---  | ---                                       | ---  | ---           | ---                          | ---            | ---   | ---  |
| Extreme---    | ---                         | ---                         | ---     | 100  | -31                                       | ---  | ---           | ---                          | ---            | ---   | ---  |
| Total-----    | ---                         | ---                         | ---     | ---  | ---                                       | 2,550  | 23.75         | 18.82                        | 28.34          | 54  | 37.3 |

\* 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 1951-84 at Artichoke Lake, Minnesota)

| Probability                          | Temperature       |                   |                   |
|--------------------------------------|-------------------|-------------------|-------------------|
|                                      | 24 °F<br>or lower | 28 °F<br>or lower | 32 °F<br>or lower |
| Last freezing temperature in spring: |                   |                   |                   |
| 1 year in 10 later than--            | May 4             | May 14            | May 24            |
| 2 years in 10 later than--           | Apr. 29           | May 9             | May 19            |
| 5 years in 10 later than--           | Apr. 19           | Apr. 29           | May 10            |
| First freezing temperature in fall:  |                   |                   |                   |
| 1 year in 10 earlier than--          | Oct. 3            | Sept. 27          | Sept. 14          |
| 2 years in 10 earlier than--         | Oct. 9            | Oct. 2            | Sept. 19          |
| 5 years in 10 earlier than--         | Oct. 20           | Oct. 10           | Sept. 29          |

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-84 at Artichoke Lake, Minnesota)

| Probability   | Daily minimum temperature during growing season |                      |                      |
|---------------|---|----------------------|----------------------|
|               | Higher than<br>24 °F                            | Higher than<br>28 °F | Higher than<br>32 °F |
|               | Days  | Days                 | Days                 |
| 9 years in 10 | 165   | 144                  | 121                  |
| 8 years in 10 | 171   | 151                  | 128                  |
| 5 years in 10 | 183   | 164                  | 142                  |
| 2 years in 10 | 195   | 176                  | 156                  |
| 1 year in 10  | 202   | 183                  | 163                  |

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

| Map symbol | Soil name   | Acres   | Percent |
|------------|---|---------|---------|
| 26         | Aazdahl clay loam-----  | 3,716   | 1.2     |
| 34         | Parnell silty clay loam-----                                  | 2,743   | 0.9     |
| 36         | Flom silty clay loam-----                                     | 4,731   | 1.5     |
| 51         | La Prairie silt loam-----                                     | 1,506   | 0.5     |
| 60         | Glyndon silty clay loam-----                                  | 1,180   | 0.4     |
| 70         | Svea loam-----  | 9,635   | 3.0     |
| 127B       | Sverdrup fine sandy loam, 1 to 6 percent slopes-----          | 2,380   | 0.7     |
| 137        | Dovray silty clay-----  | 1,154   | 0.4     |
| 141A       | Egeland fine sandy loam, 0 to 2 percent slopes-----           | 1,897   | 0.6     |
| 141B       | Egeland fine sandy loam, 2 to 6 percent slopes-----           | 486     | 0.2     |
| 171B       | Formdale clay loam, 2 to 4 percent slopes-----                | 1,960   | 0.6     |
| 180        | Gonvick loam-----   | 4,152   | 1.3     |
| 184A       | Hamerly loam, 1 to 3 percent slopes-----                      | 2,342   | 0.7     |
| 184B       | Hamerly loam, 3 to 6 percent slopes-----                      | 3,523   | 1.1     |
| 185B       | Hattie silty clay, 1 to 4 percent slopes-----                 | 24,543  | 7.7     |
| 185C       | Hattie silty clay, 4 to 10 percent slopes-----                | 3,501   | 1.1     |
| 192A       | Estelline silt loam, 0 to 2 percent slopes-----               | 1,013   | 0.3     |
| 192B       | Estelline silt loam, 2 to 6 percent slopes-----               | 315     | 0.1     |
| 210        | Fulda silty clay-----   | 9,080   | 2.9     |
| 236        | Vallers clay loam-----  | 6,484   | 2.0     |
| 246        | Marysland clay loam-----                                      | 3,212   | 1.0     |
| 276        | Oldham silty clay-----  | 3,688   | 1.2     |
| 288D       | Esmond loam, 12 to 18 percent slopes-----                     | 1,756   | 0.6     |
| 293A       | Swenoda sandy loam, 0 to 2 percent slopes-----                | 1,662   | 0.5     |
| 293B       | Swenoda sandy loam, 2 to 6 percent slopes-----                | 505     | 0.2     |
| 296B       | Fram loam, 1 to 4 percent slopes-----                         | 8,169   | 2.6     |
| 314        | Spottswood loam-----  | 2,021   | 0.6     |
| 339        | Fordville loam-----   | 1,579   | 0.5     |
| 341        | Arvilla loam-----   | 965     | 0.3     |
| 344        | Bigstone silty clay loam-----                                 | 4,996   | 1.6     |
| 347        | Malachy loam-----   | 923     | 0.3     |
| 373B       | Renshaw loam, 0 to 6 percent slopes-----                      | 2,226   | 0.7     |
| 402B       | Sioux loam, 1 to 6 percent slopes-----                        | 450     | 0.1     |
| 402E       | Sioux loam, 6 to 35 percent slopes-----                       | 933     | 0.3     |
| 410        | Athelwold silt loam-----                                      | 1,159   | 0.4     |
| 418        | Lamoure silty clay loam-----                                  | 7,321   | 2.3     |
| 437D       | Buse clay loam, 12 to 18 percent slopes-----                  | 742     | 0.2     |
| 450        | Rauville silty clay loam-----                                 | 8,333   | 2.6     |
| 494B       | Darnen loam, 1 to 6 percent slopes-----                       | 3,303   | 1.0     |
| 694B       | Zell silt loam, 2 to 8 percent slopes-----                    | 1,336   | 0.4     |
| 698        | Doran clay loam-----  | 760     | 0.2     |
| 787        | Fram-Vallers-Parnell complex-----                             | 19,756  | 6.2     |
| 814        | Hamerly-Lindaas complex-----                                  | 24,503  | 7.7     |
| 827B       | Esmond-Heimdal loams, 2 to 6 percent slopes-----              | 29,507  | 9.3     |
| 827C2      | Esmond-Heimdal loams, 6 to 12 percent slopes, eroded-----     | 9,227   | 2.9     |
| 900        | Hamerly-Aazdahl-Lindaas complex-----                          | 11,204  | 3.5     |
| 915B       | Formdale-Buse clay loams, 4 to 6 percent slopes-----          | 5,912   | 1.9     |
| 915C2      | Buse-Formdale clay loams, 6 to 12 percent slopes, eroded----- | 6,309   | 2.0     |
| 922        | Hamerly-Parnell complex-----                                  | 39,744  | 12.5    |
| 923C       | Copaston-Rock outcrop complex, 1 to 25 percent slopes-----    | 701     | 0.2     |
| 1013       | Pits, quarry-----   | 216     | 0.1     |
| 1030       | Udorthents-Pits, gravel, complex-----                         | 559     | 0.2     |
| 1817F      | Esmond loam, 18 to 45 percent slopes, bouldery-----           | 3,911   | 1.2     |
| 1916       | Lindaas silty clay loam-----                                  | 4,218   | 1.3     |
| 1940       | Bigstone silty clay loam, ponded-----                         | 15,211  | 4.8     |
| 1949       | Gardena silt loam-----  | 1,714   | 0.5     |
| 1994       | Embden loam-----  | 2,728   | 0.9     |
|            | Total land area-----  | 317,800 | 100.0   |
|            | Water-----  | 20,300  | ---     |
|            | Total area-----   | 338,100 | ---     |

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   |
|------------|---|
| 26         | Aazdahl clay loam   |
| 36         | Flom silty clay loam (where drained)  |
| 51         | La Prairie silt loam  |
| 60         | Glyndon silty clay loam   |
| 70         | Svea loam   |
| 127B       | Sverdrup fine sandy loam, 1 to 6 percent slopes (where irrigated)   |
| 137        | Dovray silty clay (where drained)   |
| 141A       | Egeland fine sandy loam, 0 to 2 percent slopes  |
| 141B       | Egeland fine sandy loam, 2 to 6 percent slopes  |
| 171B       | Formdale clay loam, 2 to 4 percent slopes   |
| 180        | Gonvick loam  |
| 184A       | Hamerly loam, 1 to 3 percent slopes   |
| 184B       | Hamerly loam, 3 to 6 percent slopes   |
| 185B       | Hattie silty clay, 1 to 4 percent slopes  |
| 192A       | Estelline silt loam, 0 to 2 percent slopes  |
| 192B       | Estelline silt loam, 2 to 6 percent slopes  |
| 210        | Fulda silty clay (where drained)  |
| 236        | Vallers clay loam (where drained)   |
| 246        | Marysland clay loam (where drained)   |
| 276        | Oldham silty clay (where drained)   |
| 293A       | Swenoda sandy loam, 0 to 2 percent slopes   |
| 293B       | Swenoda sandy loam, 2 to 6 percent slopes   |
| 296B       | Fram loam, 1 to 4 percent slopes (where drained)  |
| 314        | Spottswood loam   |
| 339        | Fordville loam  |
| 341        | Arvilla loam (where irrigated)  |
| 344        | Bigstone silty clay loam (where drained)  |
| 347        | Malachy loam  |
| 373B       | Renshaw loam, 0 to 6 percent slopes (where irrigated)   |
| 410        | Athelwold silt loam   |
| 418        | Lamoure silty clay loam (where protected from flooding or not frequently flooded during the growing season) |
| 494B       | Darnen loam, 1 to 6 percent slopes  |
| 694B       | Zell silt loam, 2 to 8 percent slopes   |
| 698        | Doran clay loam   |
| 787        | Fram-Vallers-Parnell complex (where drained)  |
| 814        | Hamerly-Lindaas complex (where drained)   |
| 827B       | Esmond-Heimdal loams, 2 to 6 percent slopes   |
| 900        | Hamerly-Aazdahl-Lindaas complex (where drained)   |
| 915B       | Formdale-Buse clay loams, 4 to 6 percent slopes   |
| 922        | Hamerly-Parnell complex (where drained)   |
| 1916       | Lindaas silty clay loam (where drained)   |
| 1949       | Gardena silt loam   |
| 1994       | Embden loam   |

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(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<br>map symbol | Land<br>capability | Spring wheat | Corn | Soybeans | Oats | Alfalfa hay | Barley |
|-----------------------------|--------------------|--------------|------|----------|------|-------------|--------|
|                             |                    | Bu           | Bu   | Bu       | Bu   | Tons        | Bu     |
| 26-----<br>Aazdahl          | I                  | 49           | 100  | 37       | 95   | 4.2         | 72     |
| 34-----<br>Parnell          | IIIw               | 35           | 83   | 24       | 68   | 2.4         | 51     |
| 36-----<br>Flom             | IIw                | 46           | 94   | 34       | 89   | 3.4         | 68     |
| 51-----<br>La Prairie       | IIw                | 48           | 97   | 36       | 93   | 4.0         | 71     |
| 60-----<br>Glyndon          | IIs                | 49           | 100  | 32       | 95   | 4.0         | 72     |
| 70-----<br>Svea             | I                  | 50           | 110  | 37       | 97   | 4.4         | 74     |
| 127B-----<br>Sverdrup       | IIIe               | 25           | 50   | 18       | 48   | 2.4         | 37     |
| 137-----<br>Dovray          | IIIw               | 34           | 76   | 24       | 66   | 3.0         | 50     |
| 141A-----<br>Egeland        | IIIIs              | 30           | 63   | 20       | 58   | 3.4         | 44     |
| 141B-----<br>Egeland        | IIIe               | 27           | 58   | 18       | 52   | 3.0         | 40     |
| 171B-----<br>Formdale       | IIe                | 48           | 97   | 35       | 93   | 4.0         | 71     |
| 180-----<br>Gonvick         | I                  | 50           | 105  | 37       | 97   | 4.4         | 74     |
| 184A-----<br>Hamerly        | IIs                | 44           | 92   | 32       | 85   | 4.0         | 65     |
| 184B-----<br>Hamerly        | IIe                | 39           | 88   | 28       | 75   | 3.6         | 57     |
| 185B-----<br>Hattie         | IIs                | 39           | 88   | 28       | 75   | 3.8         | 57     |
| 185C-----<br>Hattie         | IIIe               | 37           | 84   | 25       | 71   | 3.4         | 53     |
| 192A-----<br>Estelline      | IIs                | 35           | 78   | 24       | 68   | 3.2         | 51     |
| 192B-----<br>Estelline      | IIe                | 32           | 70   | 22       | 62   | 2.8         | 47     |
| 210-----<br>Fulda           | IIw                | 39           | 89   | 29       | 75   | 3.2         | 57     |

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

| Soil name and<br>map symbol | Land<br>capability | Spring wheat | Corn | Soybeans | Oats | Alfalfa hay | Barley |
|-----------------------------|--------------------|--------------|------|----------|------|-------------|--------|
|                             |                    | Bu           | Bu   | Bu       | Bu   | Tons        | Bu     |
| 236-----<br>Vallers         | IIw                | 41           | 92   | 27       | 79   | 3.2         | 60     |
| 246-----<br>Marysland       | IIw                | 33           | 72   | 22       | 64   | 2.8         | 49     |
| 276-----<br>Oldham          | IIIw               | 36           | 83   | 24       | 69   | 3.0         | 53     |
| 288D-----<br>Esmond         | VIe                | ---          | ---  | ---      | ---  | ---         | ---    |
| 293A-----<br>Swenoda        | IIs                | 39           | 88   | 27       | 75   | 3.4         | 57     |
| 293B-----<br>Swenoda        | IIe                | 37           | 84   | 22       | 71   | 3.0         | 54     |
| 296B-----<br>Fram           | IIe                | 39           | 88   | 29       | 75   | 3.8         | 57     |
| 314-----<br>Spottswood      | IIs                | 36           | 76   | 24       | 68   | 3.2         | 52     |
| 339-----<br>Fordville       | IIs                | 34           | 74   | 22       | 66   | 3.0         | 50     |
| 341-----<br>Arvilla         | IIIs               | 25           | 50   | 18       | 48   | 2.0         | 37     |
| 344-----<br>Bigstone        | IIIw               | 39           | 88   | 23       | 75   | 2.6         | 57     |
| 347-----<br>Malachy         | IIs                | 32           | 70   | 20       | 62   | 2.4         | 48     |
| 373B-----<br>Renshaw        | IVs                | 25           | 50   | 18       | 48   | 2.0         | 37     |
| 402B-----<br>Sioux          | VIs                | ---          | ---  | ---      | ---  | 1.8         | ---    |
| 402E-----<br>Sioux          | VIIIs              | ---          | ---  | ---      | ---  | ---         | ---    |
| 410-----<br>Athelwold       | I                  | 36           | 82   | 26       | 70   | 3.2         | 53     |
| 418-----<br>Lamoure         | IIw                | 36           | 83   | 24       | 69   | 3.2         | 53     |
| 437D-----<br>Buse           | IVe                | ---          | ---  | ---      | ---  | 2.0         | ---    |
| 450-----<br>Rauville        | VIw                | ---          | ---  | ---      | ---  | ---         | ---    |
| 494B-----<br>Darnen         | IIe                | 49           | 100  | 36       | 95   | 4.0         | 72     |
| 694B-----<br>Zell           | IIIe               | 39           | 88   | 29       | 75   | 3.8         | 57     |

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

| Soil name and<br>map symbol                              | Land<br>capability  | Spring wheat | Corn | Soybeans | Oats | Alfalfa hay | Barley |
|--|---------------------|--------------|------|----------|------|-------------|--------|
|  |                     | Bu           | Bu   | Bu       | Bu   | Tons        | Bu     |
| 698-----<br>Doran  | IIw                 | 44           | 92   | 35       | 85   | 3.8         | 65     |
| 787-----<br>Fram-----<br>Vallers-----<br>Parnell-----    | IIIs<br>IIw<br>IIIw | 38           | 86   | 25       | 74   | 3.2         | 57     |
| 814-----<br>Hamerly-----<br>Lindaas-----                 | IIIs<br>IIw         | 42           | 92   | 30       | 81   | 3.4         | 62     |
| 827B-----<br>Esmond-Heimdal                              | IIe                 | 39           | 88   | 29       | 75   | 3.6         | 57     |
| 827C2-----<br>Esmond-Heimdal                             | IIIe                | 35           | 80   | 23       | 70   | 3.2         | 52     |
| 900-----<br>Hamerly-----<br>Aazdahl-----<br>Lindaas----- | IIIs<br>I<br>IIw    | 44           | 92   | 31       | 87   | 3.6         | 64     |
| 915B-----<br>Formdale-Buse                               | IIe                 | 44           | 92   | 31       | 85   | 3.8         | 65     |
| 915C2-----<br>Buse-Formdale                              | IIIe                | 37           | 84   | 23       | 75   | 3.4         | 55     |
| 922-----<br>Hamerly-----<br>Parnell-----                 | IIIs<br>IIIw        | 38           | 86   | 25       | 75   | 3.2         | 56     |
| 923C-----<br>Copaston-----<br>Rock outcrop.              | VIIIs               | ---          | ---  | ---      | ---  | ---         | ---    |
| 1013.<br>Pits  |                     |              |      |          |      |             |        |
| 1030.<br>Udorthents-Pits                                 |                     |              |      |          |      |             |        |
| 1817F-----<br>Esmond                                     | VIIe                | ---          | ---  | ---      | ---  | 1.6         | ---    |
| 1916-----<br>Lindaas                                     | IIw                 | 40           | 91   | 28       | 77   | 3.2         | 59     |
| 1940-----<br>Bigstone                                    | VIIIw               | ---          | ---  | ---      | ---  | ---         | ---    |
| 1949-----<br>Gardena                                     | I                   | 51           | 115  | 38       | 98   | 4.4         | 75     |
| 1994-----<br>Embden                                      | IIIs                | 34           | 74   | 24       | 66   | 3.0         | 50     |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- |  |  |   |  |
|--------------------------|--|--|--|---|--|
|                          | <8   | 8-15   | 16-25  | 26-35   | >35  |
| 26-----<br>Aazdahl       | Silver<br>buffaloberry,<br>Nanking cherry,<br>cotoneaster.   | Lilac, common<br>chokecherry,<br>American plum,<br>Siberian<br>peashrub, Amur<br>maple.                        | Russian-olive,<br>Siberian<br>crabapple, bur<br>oak, blue spruce,<br>white fir, white<br>spruce, ponderosa<br>pine.        | Basswood, laurel<br>willow, green<br>ash, hackberry,<br>silver maple.                       | Eastern<br>cottonwood.                     |
| 34-----<br>Parnell       | ---  | American plum,<br>common<br>chokecherry,<br>Siberian<br>peashrub, lilac,<br>redosier dogwood,<br>flame willow. | Blue spruce, white<br>spruce,<br>Manchurian<br>crabapple.  | Golden willow,<br>laurel willow,<br>green ash, silver<br>maple.                             | Carolina poplar,<br>eastern<br>cottonwood. |
| 36-----<br>Flom          | Cotoneaster,<br>Nanking cherry,<br>redosier dogwood.         | Lilac, Amur maple,<br>flame willow,<br>American plum,<br>common<br>chokecherry.                                | Russian-olive,<br>Siberian<br>crabapple,<br>hackberry, blue<br>spruce, white<br>spruce.                                    | Green ash,<br>laurel willow,<br>silver maple.   | Eastern<br>cottonwood.                     |
| 51-----<br>La Prairie    | Nanking cherry,<br>cotoneaster.                              | Siberian peashrub,<br>American plum,<br>lilac, silver<br>buffaloberry,<br>chokecherry, Amur<br>maple.          | Ponderosa pine,<br>blue spruce, bur<br>oak, Siberian<br>crabapple, white<br>spruce, eastern<br>redcedar,<br>Russian-olive. | Golden willow,<br>green ash,<br>hackberry, laurel<br>willow, silver<br>maple, basswood.     | Eastern<br>cottonwood,<br>Siberian elm.    |
| 60-----<br>Glyndon       | Lilac, Nanking<br>cherry.                                    | Eastern redcedar,<br>Siberian<br>peashrub, common<br>chokecherry,<br>American plum,<br>silver<br>buffaloberry. | Blue spruce, white<br>spruce, bur oak,<br>Russian-olive,<br>crabapple.   | Golden willow,<br>Siberian elm,<br>laurel willow,<br>green ash, silver<br>maple, hackberry. | Eastern<br>cottonwood.                     |
| 70-----<br>Svea          | Nanking cherry,<br>cotoneaster.                              | Siberian peashrub,<br>American plum,<br>lilac, common<br>chokecherry,<br>silver<br>buffaloberry.               | Ponderosa pine,<br>blue spruce, bur<br>oak, Siberian<br>crabapple, Amur<br>maple, eastern<br>redcedar.                     | Golden willow,<br>green ash,<br>hackberry,<br>basswood, laurel<br>willow, silver<br>maple.  | Eastern<br>cottonwood,<br>Siberian elm.    |
| 127B-----<br>Sverdrup    | Lilac,<br>cotoneaster,<br>American plum.                     | Common<br>chokecherry,<br>Siberian<br>peashrub, silver<br>buffaloberry,<br>Siberian<br>crabapple,<br>redcedar. | Russian-olive,<br>green ash,<br>hackberry,<br>ponderosa pine.  | Silver maple-----   | Eastern<br>cottonwood.                     |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol   | Trees having predicted 20-year average height, in feet, of-- |   |  |  |                                   |
|----------------------------|--|---|--|--|-----------------------------------|
|                            | <8   | 8-15  | 16-25  | 26-35  | >35                               |
| 137-----<br>Dovray         | Redosier dogwood   | American plum, common<br>chokecherry, lilac, flame willow.  | Blue spruce, white spruce, Siberian crabapple.   | Golden willow, silver maple, white willow, green ash, laurel willow.   | Eastern cottonwood.               |
| 141A, 141B-----<br>Egeland | ---  | Rocky Mountain juniper, eastern redcedar, silver buffaloberry, American plum, Siberian peashrub, lilac, chokecherry.                                      | Green ash, bur oak, hackberry, ponderosa pine, Russian-olive, Manchurian crabapple.  | Siberian elm, silver maple.  | Eastern cottonwood.               |
| 171B-----<br>Formdale      | Nanking cherry, cotoneaster.                                 | Eastern redcedar, American plum, lilac, Siberian peashrub, chokecherry, redosier dogwood, silver buffaloberry, Amur maple.                                | Green ash, blue spruce, Russian-olive, bur oak, Manchurian crabapple, ponderosa pine, white fir, white spruce.                   | Green ash, hackberry, silver maple, basswood.  | Eastern cottonwood.               |
| 180-----<br>Govick         | Cotoneaster, Nanking cherry.                                 | Siberian peashrub, American cranberrybush, lilac, redosier dogwood, common chokecherry, American plum, silver buffaloberry, Amur maple, eastern redcedar. | Eastern redcedar, white spruce, blue spruce, bur oak, ponderosa pine, hackberry, white fir, Russian-olive, Manchurian crabapple. | Norway spruce, jack pine, red pine, eastern white pine, green ash, basswood, hackberry, silver maple, golden willow. | Eastern cottonwood.               |
| 184A, 184B-----<br>Hamerly | Lilac, Nanking cherry.                                       | Siberian peashrub, American plum, lilac, eastern redcedar, common chokecherry, silver buffaloberry.   | Russian-olive, ponderosa pine, blue spruce, crabapple, Siberian crabapple, bur oak, eastern redcedar, white spruce.              | Golden willow, green ash, hackberry, laurel willow.  | Eastern cottonwood, Siberian elm. |
| 185B-----<br>Hattie        | American plum, lilac, late lilac, Nanking cherry.            | Eastern redcedar, Manchurian crabapple, Siberian peashrub, common chokecherry, honeysuckle, silver buffaloberry, sargent crabapple, American plum.        | Green ash, Russian-olive, sugar maple, bur oak, hackberry, Austrian pine, ponderosa pine.  | Siberian elm, silver maple.  | Eastern cottonwood.               |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol     | Trees having predicted 20-year average height, in feet, of--               |  |  |   |  |
|------------------------------|--|--|--|---|--|
|                              | <8   | 8-15   | 16-25  | 26-35   | >35  |
| 185C-----<br>Hattie          | American plum,<br>lilac,<br>honeysuckle, late<br>lilac, Nanking<br>cherry. | Eastern redcedar,<br>Manchurian<br>crabapple,<br>Persian lilac,<br>Siberian<br>peashrub, common<br>chokecherry,<br>birchleaf<br>buckthorn,<br>sargent<br>crabapple, silver<br>buffaloberry,<br>Siberian<br>crabapple.                            | Green ash,<br>Russian-olive,<br>Austrian pine,<br>black locust, bur<br>oak, hackberry,<br>thornless<br>honeylocust,<br>ponderosa pine. | Siberian elm,<br>silver maple.  | Eastern<br>cottonwood,<br>silver maple.  |
| 192A, 192B-----<br>Estelline | Lilac, Peking<br>cotoneaster.  | Siberian peashrub,<br>Russian-olive,<br>Siberian<br>crabapple,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, common<br>chokecherry,<br>silver<br>buffaloberry,<br>American plum.  | Green ash,<br>ponderosa pine,<br>white fir, bur<br>oak, hackberry.   | Siberian elm-----   | Eastern<br>cottonwood.   |
| 210-----<br>Fulda            | Cotoneaster,<br>Nanking cherry,<br>redosier dogwood.                       | Amur maple, lilac,<br>common<br>chokecherry,<br>Black Hills<br>spruce, eastern<br>redcedar, flame<br>willow,<br>honeysuckle,<br>hedge<br>cotoneaster,<br>nannyberry<br>viburnum,<br>redosier dogwood,<br>Siberian<br>peashrub,<br>American plum. | Austrian pine,<br>blue spruce,<br>hackberry,<br>Manchurian<br>crabapple, Norway<br>spruce, ponderosa<br>pine.                          | Golden willow,<br>green ash,<br>thornless<br>honeylocust,<br>laurel willow. | Carolina poplar,<br>eastern<br>cottonwood,<br>imperial Carolina<br>poplar, silver<br>maple, Siouxland<br>cottonwood. |
| 236-----<br>Vallers          | Redosier dogwood,<br>Nanking cherry.                                       | Lilac, Siberian<br>peashrub, common<br>chokecherry,<br>eastern redcedar.   | White spruce, bur<br>oak, Russian-<br>olive, blue<br>spruce,<br>hackberry, green<br>ash, ponderosa<br>pine.                            | Golden willow,<br>Siberian elm,<br>laurel willow.                           | Eastern<br>cottonwood.   |
| 246-----<br>Marysland        | Redosier dogwood,<br>Nanking cherry.                                       | Siberian peashrub,<br>common<br>chokecherry,<br>eastern redcedar,<br>lilac.  | White spruce,<br>Russian-olive,<br>green ash, Black<br>Hills spruce,<br>hackberry,<br>ponderosa pine.                                  | Golden willow,<br>laurel willow.  | Eastern<br>cottonwood,<br>Siberian elm.  |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- |  |   |   |   |
|--------------------------|--|--|---|---|---|
|                          | <8   | 8-15   | 16-25   | 26-35   | >35                                     |
| 276-----<br>Oldham       | Lilac, silver<br>buffaloberry,<br>redosier dogwood.          | Cotoneaster,<br>Siberian<br>peashrub, flame<br>willow, common<br>chokecherry,<br>American plum.  | Hackberry, blue<br>spruce, ponderosa<br>pine, Manchurian<br>crabapple,<br>eastern redcedar.                                       | Golden willow,<br>green ash, laurel<br>willow, silver<br>maple. | Eastern<br>cottonwood.                  |
| 288D.<br>Esmond          |  |  |   |   |   |
| 293A-----<br>Svenoda     | ---  | Rocky Mountain<br>juniper, eastern<br>redcedar,<br>American plum,<br>Siberian<br>peashrub, lilac,<br>common<br>chokecherry,<br>silver<br>buffaloberry. | Green ash, bur<br>oak, hackberry,<br>ponderosa pine<br>Russian-olive,<br>Siberian<br>crabapple, white<br>spruce, blue<br>spruce.  | Siberian elm,<br>silver maple.                                  | Eastern<br>cottonwood.                  |
| 293B-----<br>Svenoda     | ---  | Eastern redcedar,<br>American elm,<br>Siberian<br>peashrub, lilac,<br>silver<br>buffaloberry,<br>common<br>chokecherry.                                | Green ash, bur<br>oak, hackberry,<br>ponderosa pine,<br>Russian-olive,<br>Siberian<br>crabapple, white<br>spruce, blue<br>spruce. | Siberian elm,<br>honeylocust,<br>silver maple.                  | Eastern<br>cottonwood.                  |
| 296B-----<br>Fram        | Lilac, Nanking<br>cherry.                                    | Siberian peashrub,<br>blue spruce,<br>eastern redcedar,<br>lilac, American<br>plum, silver<br>buffaloberry.  | Ponderosa pine,<br>hackberry, bur<br>oak, Siberian<br>crabapple,<br>Russian-olive,<br>crabapple, blue<br>spruce.                  | Golden willow,<br>green ash,<br>laurel willow.                  | Eastern<br>cottonwood.                  |
| 314-----<br>Spottswood   | ---  | Lilac, Siberian<br>peashrub,<br>American plum.   | Ponderosa pine,<br>blue spruce,<br>eastern redcedar,<br>Manchurian<br>crabapple.  | Golden willow,<br>green ash,<br>hackberry.                      | Eastern<br>cottonwood,<br>Siberian elm. |
| 339-----<br>Fordville    | Lilac,<br>cotoneaster,<br>American plum.                     | Russian-olive,<br>Siberian<br>peashrub,<br>crabapple,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, common<br>chokecherry.                        | Honeylocust, green<br>ash, ponderosa<br>pine, Russian-<br>olive, white<br>spruce,<br>hackberry, bur<br>oak, blue spruce.          | Siberian elm,<br>silver maple.                                  | Eastern<br>cottonwood.                  |
| 341-----<br>Arvilla      | Lilac,<br>cotoneaster,<br>American plum.                     | Russian-olive,<br>Siberian<br>crabapple,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, Siberian<br>peashrub, common<br>chokecherry.               | Honeylocust, green<br>ash, ponderosa<br>pine, white fir,<br>hackberry, bur<br>oak, blue spruce,<br>white spruce.                  | Siberian elm,<br>silver maple.                                  | Eastern<br>cottonwood.                  |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of--              |  |   |  |   |
|--------------------------|---|--|---|--|---|
|                          | <8  | 8-15   | 16-25   | 26-35  | >35                                     |
| 344-----<br>Bigstone     | Lilac, silver<br>buffaloberry.  | Redosier dogwood,<br>flame willow,<br>common<br>chokecherry.   | Green ash,<br>hackberry.  | Golden willow,<br>laurel willow,<br>silver maple.  | Eastern<br>cottonwood.                  |
| 347-----<br>Malachy      | Lilac,<br>Nanking cherry.   | Silver<br>buffaloberry,<br>redosier dogwood,<br>ponderosa pine,<br>Siberian<br>peashrub, common<br>chokecherry,<br>eastern redcedar,<br>American plum,<br>cotoneaster. | Green ash,<br>crabapple,<br>Russian-olive,<br>blue spruce,<br>white spruce,<br>bur oak,<br>hackberry.                               | Golden willow,<br>Siberian elm,<br>laurel willow.  | Eastern<br>cottonwood.                  |
| 373B-----<br>Renshaw     | Lilac,<br>cotoneaster,<br>American plum.                                  | Russian-olive,<br>Siberian<br>crabapple,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, Siberian<br>peashrub, common<br>chokecherry.                               | Honeylocust, green<br>ash, ponderosa<br>pine, white fir,<br>hackberry, bur<br>oak, blue spruce,<br>white spruce.                    | Siberian elm,<br>silver maple.   | Eastern<br>cottonwood.                  |
| 402B, 402E.<br>Sioux     |   |  |   |  |   |
| 410-----<br>Athelwold    | Nanking cherry,<br>cotoneaster.   | Siberian peashrub,<br>American plum,<br>lilac, silver<br>buffaloberry,<br>chokecherry,<br>Amur maple.  | Ponderosa pine,<br>blue spruce,<br>white spruce,<br>Siberian<br>crabapple, bur<br>oak, eastern<br>redcedar,<br>Russian-olive.       | Golden willow,<br>green ash,<br>hackberry,<br>basswood, laurel<br>willow, silver<br>maple. | Eastern<br>cottonwood,<br>Siberian elm. |
| 418-----<br>Lamoure      | Silver<br>buffaloberry,<br>lilac, redosier<br>dogwood, Nanking<br>cherry. | Siberian peashrub,<br>common<br>chokecherry.   | Hackberry, blue<br>spruce, ponderosa<br>pine, Manchurian<br>crabapple,<br>eastern redcedar,<br>white spruce,<br>Russian-olive.      | Golden willow,<br>green ash, laurel<br>willow.   | Eastern<br>cottonwood.                  |
| 437D.<br>Buse            |   |  |   |  |   |
| 450.<br>Rauville         |   |  |   |  |   |
| 494B-----<br>Darnen      | Nanking cherry,<br>cotoneaster.   | Eastern redcedar,<br>Siberian<br>peashrub,<br>chokecherry,<br>redosier dogwood,<br>American plum,<br>lilac, silver<br>buffaloberry,<br>Amur maple.                     | Blue spruce,<br>ponderosa pine,<br>green ash,<br>Russian-olive,<br>bur oak, white<br>fir, Manchurian<br>crabapple, white<br>spruce. | Tatarian<br>honeysuckle,<br>green ash,<br>hackberry, silver<br>maple, basswood.            | Eastern<br>cottonwood.                  |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- |  |   |   |                                      |
|--------------------------|--|--|---|---|--------------------------------------|
|                          | <8   | 8-15   | 16-25   | 26-35   | >35                                  |
| 694B-----<br>Zell        | Lilac, silver buffaloberry, American plum.                   | Russian-olive, hackberry, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, white spruce, blue spruce.  | Siberian elm, green ash, ponderosa pine, bur oak.   | Eastern cottonwood.   | ---                                  |
| 698-----<br>Doran        | Silver buffaloberry, Nanking cherry, cotoneaster.            | Siberian peashrub, American plum, lilac, common chokecherry, Amur maple.   | Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar, bur oak, Russian-olive, white spruce, white fir. | Golden willow, green ash, hackberry, laurel willow, basswood, silver maple. | Eastern cottonwood, Siberian elm.    |
| 787:<br>Fram-----        | Lilac, Nanking cherry.                                       | Siberian peashrub, blue spruce, eastern redcedar, lilac, American plum, silver buffaloberry.                       | Ponderosa pine, hackberry, bur oak, Siberian crabapple, Russian-olive, crabapple, blue spruce.                      | Golden willow, green ash, laurel willow.                                    | Eastern cottonwood.                  |
| Vallers-----             | Redosier dogwood, Nanking cherry.                            | Lilac, Siberian peashrub, common chokecherry, eastern redcedar.  | White spruce, bur oak, Russian-olive, blue spruce, hackberry, green ash, ponderosa pine.                            | Golden willow, Siberian elm, laurel willow.                                 | Eastern cottonwood.                  |
| Parnell-----             | ---  | American plum, common chokecherry, Siberian peashrub, lilac, redosier dogwood, flame willow.                       | Blue spruce, white spruce, Manchurian crabapple.  | Golden willow, laurel willow, green ash, silver maple.                      | Carolina poplar, eastern cottonwood. |
| 814:<br>Hamerly-----     | Lilac, Nanking cherry.                                       | Siberian peashrub, American plum, lilac, eastern redcedar, common chokecherry, American plum, silver buffaloberry. | Russian-olive, ponderosa pine, blue spruce, crabapple, Siberian crabapple, bur oak, eastern redcedar, white spruce. | Golden willow, green ash, hackberry, laurel willow.                         | Eastern cottonwood, Siberian elm.    |
| Lindaas-----             | Cotoneaster, Nanking cherry.                                 | Lilac, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub, American plum, flame willow.     | Siberian crabapple, green ash, Black Hills spruce, ponderosa pine, hackberry.                                       | Golden willow, laurel willow.   | Eastern cottonwood, silver maple.    |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- |  |   |   |   |
|--------------------------|--|--|---|---|---|
|                          | <8   | 8-15   | 16-25   | 26-35   | >35                                     |
| 827B:<br>Esmond-----     | American plum,<br>lilac.                                     | Russian-olive,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, Siberian<br>peashrub,<br>hackberry, white<br>spruce, blue<br>spruce.                       | Green ash,<br>ponderosa pine,<br>bur oak.   | Eastern cottonwood  | ---                                     |
| Heimdal-----             | Nanking cherry,<br>cotoneaster.                              | Chokecherry,<br>silver<br>buffaloberry,<br>Amur maple.   | White fir, white<br>spruce.   | Green ash,<br>hackberry, silver<br>maple, basswood.                   | Eastern<br>cottonwood.                  |
| 827C2:<br>Esmond-----    | American plum,<br>lilac.                                     | Russian-olive,<br>eastern redcedar,<br>Rocky Mountain<br>juniper, Siberian<br>peashrub,<br>hackberry, white<br>spruce, blue<br>spruce.                       | Green ash,<br>ponderosa pine,<br>bur oak.   | Eastern cottonwood  | ---                                     |
| Heimdal-----             | Nanking cherry,<br>cotoneaster.                              | American plum,<br>lilac, Siberian<br>peashrub,<br>eastern redcedar,<br>redosier dogwood,<br>silver<br>buffaloberry,<br>common<br>chokecherry,<br>Amur maple. | Manchurian<br>crabapple, bur<br>oak, ponderosa<br>pine, Russian-<br>olive, blue<br>spruce,<br>hackberry,<br>white spruce.                   | Green ash-----  | Eastern<br>cottonwood.                  |
| 900:<br>Hamerly-----     | Lilac, Nanking<br>cherry.                                    | Siberian peashrub,<br>American plum,<br>lilac, eastern<br>redcedar, common<br>chokecherry,<br>silver<br>buffaloberry.  | Ponderosa pine,<br>blue spruce,<br>Siberian<br>crabapple,<br>eastern redcedar,<br>white spruce,<br>bur oak,<br>crabapple,<br>Russian-olive. | Golden willow,<br>green ash,<br>hackberry,<br>laurel willow.          | Eastern<br>cottonwood,<br>Siberian elm. |
| Aazdahl-----             | Silver<br>buffaloberry,<br>Nanking cherry,<br>cotoneaster.   | Lilac, common<br>chokecherry,<br>American plum,<br>Siberian<br>peashrub,<br>Amur maple.  | Russian-olive,<br>Siberian<br>crabapple,<br>bur oak, white<br>fir, blue spruce,<br>white spruce,<br>ponderosa pine.                         | Basswood, laurel<br>willow, green<br>ash, hackberry,<br>silver maple. | Eastern<br>cottonwood.                  |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- |  |   |  |   |
|--------------------------|--|--|---|--|---|
|                          | <8   | 8-15   | 16-25   | 26-35  | >35                                     |
| 900:<br>Lindaas-----     | Cotoneaster,<br>Nanking cherry.                              | Lilac, redosier<br>dogwood, eastern<br>redcedar, common<br>chokecherry,<br>Siberian<br>peashrub,<br>American plum,<br>flame willow.                | Siberian<br>crabapple, green<br>ash, Black Hills<br>spruce, ponderosa<br>pine, hackberry.   | Golden willow,<br>laurel willow.                             | Eastern<br>cottonwood,<br>silver maple. |
| 915B:<br>Formdale-----   | Nanking cherry,<br>cotoneaster.                              | Eastern redcedar,<br>American plum,<br>lilac, Siberian<br>peashrub,<br>redosier dogwood,<br>silver<br>buffaloberry,<br>chokecherry,<br>Amur maple. | Green ash, blue<br>spruce, Russian-<br>olive, bur oak,<br>Manchurian<br>crabapple,<br>ponderosa pine,<br>white fir,<br>white spruce.                  | Green ash,<br>hackberry,<br>silver maple,<br>basswood.       | Eastern<br>cottonwood.                  |
| Buse-----                | Silver<br>buffaloberry,<br>lilac, American<br>plum.          | Eastern redcedar,<br>Siberian<br>peashrub, lilac,<br>Russian-olive,<br>white spruce,<br>blue spruce.   | Green ash, bur<br>oak, ponderosa<br>pine.   | Siberian elm,<br>eastern<br>cottonwood.                      | ---                                     |
| 915C2:<br>Buse-----      | Silver<br>buffaloberry,<br>lilac, American<br>plum.          | Eastern redcedar,<br>Siberian<br>peashrub, lilac,<br>Russian-olive,<br>white spruce,<br>blue spruce.   | Green ash, bur<br>oak, ponderosa<br>pine.   | Siberian elm,<br>eastern<br>cottonwood.                      | ---                                     |
| Formdale-----            | Nanking cherry,<br>cotoneaster.                              | Eastern redcedar,<br>American plum,<br>lilac, Siberian<br>peashrub,<br>redosier dogwood,<br>chokecherry,<br>Amur maple,<br>silver<br>buffaloberry. | Green ash, blue<br>spruce, Russian-<br>olive, bur oak,<br>Manchurian<br>crabapple,<br>hackberry,<br>ponderosa pine,<br>white spruce,<br>silver maple. | Eastern<br>cottonwood.                                       | ---                                     |
| 922:<br>Hamerly-----     | Lilac, Nanking<br>cherry.                                    | Siberian peashrub,<br>American plum,<br>lilac, eastern<br>redcedar, common<br>chokecherry,<br>silver<br>buffaloberry.                              | Ponderosa pine,<br>blue spruce,<br>crabapple,<br>Siberian<br>crabapple, bur<br>oak, eastern<br>redcedar, white<br>spruce, Russian-<br>olive.          | Golden willow,<br>green ash,<br>hackberry,<br>laurel willow. | Eastern<br>cottonwood,<br>Siberian elm. |

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol  | Trees having predicted 20-year average height, in feet, of-- |   |   |  |  |
|---|--|---|---|--|--|
|   | <8   | 8-15  | 16-25   | 26-35  | >35  |
| 922:<br>Parnell-----  | ---  | American plum,<br>common<br>chokecherry,<br>Siberian<br>peashrub, lilac,<br>redosier dogwood,<br>flame willow.                      | Blue spruce,<br>white spruce,<br>Manchurian<br>crabapple.   | Golden willow,<br>laurel willow,<br>green ash,<br>silver maple.                            | Carolina poplar,<br>eastern<br>cottonwood. |
| 923C:<br>Copaston.<br><br>Rock outcrop.<br><br>1013.<br>Pits<br><br>1030:<br>Udorthents.<br><br>Pits.<br><br>1817F.<br>Esmond |  |   |   |  |  |
| 1916-----<br>Lindaas  | Cotoneaster,<br>Nanking cherry.                              | Lilac, redosier<br>dogwood, eastern<br>redcedar, common<br>chokecherry,<br>Siberian<br>peashrub,<br>American plum,<br>flame willow. | Siberian<br>crabapple, green<br>ash, Black Hills<br>spruce,<br>ponderosa pine,<br>hackberry.  | Golden willow,<br>laurel willow.   | Eastern<br>cottonwood,<br>silver maple.    |
| 1940.<br>Bigstone   |  |   |   |  |  |
| 1949-----<br>Gardena  | Silver<br>buffaloberry,<br>Nanking cherry,<br>cotoneaster.   | Siberian peashrub,<br>American plum,<br>lilac, common<br>chokecherry,<br>Amur maple.  | Ponderosa pine,<br>blue spruce,<br>Siberian<br>crabapple,<br>white fir,<br>eastern redcedar,<br>Russian-olive,<br>white spruce.             | Golden willow,<br>green ash,<br>hackberry,<br>basswood,<br>laurel willow,<br>silver maple. | Eastern<br>cottonwood,<br>Siberian elm.    |
| 1994-----<br>Emden  | Silver<br>buffaloberry,<br>Nanking cherry,<br>cotoneaster.   | Siberian peashrub,<br>American plum,<br>lilac, common<br>chokecherry,<br>Amur maple.  | Ponderosa pine,<br>blue spruce,<br>Siberian<br>crabapple,<br>eastern redcedar,<br>white spruce,<br>bur oak,<br>Russian-olive,<br>white fir. | Golden willow,<br>green ash,<br>hackberry,<br>laurel willow,<br>basswood,<br>silver maple. | Eastern<br>cottonwood,<br>Siberian elm.    |

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

| Soil name and map symbol   | Camp areas                             | Picnic areas                           | Playgrounds                                      | Paths and trails                   | Golf fairways                      |
|----------------------------|--|--|--|------------------------------------|------------------------------------|
| 26-----<br>Aazdahl         | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----                        | Slight.                            |
| 34-----<br>Parnell         | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding.                | Severe:<br>ponding.                |
| 36-----<br>Flom            | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>percs slowly. | Severe:<br>wetness.                              | Moderate:<br>wetness.              | Moderate:<br>wetness.              |
| 51-----<br>La Prairie      | Severe:<br>flooding.                   | Slight-----                            | Moderate:<br>flooding.                           | Slight-----                        | Moderate:<br>flooding.             |
| 60-----<br>Glyndon         | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----                        | Slight.                            |
| 70-----<br>Svea            | Slight-----                            | Slight-----                            | Moderate:<br>small stones.                       | Slight-----                        | Slight.                            |
| 127B-----<br>Sverdrup      | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----                        | Moderate:<br>droughty.             |
| 137-----<br>Dovray         | Severe:<br>ponding,<br>too clayey.     | Severe:<br>ponding,<br>too clayey.     | Severe:<br>too clayey,<br>ponding.               | Severe:<br>ponding,<br>too clayey. | Severe:<br>ponding,<br>too clayey. |
| 141A-----<br>Egeland       | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----                        | Moderate:<br>droughty.             |
| 141B-----<br>Egeland       | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----                        | Moderate:<br>droughty.             |
| 171B-----<br>Formdale      | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----                        | Slight.                            |
| 180-----<br>Gonvick        | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----                        | Slight.                            |
| 184A, 184B-----<br>Hamerly | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>slope,<br>wetness,<br>percs slowly. | Slight-----                        | Slight.                            |
| 185B-----<br>Hattie        | Moderate:<br>too clayey.               | Moderate:<br>too clayey.               | Moderate:<br>slope,<br>too clayey.               | Moderate:<br>too clayey.           | Severe:<br>too clayey.             |
| 185C-----<br>Hattie        | Moderate:<br>too clayey.               | Moderate:<br>too clayey.               | Severe:<br>slope.                                | Moderate:<br>too clayey.           | Severe:<br>too clayey.             |
| 192A-----<br>Estelline     | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----                        | Slight.                            |
| 192B-----<br>Estelline     | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----                        | Slight.                            |

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas                                      | Picnic areas                           | Playgrounds                          | Paths and trails                   | Golf fairways                      |
|--------------------------|---|--|--------------------------------------|------------------------------------|------------------------------------|
| 210-----<br>Fulda        | Severe:<br>flooding,<br>wetness,<br>too clayey. | Severe:<br>too clayey.                 | Severe:<br>too clayey,<br>wetness.   | Severe:<br>too clayey.             | Severe:<br>too clayey.             |
| 236-----<br>Vallers      | Severe:<br>wetness.                             | Moderate:<br>wetness,<br>percs slowly. | Severe:<br>wetness.                  | Moderate:<br>wetness.              | Moderate:<br>wetness.              |
| 246-----<br>Marysland    | Severe:<br>flooding,<br>wetness.                | Moderate:<br>wetness.                  | Severe:<br>wetness.                  | Moderate:<br>wetness.              | Moderate:<br>wetness.              |
| 276-----<br>Oldham       | Severe:<br>ponding,<br>too clayey.              | Severe:<br>ponding,<br>too clayey.     | Severe:<br>too clayey,<br>ponding.   | Severe:<br>ponding,<br>too clayey. | Severe:<br>ponding,<br>too clayey. |
| 288D-----<br>Esmond      | Severe:<br>slope.                               | Severe:<br>slope.                      | Severe:<br>slope.                    | Moderate:<br>slope.                | Severe:<br>slope.                  |
| 293A-----<br>Svenoda     | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Slight.                            |
| 293B-----<br>Svenoda     | Slight-----                                     | Slight-----                            | Moderate:<br>slope.                  | Slight-----                        | Slight.                            |
| 296B-----<br>Fram        | Moderate:<br>wetness.                           | Moderate:<br>wetness.                  | Moderate:<br>slope,<br>wetness.      | Slight-----                        | Slight.                            |
| 314-----<br>Spottswood   | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Slight.                            |
| 339-----<br>Fordville    | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Slight.                            |
| 341-----<br>Arvilla      | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Moderate:<br>droughty.             |
| 344-----<br>Bigstone     | Severe:<br>ponding.                             | Severe:<br>ponding.                    | Severe:<br>ponding.                  | Severe:<br>ponding.                | Severe:<br>ponding.                |
| 347-----<br>Malachy      | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Slight.                            |
| 373B-----<br>Renshaw     | Slight-----                                     | Slight-----                            | Moderate:<br>slope.                  | Slight-----                        | Moderate:<br>droughty.             |
| 402B-----<br>Sioux       | Slight-----                                     | Slight-----                            | Moderate:<br>slope,<br>small stones. | Slight-----                        | Moderate:<br>droughty.             |
| 402E-----<br>Sioux       | Severe:<br>slope.                               | Severe:<br>slope.                      | Severe:<br>slope.                    | Severe:<br>slope.                  | Severe:<br>slope.                  |
| 410-----<br>Athelwold    | Slight-----                                     | Slight-----                            | Slight-----                          | Slight-----                        | Slight.                            |
| 418-----<br>Lamoure      | Severe:<br>flooding,<br>wetness.                | Severe:<br>wetness.                    | Severe:<br>wetness.                  | Severe:<br>wetness.                | Severe:<br>wetness.                |

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas                             | Picnic areas                           | Playgrounds                                      | Paths and trails      | Golf fairways                    |
|--------------------------|--|--|--|-----------------------|----------------------------------|
| 437D-----<br>Buse        | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.                                | Moderate:<br>slope.   | Severe:<br>slope.                |
| 450-----<br>Rauville     | Severe:<br>flooding,<br>ponding.       | Severe:<br>ponding.                    | Severe:<br>ponding,<br>flooding.                 | Severe:<br>ponding.   | Severe:<br>ponding,<br>flooding. |
| 494B-----<br>Darnen      | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----           | Slight.                          |
| 694B-----<br>Zell        | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----           | Slight.                          |
| 698-----<br>Doran        | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----           | Slight.                          |
| 787:<br>Fram-----        | Moderate:<br>wetness.                  | Moderate:<br>wetness.                  | Moderate:<br>slope,<br>wetness.                  | Slight-----           | Slight.                          |
| Vallars-----             | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>percs slowly. | Severe:<br>wetness.                              | Moderate:<br>wetness. | Moderate:<br>wetness.            |
| Parnell-----             | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding.   | Severe:<br>ponding.              |
| 814:<br>Hamerly-----     | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>slope,<br>wetness,<br>percs slowly. | Slight-----           | Slight.                          |
| Lindaas-----             | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding.   | Severe:<br>ponding.              |
| 827B:<br>Esmond-----     | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----           | Slight.                          |
| Heimdal-----             | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----           | Slight.                          |
| 827C2:<br>Esmond-----    | Moderate:<br>slope.                    | Moderate:<br>slope.                    | Severe:<br>slope.                                | Slight-----           | Moderate:<br>slope.              |
| Heimdal-----             | Slight-----                            | Slight-----                            | Severe:<br>slope.                                | Slight-----           | Slight.                          |
| 900:<br>Hamerly-----     | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>slope,<br>wetness,<br>percs slowly. | Slight-----           | Slight.                          |
| Aazdahl-----             | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----           | Slight.                          |
| Lindaas-----             | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding.   | Severe:<br>ponding.              |

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas                             | Picnic areas                           | Playgrounds                                      | Paths and trails    | Golf fairways             |
|--------------------------|--|--|--|---------------------|---------------------------|
| 915B:<br>Formdale-----   | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----         | Slight.                   |
| Buse-----                | Slight-----                            | Slight-----                            | Moderate:<br>slope,<br>small stones.             | Slight-----         | Slight.                   |
| 915C2:<br>Buse-----      | Moderate:<br>slope.                    | Moderate:<br>slope.                    | Severe:<br>slope.                                | Slight-----         | Moderate:<br>slope.       |
| Formdale-----            | Moderate:<br>slope.                    | Moderate:<br>slope.                    | Severe:<br>slope.                                | Slight-----         | Moderate:<br>slope.       |
| 922:<br>Hamerly-----     | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>slope,<br>wetness,<br>percs slowly. | Slight-----         | Slight.                   |
| Parnell-----             | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding. | Severe:<br>ponding.       |
| 923C:<br>Copaston-----   | Severe:<br>depth to rock.              | Severe:<br>depth to rock.              | Severe:<br>slope,<br>depth to rock.              | Slight-----         | Severe:<br>depth to rock. |
| Rock outcrop.            |  |  |  |                     |                           |
| 1013.<br>Pits            |  |  |  |                     |                           |
| 1030:<br>Udorthents----- | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.                                | Severe:<br>slope.   | Severe:<br>slope.         |
| Pits.                    |  |  |  |                     |                           |
| 1817F-----<br>Esmond     | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>large stones,<br>slope.               | Severe:<br>slope.   | Severe:<br>slope.         |
| 1916-----<br>Lindaas     | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding. | Severe:<br>ponding.       |
| 1940-----<br>Bigstone    | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                              | Severe:<br>ponding. | Severe:<br>ponding.       |
| 1949-----<br>Gardena     | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----         | Slight.                   |
| 1994-----<br>Embden      | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----         | Slight.                   |

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

| Soil name and map symbol   | Potential for habitat elements |                     |                          |                |                     |                |                     | Potential as habitat for-- |                   |                  |
|----------------------------|--------------------------------|---------------------|--------------------------|----------------|---------------------|----------------|---------------------|----------------------------|-------------------|------------------|
|                            | Grain and seed crops           | Grasses and legumes | Wild herba- ceous plants | Hardwood trees | Conif- erous plants | Wetland plants | Shallow water areas | Openland wildlife          | Woodland wildlife | Wetland wildlife |
| 26-----<br>Aazdahl         | Good                           | Good                | Good                     | Good           | Good                | Poor           | Fair                | Good                       | Fair              | Poor.            |
| 34-----<br>Parnell         | Fair                           | Fair                | Poor                     | Poor           | Very poor.          | Good           | Good                | Fair                       | Poor              | Good.            |
| 36-----<br>Flom            | Good                           | Good                | Good                     | Fair           | Fair                | Good           | Good                | Good                       | Fair              | Good.            |
| 51-----<br>La Prairie      | Good                           | Good                | Good                     | ---            | ---                 | Poor           | Poor                | Good                       | ---               | Poor.            |
| 60-----<br>Glyndon         | Good                           | Good                | Good                     | Fair           | Poor                | Poor           | Poor                | Good                       | Fair              | Poor.            |
| 70-----<br>Svea            | Good                           | Good                | Good                     | Good           | Good                | Poor           | Poor                | Good                       | Good              | Poor.            |
| 127B-----<br>Sverdrup      | Fair                           | Fair                | Fair                     | Fair           | Fair                | Poor           | Very poor.          | Fair                       | Fair              | Poor.            |
| 137-----<br>Dovray         | Poor                           | Poor                | Poor                     | Poor           | Poor                | Good           | Good                | Poor                       | Poor              | Good.            |
| 141A, 141B-----<br>Egeland | Fair                           | Fair                | Good                     | Fair           | Very poor.          | Very poor.     | Very poor.          | Fair                       | ---               | Very poor.       |
| 171B-----<br>Formdale      | Good                           | Good                | Good                     | Good           | Fair                | Poor           | Fair                | Good                       | Fair              | Poor.            |
| 180-----<br>Gonvick        | Good                           | Good                | Good                     | Good           | Fair                | Poor           | Poor                | Good                       | Good              | Poor.            |
| 184A-----<br>Hamerly       | Good                           | Good                | Good                     | Good           | Good                | Fair           | Fair                | Good                       | Good              | Fair.            |
| 184B-----<br>Hamerly       | Good                           | Good                | Good                     | Good           | Good                | Poor           | Very poor.          | Good                       | Good              | Very poor.       |
| 185B-----<br>Hattie        | Good                           | Good                | Fair                     | Fair           | Fair                | Poor           | Poor                | Good                       | Fair              | Very poor.       |
| 185C-----<br>Hattie        | Fair                           | Good                | Fair                     | Fair           | Fair                | Very poor.     | Very poor.          | Fair                       | Fair              | Very poor.       |
| 192A-----<br>Estelline     | Good                           | Good                | Good                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Good                       | Very poor.        | Very poor.       |
| 192B-----<br>Estelline     | Fair                           | Good                | Good                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Fair                       | Very poor.        | Very poor.       |
| 210-----<br>Fulda          | Fair                           | Fair                | Fair                     | Fair           | Fair                | Good           | Good                | Fair                       | Fair              | Fair.            |
| 236-----<br>Vallers        | Fair                           | Fair                | Fair                     | Fair           | Poor                | Good           | Good                | Fair                       | Fair              | Good.            |

TABLE 9.--WILDLIFE HABITAT--Continued

| Soil name and map symbol   | Potential for habitat elements |                     |                          |                |                     |                |                     | Potential as habitat for-- |                   |                  |
|----------------------------|--------------------------------|---------------------|--------------------------|----------------|---------------------|----------------|---------------------|----------------------------|-------------------|------------------|
|                            | Grain and seed crops           | Grasses and legumes | Wild herba- ceous plants | Hardwood trees | Conif- erous plants | Wetland plants | Shallow water areas | Openland wildlife          | Woodland wildlife | Wetland wildlife |
| 246-----<br>Marysland      | Good                           | Good                | Fair                     | Fair           | Fair                | Good           | Good                | Fair                       | Fair              | Good.            |
| 276-----<br>Oldham         | Good                           | Good                | Good                     | Poor           | Poor                | Good           | Good                | Good                       | Poor              | Good.            |
| 288D-----<br>Esmond        | Very poor.                     | Very poor.          | Good                     | ---            | ---                 | Very poor.     | Very poor.          | Poor                       | ---               | Very poor.       |
| 293A, 293B-----<br>Swenoda | Fair                           | Fair                | Good                     | Good           | Very poor.          | Very poor.     | Very poor.          | Fair                       | Very poor.        | Very poor.       |
| 296B-----<br>Fram          | Good                           | Good                | Good                     | ---            | ---                 | Fair           | Poor                | Good                       | ---               | Poor.            |
| 314-----<br>Spottswood     | Good                           | Good                | Fair                     | Good           | Very poor.          | Very poor.     | Very poor.          | Good                       | Very poor.        | Very poor.       |
| 339-----<br>Fordville      | Good                           | Good                | Good                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Good                       | Very poor.        | Very poor.       |
| 341-----<br>Arvilla        | Fair                           | Good                | Fair                     | Fair           | Fair                | Very poor.     | Very poor.          | Fair                       | Fair              | Very poor.       |
| 344-----<br>Bigstone       | Fair                           | Fair                | Poor                     | Poor           | Poor                | Good           | Good                | Fair                       | Poor              | Good.            |
| 347-----<br>Malachy        | Fair                           | Fair                | Good                     | Fair           | Fair                | Fair           | Fair                | Fair                       | Fair              | Fair.            |
| 373B-----<br>Renshaw       | Poor                           | Fair                | Poor                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Poor                       | Very poor.        | Very poor.       |
| 402B-----<br>Sioux         | Very poor.                     | Very poor.          | Poor                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Very poor.                 | Very poor.        | Very poor.       |
| 402E-----<br>Sioux         | Very poor.                     | Very poor.          | Poor                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Very poor.                 | Very poor.        | Very poor.       |
| 410-----<br>Athelwold      | Good                           | Good                | Good                     | Good           | Very poor.          | Very poor.     | Very poor.          | Good                       | Very poor.        | Very poor.       |
| 418-----<br>Lamoure        | Good                           | Good                | Fair                     | Good           | Good                | Fair           | Fair                | Good                       | Good              | Fair.            |
| 437D-----<br>Buse          | Fair                           | Fair                | Fair                     | Fair           | Fair                | Very poor.     | Very poor.          | Fair                       | Fair              | Very poor.       |
| 450-----<br>Rauville       | Very poor.                     | Poor                | Fair                     | Very poor.     | Very poor.          | Good           | Good                | Very poor.                 | Very poor.        | Fair.            |
| 494B-----<br>Darnen        | Good                           | Good                | Good                     | Good           | Good                | Poor           | Poor                | Good                       | Good              | Poor.            |
| 694B-----<br>Zell          | Fair                           | Fair                | Fair                     | Poor           | Very poor.          | Very poor.     | Very poor.          | Fair                       | Very poor.        | Very poor.       |
| 698-----<br>Doran          | Good                           | Good                | Good                     | ---            | ---                 | Fair           | Fair                | Good                       | ---               | Fair.            |



TABLE 9.--WILDLIFE HABITAT--Continued

| Soil name and map symbol | Potential for habitat elements |                     |                          |                |                     |                |                     | Potential as habitat for-- |                   |                  |
|--------------------------|--------------------------------|---------------------|--------------------------|----------------|---------------------|----------------|---------------------|----------------------------|-------------------|------------------|
|                          | Grain and seed crops           | Grasses and legumes | Wild herba- ceous plants | Hardwood trees | Conif- erous plants | Wetland plants | Shallow water areas | Openland wildlife          | Woodland wildlife | Wetland wildlife |
| 1030:<br>Udorthents----- | Poor                           | Poor                | Fair                     | Good           | Good                | Poor           | Very poor.          | Poor                       | Fair              | Very poor.       |
| Pits.                    |                                |                     |                          |                |                     |                |                     |                            |                   |                  |
| 1817F-----<br>Esmond     | Very poor.                     | Very poor.          | Good                     | ---            | ---                 | Very poor.     | Very poor.          | Poor                       | ---               | Very poor.       |
| 1916-----<br>Lindaas     | Poor                           | Poor                | Fair                     | ---            | ---                 | Good           | Good                | Poor                       | ---               | Good.            |
| 1940-----<br>Bigstone    | Very poor.                     | Very poor.          | Very poor.               | Very poor.     | Very poor.          | Good           | Good                | Very poor.                 | Very poor.        | Good.            |
| 1949-----<br>Gardena     | Good                           | Good                | Good                     | Good           | Very poor.          | Very poor.     | Very poor.          | Good                       | Very poor.        | Very poor.       |
| 1994-----<br>Embden      | Fair                           | Good                | Good                     | Good           | Good                | Poor           | Poor                | Good                       | Good              | Poor.            |

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Shallow excavations                  | Dwellings without basements            | Dwellings with basements               | Small commercial buildings                       | Local roads and streets                               | Lawns and landscaping              |
|--------------------------|--------------------------------------|--|--|--|---|------------------------------------|
| 26-----<br>Aazdahl       | Moderate:<br>wetness.                | Moderate:<br>shrink-swell.             | Moderate:<br>wetness,<br>shrink-swell. | Moderate:<br>shrink-swell.                       | Severe:<br>frost action,<br>low strength.             | Slight.                            |
| 34-----<br>Parnell       | Severe:<br>ponding.                  | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.             | Severe:<br>shrink-swell,<br>low strength,<br>ponding. | Severe:<br>ponding.                |
| 36-----<br>Flom          | Severe:<br>wetness.                  | Severe:<br>wetness.                    | Severe:<br>wetness.                    | Severe:<br>wetness.                              | Severe:<br>low strength,<br>frost action.             | Moderate:<br>wetness.              |
| 51-----<br>La Prairie    | Moderate:<br>wetness,<br>flooding.   | Severe:<br>flooding.                   | Severe:<br>flooding.                   | Severe:<br>flooding.                             | Severe:<br>flooding.                                  | Moderate:<br>flooding.             |
| 60-----<br>Glyndon       | Severe:<br>cutbanks cave.            | Slight-----                            | Moderate:<br>wetness.                  | Slight-----                                      | Severe:<br>frost action.                              | Slight.                            |
| 70-----<br>Svea          | Moderate:<br>wetness.                | Moderate:<br>shrink-swell.             | Moderate:<br>wetness,<br>shrink-swell. | Moderate:<br>shrink-swell.                       | Severe:<br>low strength.                              | Slight.                            |
| 127B-----<br>Sverdrup    | Severe:<br>cutbanks cave.            | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----   | Moderate:<br>droughty.             |
| 137-----<br>Dovray       | Severe:<br>ponding.                  | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.             | Severe:<br>shrink-swell,<br>low strength,<br>ponding. | Severe:<br>ponding,<br>too clayey. |
| 141A-----<br>Egeland     | Severe:<br>cutbanks cave.            | Slight-----                            | Slight-----                            | Slight-----                                      | Slight-----   | Moderate:<br>droughty.             |
| 141B-----<br>Egeland     | Severe:<br>cutbanks cave.            | Slight-----                            | Slight-----                            | Moderate:<br>slope.                              | Slight-----   | Moderate:<br>droughty.             |
| 171B-----<br>Formdale    | Slight-----                          | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell.                       | Severe:<br>low strength.                              | Slight.                            |
| 180-----<br>Gonvick      | Moderate:<br>wetness.                | Moderate:<br>shrink-swell.             | Moderate:<br>wetness.                  | Moderate:<br>shrink-swell.                       | Severe:<br>low strength,<br>frost action.             | Slight.                            |
| 184A-----<br>Hamerly     | Severe:<br>wetness.                  | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>shrink-swell.           | Severe:<br>frost action.                              | Slight.                            |
| 184B-----<br>Hamerly     | Severe:<br>wetness.                  | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>shrink-swell,<br>slope. | Severe:<br>frost action.                              | Slight.                            |
| 185B-----<br>Hattie      | Moderate:<br>too clayey,<br>wetness. | Severe:<br>shrink-swell.               | Severe:<br>shrink-swell.               | Severe:<br>shrink-swell.                         | Severe:<br>shrink-swell,<br>low strength.             | Severe:<br>too clayey.             |

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations                   | Dwellings without basements                       | Dwellings with basements                          | Small commercial buildings                        | Local roads and streets                                    | Lawns and landscaping              |
|--------------------------|---------------------------------------|---|---|---|--|------------------------------------|
| 185C-----<br>Hattie      | Moderate:<br>too clayey.              | Severe:<br>shrink-swell.                          | Severe:<br>shrink-swell.                          | Severe:<br>shrink-swell.                          | Severe:<br>low strength,<br>shrink-swell.                  | Severe:<br>too clayey.             |
| 192A-----<br>Estelline   | Severe:<br>cutbanks cave.             | Moderate:<br>shrink-swell.                        | Slight-----                                       | Moderate:<br>shrink-swell.                        | Severe:<br>low strength.                                   | Slight.                            |
| 192B-----<br>Estelline   | Severe:<br>cutbanks cave.             | Moderate:<br>shrink-swell.                        | Slight-----                                       | Moderate:<br>shrink-swell,<br>slope.              | Severe:<br>low strength.                                   | Slight.                            |
| 210-----<br>Fulda        | Severe:<br>wetness.                   | Severe:<br>flooding,<br>wetness,<br>shrink-swell. | Severe:<br>flooding,<br>wetness,<br>shrink-swell. | Severe:<br>flooding,<br>wetness,<br>shrink-swell. | Severe:<br>shrink-swell,<br>low strength,<br>frost action. | Severe:<br>too clayey.             |
| 236-----<br>Vallers      | Severe:<br>wetness.                   | Severe:<br>wetness.                               | Severe:<br>wetness.                               | Severe:<br>wetness.                               | Severe:<br>frost action.                                   | Moderate:<br>wetness.              |
| 246-----<br>Marysland    | Severe:<br>cutbanks cave,<br>wetness. | Severe:<br>flooding,<br>wetness.                  | Severe:<br>flooding,<br>wetness.                  | Severe:<br>flooding,<br>wetness.                  | Severe:<br>frost action.                                   | Moderate:<br>wetness.              |
| 276-----<br>Oldham       | Severe:<br>ponding.                   | Severe:<br>ponding,<br>shrink-swell.              | Severe:<br>ponding,<br>shrink-swell.              | Severe:<br>ponding,<br>shrink-swell.              | Severe:<br>shrink-swell,<br>low strength,<br>ponding.      | Severe:<br>ponding,<br>too clayey. |
| 288D-----<br>Esmond      | Severe:<br>slope.                     | Severe:<br>slope.                                 | Severe:<br>slope.                                 | Severe:<br>slope.                                 | Severe:<br>slope.  | Severe:<br>slope.                  |
| 293A-----<br>Svenoda     | Moderate:<br>wetness.                 | Slight-----                                       | Moderate:<br>wetness,<br>shrink-swell.            | Slight-----                                       | Moderate:<br>frost action.                                 | Slight.                            |
| 293B-----<br>Svenoda     | Slight-----                           | Slight-----                                       | Moderate:<br>shrink-swell.                        | Moderate:<br>slope.                               | Moderate:<br>frost action.                                 | Slight.                            |
| 296B-----<br>Fram        | Severe:<br>wetness.                   | Moderate:<br>wetness.                             | Severe:<br>wetness.                               | Moderate:<br>wetness.                             | Severe:<br>frost action.                                   | Slight.                            |
| 314-----<br>Spottswood   | Severe:<br>cutbanks cave.             | Moderate:<br>shrink-swell.                        | Moderate:<br>wetness.                             | Moderate:<br>shrink-swell.                        | Severe:<br>low strength.                                   | Slight.                            |
| 339-----<br>Fordville    | Severe:<br>cutbanks cave.             | Slight-----                                       | Slight-----                                       | Slight-----                                       | Slight-----  | Slight.                            |
| 341-----<br>Arvilla      | Severe:<br>cutbanks cave.             | Slight-----                                       | Slight-----                                       | Slight-----                                       | Slight-----  | Moderate:<br>droughty.             |
| 344-----<br>Bigstone     | Severe:<br>ponding.                   | Severe:<br>ponding.                               | Severe:<br>ponding.                               | Severe:<br>ponding.                               | Severe:<br>low strength,<br>ponding,<br>frost action.      | Severe:<br>ponding.                |
| 347-----<br>Malachy      | Severe:<br>cutbanks cave.             | Slight-----                                       | Moderate:<br>wetness.                             | Slight-----                                       | Severe:<br>frost action.                                   | Slight.                            |
| 373B-----<br>Renshaw     | Severe:<br>cutbanks cave.             | Slight-----                                       | Slight-----                                       | Slight-----                                       | Slight-----  | Moderate:<br>droughty.             |
| 402B-----<br>Sioux       | Severe:<br>cutbanks cave.             | Slight-----                                       | Slight-----                                       | Slight-----                                       | Slight-----  | Moderate:<br>droughty.             |

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations                   | Dwellings without basements            | Dwellings with basements               | Small commercial buildings             | Local roads and streets                                    | Lawns and landscaping            |
|--------------------------|---------------------------------------|--|--|--|--|----------------------------------|
| 402E-----<br>Sioux       | Severe:<br>cutbanks cave,<br>slope.   | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.  | Severe:<br>slope.                |
| 410-----<br>Athelwold    | Severe:<br>cutbanks cave.             | Moderate:<br>shrink-swell.             | Moderate:<br>wetness.                  | Moderate:<br>shrink-swell.             | Severe:<br>low strength,<br>frost action.                  | Slight.                          |
| 418-----<br>Lamoure      | Severe:<br>wetness.                   | Severe:<br>flooding,<br>wetness.       | Severe:<br>flooding,<br>wetness.       | Severe:<br>flooding,<br>wetness.       | Severe:<br>low strength,<br>wetness,<br>flooding.          | Severe:<br>wetness.              |
| 437D-----<br>Buse        | Severe:<br>slope.                     | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.                      | Severe:<br>slope.  | Severe:<br>slope.                |
| 450-----<br>Rauville     | Severe:<br>cutbanks cave,<br>ponding. | Severe:<br>flooding,<br>ponding.       | Severe:<br>flooding,<br>ponding.       | Severe:<br>flooding,<br>ponding.       | Severe:<br>low strength,<br>ponding,<br>flooding.          | Severe:<br>ponding,<br>flooding. |
| 494B-----<br>Darnen      | Severe:<br>excess humus.              | Severe:<br>low strength.               | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>low strength.               | Moderate:<br>frost action.                                 | Slight.                          |
| 694B-----<br>Zell        | Slight-----                           | Slight-----                            | Slight-----                            | Moderate:<br>slope.                    | Severe:<br>frost action.                                   | Slight.                          |
| 698-----<br>Doran        | Moderate:<br>wetness.                 | Severe:<br>shrink-swell.               | Severe:<br>shrink-swell.               | Severe:<br>shrink-swell.               | Severe:<br>shrink-swell,<br>low strength,<br>frost action. | Slight.                          |
| 787:<br>Fram-----        | Severe:<br>wetness.                   | Moderate:<br>wetness.                  | Severe:<br>wetness.                    | Moderate:<br>wetness.                  | Severe:<br>frost action.                                   | Slight.                          |
| Valliers-----            | Severe:<br>wetness.                   | Severe:<br>wetness.                    | Severe:<br>wetness.                    | Severe:<br>wetness.                    | Severe:<br>frost action.                                   | Moderate:<br>wetness.            |
| Parnell-----             | Severe:<br>ponding.                   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>shrink-swell,<br>low strength,<br>ponding.      | Severe:<br>ponding.              |
| 814:<br>Hamerly-----     | Severe:<br>wetness.                   | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>frost action.                                   | Slight.                          |
| Lindaas-----             | Severe:<br>ponding.                   | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>low strength,<br>ponding,<br>frost action.      | Severe:<br>ponding.              |
| 827B:<br>Esmond-----     | Slight-----                           | Slight-----                            | Slight-----                            | Moderate:<br>slope.                    | Moderate:<br>frost action.                                 | Slight.                          |
| Heimdal-----             | Slight-----                           | Slight-----                            | Slight-----                            | Moderate:<br>slope.                    | Moderate:<br>frost action.                                 | Slight.                          |

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations       | Dwellings without basements            | Dwellings with basements               | Small commercial buildings             | Local roads and streets                               | Lawns and landscaping     |
|--------------------------|---------------------------|--|--|--|---|---------------------------|
| 827C2:<br>Esmond-----    | Moderate:<br>slope.       | Moderate:<br>slope.                    | Moderate:<br>slope.                    | Severe:<br>slope.                      | Moderate:<br>slope,<br>frost action.                  | Moderate:<br>slope.       |
| Heimdahl-----            | Slight-----               | Slight-----                            | Slight-----                            | Moderate:<br>slope.                    | Moderate:<br>frost action.                            | Slight.                   |
| 900:<br>Hamerly-----     | Severe:<br>wetness.       | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>frost action.                              | Slight.                   |
| Aazdahl-----             | Moderate:<br>wetness.     | Moderate:<br>shrink-swell.             | Moderate:<br>wetness,<br>shrink-swell. | Moderate:<br>shrink-swell.             | Severe:<br>frost action,<br>low strength.             | Slight.                   |
| Lindaas-----             | Severe:<br>ponding.       | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>ponding.                    | Severe:<br>low strength,<br>ponding,<br>frost action. | Severe:<br>ponding.       |
| 915B:<br>Formdale-----   | Slight-----               | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell,<br>slope.   | Severe:<br>low strength.                              | Slight.                   |
| Buse-----                | Slight-----               | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell.             | Moderate:<br>shrink-swell,<br>slope.   | Moderate:<br>shrink-swell,<br>low strength.           | Slight.                   |
| 915C2:<br>Buse-----      | Moderate:<br>slope.       | Moderate:<br>shrink-swell,<br>slope.   | Moderate:<br>slope,<br>shrink-swell.   | Severe:<br>slope.                      | Moderate:<br>shrink-swell,<br>low strength,<br>slope. | Moderate:<br>slope.       |
| Formdale-----            | Moderate:<br>slope.       | Moderate:<br>shrink-swell,<br>slope.   | Moderate:<br>slope,<br>shrink-swell.   | Severe:<br>slope.                      | Severe:<br>low strength.                              | Moderate:<br>slope.       |
| 922:<br>Hamerly-----     | Severe:<br>wetness.       | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>wetness.                    | Moderate:<br>wetness,<br>shrink-swell. | Severe:<br>frost action.                              | Slight.                   |
| Parnell-----             | Severe:<br>ponding.       | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>ponding,<br>shrink-swell.   | Severe:<br>shrink-swell,<br>low strength,<br>ponding. | Severe:<br>ponding.       |
| 923C:<br>Copaston-----   | Severe:<br>depth to rock. | Severe:<br>depth to rock.              | Severe:<br>depth to rock.              | Severe:<br>slope,<br>depth to rock.    | Severe:<br>depth to rock.                             | Severe:<br>depth to rock. |
| Rock outcrop.            |                           |  |  |  |   |                           |
| 1013.<br>Pits            |                           |  |  |  |   |                           |

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations       | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets                               | Lawns and landscaping |
|--------------------------|---------------------------|-----------------------------|--------------------------|----------------------------|---|-----------------------|
| 1030:<br>Udorthents----- | Severe:<br>slope.         | Severe:<br>slope.           | Severe:<br>slope.        | Severe:<br>slope.          | ---   | Severe:<br>slope.     |
| Pits.                    |                           |                             |                          |                            |   |                       |
| 1817F-----<br>Esmond     | Severe:<br>slope.         | Severe:<br>slope.           | Severe:<br>slope.        | Severe:<br>slope.          | Severe:<br>slope.                                     | Severe:<br>slope.     |
| 1916-----<br>Lindaas     | Severe:<br>ponding.       | Severe:<br>ponding.         | Severe:<br>ponding.      | Severe:<br>ponding.        | Severe:<br>low strength,<br>ponding,<br>frost action. | Severe:<br>ponding.   |
| 1940-----<br>Bigstone    | Severe:<br>ponding.       | Severe:<br>ponding.         | Severe:<br>ponding.      | Severe:<br>ponding.        | Severe:<br>low strength,<br>ponding,<br>frost action. | Severe:<br>ponding.   |
| 1949-----<br>Gardena     | Moderate:<br>wetness.     | Slight-----                 | Moderate:<br>wetness.    | Slight-----                | Severe:<br>frost action.                              | Slight.               |
| 1994-----<br>Embden      | Severe:<br>cutbanks cave. | Slight-----                 | Moderate:<br>wetness.    | Slight-----                | Moderate:<br>frost action.                            | Slight.               |

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol   | Septic tank absorption fields        | Sewage lagoon areas               | Trench sanitary landfill                      | Area sanitary landfill          | Daily cover for landfill                          |
|----------------------------|--------------------------------------|-----------------------------------|---|---------------------------------|---|
| 26-----<br>Aazdahl         | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.               | Severe:<br>wetness.                           | Severe:<br>wetness.             | Fair:<br>too clayey,<br>wetness.                  |
| 34-----<br>Parnell         | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.               | Severe:<br>ponding,<br>too clayey.            | Severe:<br>ponding.             | Poor:<br>too clayey,<br>hard to pack,<br>ponding. |
| 36-----<br>Flom            | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.               | Severe:<br>wetness.                           | Severe:<br>wetness.             | Poor:<br>wetness.                                 |
| 51-----<br>La Prairie      | Severe:<br>flooding,<br>wetness.     | Severe:<br>flooding.              | Severe:<br>flooding,<br>wetness.              | Severe:<br>flooding.            | Fair:<br>too clayey.                              |
| 60-----<br>Glyndon         | Severe:<br>wetness.                  | Severe:<br>seepage,<br>wetness.   | Severe:<br>seepage,<br>wetness,<br>too sandy. | Severe:<br>seepage,<br>wetness. | Fair:<br>too sandy,<br>wetness.                   |
| 70-----<br>Svea            | Severe:<br>percs slowly.             | Moderate:<br>seepage,<br>wetness. | Severe:<br>wetness.                           | Moderate:<br>wetness.           | Fair:<br>too clayey.                              |
| 127B-----<br>Sverdrup      | Severe:<br>poor filter.              | Severe:<br>seepage.               | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.             | Poor:<br>seepage,<br>too sandy.                   |
| 137-----<br>Dovray         | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.               | Severe:<br>ponding,<br>too clayey.            | Severe:<br>ponding.             | Poor:<br>too clayey,<br>hard to pack,<br>ponding. |
| 141A, 141B-----<br>Egeland | Slight-----                          | Severe:<br>seepage.               | Severe:<br>seepage.                           | Severe:<br>seepage.             | Poor:<br>seepage.                                 |
| 171B-----<br>Formdale      | Severe:<br>percs slowly.             | Moderate:<br>slope.               | Moderate:<br>too clayey.                      | Slight-----                     | Fair:<br>too clayey.                              |
| 180-----<br>Gonvick        | Severe:<br>wetness.                  | Severe:<br>wetness.               | Severe:<br>wetness.                           | Severe:<br>wetness.             | Fair:<br>too clayey,<br>wetness.                  |
| 184A, 184B-----<br>Hamerly | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.               | Severe:<br>wetness.                           | Severe:<br>wetness.             | Fair:<br>too clayey,<br>wetness.                  |
| 185B-----<br>Hattie        | Severe:<br>wetness,<br>percs slowly. | Moderate:<br>slope.               | Severe:<br>wetness,<br>too clayey.            | Severe:<br>wetness.             | Poor:<br>too clayey,<br>hard to pack.             |
| 185C-----<br>Hattie        | Severe:<br>percs slowly.             | Severe:<br>slope.                 | Severe:<br>too clayey.                        | Slight-----                     | Poor:<br>too clayey,<br>hard to pack.             |

TABLE 11.--SANITARY FACILITIES--Continued

| Soil name and map symbol     | Septic tank absorption fields        | Sewage lagoon areas             | Trench sanitary landfill                      | Area sanitary landfill          | Daily cover for landfill                          |
|------------------------------|--------------------------------------|---------------------------------|---|---------------------------------|---|
| 192A, 192B-----<br>Estelline | Severe:<br>poor filter.              | Severe:<br>seepage.             | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.             | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 210-----<br>Fulda            | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness,<br>too clayey.            | Severe:<br>wetness.             | Poor:<br>too clayey,<br>hard to pack,<br>wetness. |
| 236-----<br>Vallers          | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness.                           | Severe:<br>wetness.             | Poor:<br>wetness.                                 |
| 246-----<br>Marysland        | Severe:<br>wetness,<br>poor filter.  | Severe:<br>seepage,<br>wetness. | Severe:<br>seepage,<br>wetness,<br>too sandy. | Severe:<br>seepage,<br>wetness. | Poor:<br>seepage,<br>too sandy,<br>wetness.       |
| 276-----<br>Oldham           | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.             | Severe:<br>ponding,<br>too clayey.            | Severe:<br>ponding.             | Poor:<br>too clayey,<br>hard to pack,<br>ponding. |
| 288D-----<br>Esmond          | Severe:<br>slope.                    | Severe:<br>slope.               | Severe:<br>slope.                             | Severe:<br>slope.               | Poor:<br>slope.                                   |
| 293A-----<br>Svenoda         | Severe:<br>wetness,<br>percs slowly. | Severe:<br>seepage,<br>wetness. | Moderate:<br>wetness,<br>too clayey.          | Severe:<br>seepage.             | Fair:<br>too clayey,<br>wetness.                  |
| 293B-----<br>Svenoda         | Severe:<br>percs slowly.             | Severe:<br>seepage.             | Moderate:<br>too clayey.                      | Severe:<br>seepage.             | Fair:<br>too clayey.                              |
| 296B-----<br>Fram            | Severe:<br>wetness.                  | Severe:<br>wetness.             | Severe:<br>wetness.                           | Severe:<br>wetness.             | Fair:<br>wetness.                                 |
| 314-----<br>Spottswood       | Severe:<br>wetness,<br>poor filter.  | Severe:<br>seepage,<br>wetness. | Severe:<br>seepage,<br>wetness,<br>too sandy. | Severe:<br>seepage,<br>wetness. | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 339-----<br>Fordville        | Severe:<br>poor filter.              | Severe:<br>seepage.             | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.             | Poor:<br>small stones,<br>too sandy,<br>seepage.  |
| 341-----<br>Arvilla          | Severe:<br>poor filter.              | Severe:<br>seepage.             | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.             | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 344-----<br>Bigstone         | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.             | Severe:<br>ponding.                           | Severe:<br>ponding.             | Poor:<br>ponding.                                 |
| 347-----<br>Malachy          | Severe:<br>wetness,<br>poor filter.  | Severe:<br>seepage,<br>wetness. | Severe:<br>seepage,<br>wetness,<br>too sandy. | Severe:<br>seepage,<br>wetness. | Poor:<br>seepage,<br>too sandy.                   |

TABLE 11.--SANITARY FACILITIES--Continued

| Soil name and map symbol | Septic tank absorption fields                     | Sewage lagoon areas                          | Trench sanitary landfill                      | Area sanitary landfill           | Daily cover for landfill                          |
|--------------------------|---|--|---|----------------------------------|---|
| 373B-----<br>Renshaw     | Severe:<br>poor filter.                           | Severe:<br>seepage.                          | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.              | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 402B-----<br>Sioux       | Severe:<br>poor filter.                           | Severe:<br>seepage.                          | Severe:<br>seepage,<br>too sandy.             | Severe:<br>seepage.              | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 402E-----<br>Sioux       | Severe:<br>poor filter,<br>slope.                 | Severe:<br>seepage,<br>slope.                | Severe:<br>seepage,<br>slope,<br>too sandy.   | Severe:<br>seepage,<br>slope.    | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 410-----<br>Athelwold    | Severe:<br>wetness,<br>poor filter.               | Severe:<br>wetness,<br>seepage.              | Severe:<br>wetness,<br>seepage,<br>too sandy. | Severe:<br>wetness,<br>seepage.  | Poor:<br>seepage,<br>too sandy,<br>small stones.  |
| 418-----<br>Lamoure      | Severe:<br>flooding,<br>wetness,<br>percs slowly. | Severe:<br>flooding,<br>wetness.             | Severe:<br>flooding,<br>wetness.              | Severe:<br>flooding,<br>wetness. | Poor:<br>hard to pack,<br>wetness.                |
| 437D-----<br>Buse        | Severe:<br>percs slowly,<br>slope.                | Severe:<br>slope.                            | Severe:<br>slope.                             | Severe:<br>slope.                | Poor:<br>slope.                                   |
| 450-----<br>Rauville     | Severe:<br>flooding,<br>ponding,<br>percs slowly. | Severe:<br>seepage,<br>flooding,<br>ponding. | Severe:<br>flooding,<br>seepage,<br>ponding.  | Severe:<br>flooding,<br>ponding. | Poor:<br>hard to pack,<br>ponding.                |
| 494B-----<br>Darnen      | Severe:<br>wetness.                               | Severe:<br>wetness.                          | Severe:<br>wetness.                           | Severe:<br>wetness.              | Fair:<br>too clayey,<br>wetness.                  |
| 694B-----<br>Zell        | Moderate:<br>percs slowly.                        | Moderate:<br>seepage,<br>slope.              | Slight-----                                   | Slight-----                      | Good.   |
| 698-----<br>Doran        | Severe:<br>wetness,<br>percs slowly.              | Moderate:<br>seepage.                        | Severe:<br>wetness.                           | Severe:<br>wetness.              | Fair:<br>too clayey,<br>wetness.                  |
| 787:<br>Fram-----        | Severe:<br>wetness.                               | Severe:<br>wetness.                          | Severe:<br>wetness.                           | Severe:<br>wetness.              | Fair:<br>wetness.                                 |
| Vallars-----             | Severe:<br>wetness,<br>percs slowly.              | Severe:<br>wetness.                          | Severe:<br>wetness.                           | Severe:<br>wetness.              | Poor:<br>wetness.                                 |
| Parnell-----             | Severe:<br>ponding,<br>percs slowly.              | Severe:<br>ponding.                          | Severe:<br>ponding,<br>too clayey.            | Severe:<br>ponding.              | Poor:<br>too clayey,<br>hard to pack,<br>ponding. |

TABLE 11.--SANITARY FACILITIES--Continued

| Soil name and map symbol | Septic tank absorption fields        | Sewage lagoon areas             | Trench sanitary landfill           | Area sanitary landfill | Daily cover for landfill         |
|--------------------------|--------------------------------------|---------------------------------|------------------------------------|------------------------|----------------------------------|
| 814:<br>Hamerly-----     | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness.                | Severe:<br>wetness.    | Fair:<br>too clayey,<br>wetness. |
| Lindaas-----             | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.             | Severe:<br>ponding.                | Severe:<br>ponding.    | Poor:<br>ponding.                |
| 827B:<br>Esmond-----     | Moderate:<br>percs slowly.           | Moderate:<br>seepage,<br>slope. | Slight-----                        | Slight-----            | Good.                            |
| Heimdal-----             | Moderate:<br>percs slowly.           | Moderate:<br>seepage,<br>slope. | Slight-----                        | Slight-----            | Good.                            |
| 827C2:<br>Esmond-----    | Moderate:<br>percs slowly,<br>slope. | Severe:<br>slope.               | Moderate:<br>slope.                | Moderate:<br>slope.    | Fair:<br>slope.                  |
| Heimdal-----             | Moderate:<br>percs slowly.           | Severe:<br>slope.               | Slight-----                        | Slight-----            | Good.                            |
| 900:<br>Hamerly-----     | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness.                | Severe:<br>wetness.    | Fair:<br>too clayey,<br>wetness. |
| Aazdahl-----             | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness.                | Severe:<br>wetness.    | Fair:<br>too clayey,<br>wetness. |
| Lindaas-----             | Severe:<br>ponding,<br>percs slowly. | Severe:<br>ponding.             | Severe:<br>ponding.                | Severe:<br>ponding.    | Poor:<br>ponding.                |
| 915B:<br>Formdale-----   | Severe:<br>percs slowly.             | Moderate:<br>slope.             | Moderate:<br>too clayey.           | Slight-----            | Fair:<br>too clayey.             |
| Buse-----                | Severe:<br>percs slowly.             | Moderate:<br>slope.             | Moderate:<br>too clayey.           | Slight-----            | Fair:<br>too clayey.             |
| 915C2:<br>Buse-----      | Severe:<br>percs slowly.             | Severe:<br>slope.               | Moderate:<br>slope,<br>too clayey. | Moderate:<br>slope.    | Fair:<br>too clayey,<br>slope.   |
| Formdale-----            | Severe:<br>percs slowly.             | Severe:<br>slope.               | Moderate:<br>slope,<br>too clayey. | Moderate:<br>slope.    | Fair:<br>too clayey,<br>slope.   |
| 922:<br>Hamerly-----     | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness.             | Severe:<br>wetness.                | Severe:<br>wetness.    | Fair:<br>too clayey,<br>wetness. |

TABLE 11.--SANITARY FACILITIES--Continued

| Soil name and map symbol | Septic tank absorption fields          | Sewage lagoon areas                             | Trench sanitary landfill              | Area sanitary landfill    | Daily cover for landfill                          |
|--------------------------|--|---|---------------------------------------|---------------------------|---|
| 922:<br>Parnell-----     | Severe:<br>ponding,<br>percs slowly.   | Severe:<br>ponding.                             | Severe:<br>ponding,<br>too clayey.    | Severe:<br>ponding.       | Poor:<br>too clayey,<br>hard to pack,<br>ponding. |
| 923C:<br>Copaston-----   | Severe:<br>depth to rock.              | Severe:<br>seepage,<br>depth to rock,<br>slope. | Severe:<br>depth to rock,<br>seepage. | Severe:<br>depth to rock. | Poor:<br>depth to rock.                           |
| Rock outcrop.            |  |   |                                       |                           |   |
| 1013.<br>Pits            |  |   |                                       |                           |   |
| 1030:<br>Udorthents----- | ---                                    | ---   | ---                                   | ---                       | Poor:<br>slope.                                   |
| Pits.                    |  |   |                                       |                           |   |
| 1817F-----<br>Esmond     | Severe:<br>slope.                      | Severe:<br>slope.                               | Severe:<br>slope.                     | Severe:<br>slope.         | Poor:<br>slope.                                   |
| 1916-----<br>Lindaas     | Severe:<br>ponding,<br>percs slowly.   | Severe:<br>ponding.                             | Severe:<br>ponding.                   | Severe:<br>ponding.       | Poor:<br>ponding.                                 |
| 1940-----<br>Bigstone    | Severe:<br>ponding,<br>percs slowly.   | Severe:<br>ponding.                             | Severe:<br>ponding.                   | Severe:<br>ponding.       | Poor:<br>ponding.                                 |
| 1949-----<br>Gardena     | Moderate:<br>wetness,<br>percs slowly. | Moderate:<br>seepage,<br>slope,<br>wetness.     | Severe:<br>wetness.                   | Moderate:<br>wetness.     | Good.   |
| 1994-----<br>Embden      | Moderate:<br>wetness.                  | Severe:<br>seepage.                             | Severe:<br>seepage,<br>wetness.       | Severe:<br>seepage.       | Fair:<br>too sandy.                               |

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol     | Roadfill  | Sand                         | Gravel                       | Topsoil                               |
|------------------------------|---|------------------------------|------------------------------|---------------------------------------|
| 26-----<br>Aazdahl           | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                |
| 34-----<br>Parnell           | Poor:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                     |
| 36-----<br>Flom              | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                |
| 51-----<br>La Prairie        | Fair:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey.                  |
| 60-----<br>Glyndon           | Fair:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>thin layer.                  |
| 70-----<br>Svea              | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                |
| 127B-----<br>Sverdrup        | Good-----   | Probable-----                | Improbable:<br>too sandy.    | Poor:<br>too sandy.                   |
| 137-----<br>Dovray           | Poor:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>too clayey,<br>wetness.      |
| 141A, 141B-----<br>Egeland   | Good-----   | Probable-----                | Improbable:<br>too sandy.    | Fair:<br>small stones.                |
| 171B-----<br>Formdale        | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones. |
| 180-----<br>Gonvick          | Fair:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones. |
| 184A, 184B-----<br>Hamerly   | Fair:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                |
| 185B-----<br>Hattie          | Poor:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>too clayey.                  |
| 185C-----<br>Hattie          | Poor:<br>low strength,<br>shrink-swell.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>too clayey.                  |
| 192A, 192B-----<br>Estelline | Good-----   | Probable-----                | Probable-----                | Poor:<br>area reclaim.                |

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill  | Sand                         | Gravel                       | Topsoil  |
|--------------------------|---|------------------------------|------------------------------|--|
| 210-----<br>Fulda        | Poor:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>too clayey.                                   |
| 236-----<br>Vallers      | Fair:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                 |
| 246-----<br>Marysland    | Fair:<br>wetness.                                   | Probable-----                | Probable-----                | Fair:<br>area reclaim,<br>small stones,<br>thin layer. |
| 276-----<br>Oldham       | Poor:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>too clayey,<br>wetness.                       |
| 288D-----<br>Esmond      | Fair:<br>slope.                                     | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>slope.  |
| 293A-----<br>Swenoda     | Fair:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                 |
| 293B-----<br>Swenoda     | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                 |
| 296B-----<br>Fram        | Fair:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                 |
| 314-----<br>Spottswood   | Good-----   | Probable-----                | Probable-----                | Poor:<br>small stones,<br>area reclaim.                |
| 339-----<br>Fordville    | Good-----   | Probable-----                | Probable-----                | Poor:<br>too sandy,<br>small stones,<br>area reclaim.  |
| 341-----<br>Arvilla      | Good-----   | Probable-----                | Probable-----                | Poor:<br>too sandy,<br>small stones,<br>area reclaim.  |
| 344-----<br>Bigstone     | Poor:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                                      |
| 347-----<br>Malachy      | Good-----   | Probable-----                | Improbable:<br>too sandy.    | Fair:<br>small stones,<br>thin layer.                  |
| 373B-----<br>Renshaw     | Good-----   | Probable-----                | Probable-----                | Poor:<br>too sandy,<br>small stones,<br>area reclaim.  |
| 402B-----<br>Sioux       | Good-----   | Probable-----                | Probable-----                | Poor:<br>too sandy,<br>small stones,<br>area reclaim.  |

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill  | Sand                         | Gravel                       | Topsoil   |
|--------------------------|---|------------------------------|------------------------------|---|
| 402E-----<br>Sioux       | Poor:<br>slope.                                     | Probable-----                | Probable-----                | Poor:<br>too sandy,<br>small stones,<br>area reclaim. |
| 410-----<br>Athelwold    | Good-----   | Probable-----                | Probable-----                | Poor:<br>area reclaim.                                |
| 418-----<br>Lamoure      | Poor:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                                     |
| 437D-----<br>Buse        | Fair:<br>shrink-swell,<br>low strength,<br>slope.   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>slope.                                       |
| 450-----<br>Rauville     | Poor:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                                     |
| 494B-----<br>Darnen      | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Good.   |
| 694B-----<br>Zell        | Good-----   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Good.   |
| 698-----<br>Doran        | Poor:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>thin layer.                                  |
| 787:<br>Fram-----        | Fair:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                |
| Vallers-----             | Fair:<br>low strength,<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                |
| Parnell-----             | Poor:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                                     |
| 814:<br>Hamerly-----     | Fair:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                |
| Lindaas-----             | Poor:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>thin layer,<br>wetness.                      |
| 827B:<br>Esmond-----     | Good-----   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                |
| Heimdal-----             | Good-----   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                                |

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill  | Sand                         | Gravel                       | Topsoil   |
|--------------------------|---|------------------------------|------------------------------|---|
| 827C2:<br>Esmond-----    | Good-----   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones,<br>slope.                |
| Heimdal-----             | Good-----   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                          |
| 900:<br>Hamerly-----     | Fair:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                          |
| Aazdahl-----             | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                          |
| Lindaas-----             | Poor:<br>wetness.                                   | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>thin layer,<br>wetness.                |
| 915B:<br>Formdale-----   | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones.           |
| Buse-----                | Fair:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones.           |
| 915C2:<br>Buse-----      | Fair:<br>shrink-swell,<br>low strength.             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones,<br>slope. |
| Formdale-----            | Poor:<br>low strength.                              | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>too clayey,<br>small stones,<br>slope. |
| 922:<br>Hamerly-----     | Fair:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Fair:<br>small stones.                          |
| Parnell-----             | Poor:<br>shrink-swell,<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                               |
| 923C:<br>Copaston-----   | Poor:<br>depth to rock.                             | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>depth to rock,<br>small stones.        |
| Rock outcrop.            |   |                              |                              |   |
| 1013.<br>Pits            |   |                              |                              |   |

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol              | Roadfill                           | Sand                         | Gravel                       | Topsoil                          |
|---------------------------------------|------------------------------------|------------------------------|------------------------------|----------------------------------|
| 1030:<br>Udorthents-----<br><br>Pits. | ---                                | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>slope.                  |
| 1817F-----<br>Esmond                  | Poor:<br>slope.                    | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>slope.                  |
| 1916-----<br>Lindaas                  | Poor:<br>wetness.                  | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>thin layer,<br>wetness. |
| 1940-----<br>Bigstone                 | Poor:<br>low strength,<br>wetness. | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Poor:<br>wetness.                |
| 1949-----<br>Gardena                  | Good-----                          | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Good.                            |
| 1994-----<br>Embden                   | Good-----                          | Improbable:<br>excess fines. | Improbable:<br>excess fines. | Good.                            |

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Limitations for--     |                                      | Features affecting--                       |   |                             |                           |
|--------------------------|-----------------------|--------------------------------------|--|---|-----------------------------|---------------------------|
|                          | Pond reservoir areas  | Embankments, dikes, and levees       | Drainage                                   | Irrigation                                | Terraces and diversions     | Grassed waterways         |
| 26-----<br>Aazdahl       | Slight-----           | Moderate:<br>wetness.                | Deep to water                              | Favorable-----                            | Erodes easily               | Erodes easily.            |
| 34-----<br>Parnell       | Slight-----           | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly.                 | Ponding,<br>percs slowly.   | Wetness,<br>percs slowly. |
| 36-----<br>Flom          | Slight-----           | Severe:<br>wetness.                  | Frost action--                             | Wetness-----                              | Wetness-----                | Wetness.                  |
| 51-----<br>La Prairie    | Moderate:<br>seepage. | Severe:<br>piping.                   | Deep to water                              | Flooding-----                             | Favorable-----              | Favorable.                |
| 60-----<br>Glyndon       | Severe:<br>seepage.   | Severe:<br>piping.                   | Frost action,<br>cutbanks cave.            | Wetness-----                              | Erodes easily,<br>wetness.  | Erodes easily.            |
| 70-----<br>Svea          | Moderate:<br>seepage. | Severe:<br>piping.                   | Deep to water                              | Favorable-----                            | Erodes easily               | Erodes easily.            |
| 127B-----<br>Sverdrup    | Severe:<br>seepage.   | Severe:<br>seepage,<br>piping.       | Deep to water                              | Slope,<br>droughty,<br>soil blowing.      | Too sandy,<br>soil blowing. | Droughty.                 |
| 137-----<br>Dovray       | Slight-----           | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>percs slowly.                  | Ponding,<br>slow intake,<br>percs slowly. | Ponding,<br>percs slowly.   | Wetness,<br>percs slowly. |
| 141A-----<br>Egeland     | Severe:<br>seepage.   | Severe:<br>seepage,<br>piping.       | Deep to water                              | Droughty-----                             | Too sandy,<br>soil blowing. | Droughty.                 |
| 141B-----<br>Egeland     | Severe:<br>seepage.   | Severe:<br>seepage,<br>piping.       | Deep to water                              | Slope,<br>droughty.                       | Too sandy,<br>soil blowing. | Droughty.                 |
| 171B-----<br>Formdale    | Moderate:<br>slope.   | Slight-----                          | Deep to water                              | Slope-----                                | Erodes easily               | Erodes easily.            |
| 180-----<br>Gonvick      | Moderate:<br>seepage. | Severe:<br>piping.                   | Frost action--                             | Wetness-----                              | Wetness-----                | Favorable.                |
| 184A-----<br>Hamerly     | Slight-----           | Severe:<br>piping.                   | Frost action--                             | Wetness-----                              | Erodes easily,<br>wetness.  | Erodes easily.            |
| 184B-----<br>Hamerly     | Moderate:<br>slope.   | Severe:<br>piping.                   | Frost action,<br>slope.                    | Slope,<br>wetness.                        | Erodes easily,<br>wetness.  | Erodes easily.            |
| 185B-----<br>Hattie      | Slight-----           | Severe:<br>hard to pack.             | Deep to water                              | Slow intake,<br>percs slowly.             | Percs slowly---             | Percs slowly.             |
| 185C-----<br>Hattie      | Moderate:<br>slope.   | Severe:<br>hard to pack.             | Deep to water                              | Slow intake,<br>percs slowly,<br>slope.   | Percs slowly---             | Percs slowly.             |
| 192A-----<br>Estelline   | Severe:<br>seepage.   | Severe:<br>seepage.                  | Deep to water                              | Favorable-----                            | Too sandy-----              | Favorable.                |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Limitations for--             |                                      | Features affecting--                       |   |                                 |                           |
|--------------------------|-------------------------------|--------------------------------------|--|---|---------------------------------|---------------------------|
|                          | Pond reservoir areas          | Embankments, dikes, and levees       | Drainage                                   | Irrigation                                | Terraces and diversions         | Grassed waterways         |
| 192B-----<br>Estelline   | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Slope-----                                | Too sandy-----                  | Favorable.                |
| 210-----<br>Fulda        | Slight-----                   | Severe:<br>hard to pack,<br>wetness. | Percs slowly,<br>frost action.             | Wetness,<br>slow intake,<br>percs slowly. | Wetness-----                    | Wetness,<br>percs slowly. |
| 236-----<br>Vallers      | Slight-----                   | Severe:<br>piping,<br>wetness.       | Frost action--                             | Wetness-----                              | Wetness-----                    | Wetness.                  |
| 246-----<br>Marysland    | Severe:<br>seepage.           | Severe:<br>seepage,<br>wetness.      | Frost action,<br>cutbanks cave.            | Wetness-----                              | Wetness,<br>too sandy.          | Wetness.                  |
| 276-----<br>Oldham       | Slight-----                   | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>slow intake,<br>percs slowly. | Ponding,<br>percs slowly.       | Wetness,<br>percs slowly. |
| 288D-----<br>Esmond      | Severe:<br>slope.             | Severe:<br>piping.                   | Deep to water                              | Slope-----                                | Slope,<br>erodes easily.        | Slope,<br>erodes easily.  |
| 293A-----<br>Swenoda     | Severe:<br>seepage.           | Severe:<br>piping.                   | Favorable-----                             | Wetness,<br>soil blowing.                 | Erodes easily,<br>wetness.      | Erodes easily.            |
| 293B-----<br>Swenoda     | Severe:<br>seepage.           | Severe:<br>piping.                   | Deep to water                              | Soil blowing,<br>slope.                   | Erodes easily,<br>soil blowing. | Erodes easily.            |
| 296B-----<br>Fram        | Moderate:<br>seepage.         | Severe:<br>piping.                   | Frost action--                             | Wetness-----                              | Erodes easily,<br>wetness.      | Erodes easily.            |
| 314-----<br>Spottswood   | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Favorable-----                            | Too sandy-----                  | Favorable.                |
| 339-----<br>Fordville    | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Rooting depth                             | Too sandy-----                  | Rooting depth.            |
| 341-----<br>Arvilla      | Severe:<br>seepage.           | Severe:<br>seepage,<br>piping.       | Deep to water                              | Droughty-----                             | Too sandy-----                  | Droughty.                 |
| 344-----<br>Bigstone     | Moderate:<br>seepage.         | Severe:<br>ponding.                  | Ponding,<br>frost action.                  | Ponding-----                              | Ponding-----                    | Wetness.                  |
| 347-----<br>Malachy      | Severe:<br>seepage.           | Severe:<br>seepage,<br>piping.       | Deep to water                              | Favorable-----                            | Too sandy-----                  | Favorable.                |
| 373B-----<br>Renshaw     | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Droughty,<br>slope.                       | Too sandy-----                  | Droughty.                 |
| 402B-----<br>Sioux       | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Slope,<br>droughty.                       | Too sandy-----                  | Droughty.                 |
| 402E-----<br>Sioux       | Severe:<br>seepage,<br>slope. | Severe:<br>seepage.                  | Deep to water                              | Slope,<br>droughty.                       | Slope,<br>too sandy.            | Slope,<br>droughty.       |
| 410-----<br>Athelwold    | Severe:<br>seepage.           | Severe:<br>seepage.                  | Deep to water                              | Favorable-----                            | Too sandy-----                  | Favorable.                |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Limitations for--               |                                      | Features affecting--                       |                           |                                 |   |
|--------------------------|---------------------------------|--------------------------------------|--|---------------------------|---------------------------------|---|
|                          | Pond reservoir areas            | Embankments, dikes, and levees       | Drainage                                   | Irrigation                | Terraces and diversions         | Grassed waterways                           |
| 418-----<br>Lamoure      | Moderate:<br>seepage.           | Severe:<br>hard to pack,<br>wetness. | Flooding,<br>frost action.                 | Wetness,<br>flooding.     | Wetness-----                    | Wetness.                                    |
| 437D-----<br>Buse        | Severe:<br>slope.               | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Slope,<br>erodes easily.        | Slope,<br>erodes easily.                    |
| 450-----<br>Rauville     | Severe:<br>seepage.             | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>flooding,<br>frost action.     | Ponding,<br>flooding.     | Ponding-----                    | Wetness.                                    |
| 494B-----<br>Darnen      | Moderate:<br>seepage,<br>slope. | Severe:<br>piping.                   | Slope-----                                 | Slope,<br>wetness.        | Erodes easily,<br>wetness.      | Erodes easily.                              |
| 694B-----<br>Zell        | Moderate:<br>seepage,<br>slope. | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Erodes easily                   | Erodes easily.                              |
| 698-----<br>Doran        | Moderate:<br>seepage.           | Moderate:<br>piping,<br>wetness.     | Deep to water                              | Percs slowly---           | Erodes easily,<br>percs slowly. | Erodes easily,<br>percs slowly.             |
| 787:<br>Fram-----        | Moderate:<br>seepage.           | Severe:<br>piping.                   | Frost action---                            | Wetness-----              | Erodes easily,<br>wetness.      | Erodes easily.                              |
| Vallers-----             | Slight-----                     | Severe:<br>piping,<br>wetness.       | Frost action---                            | Wetness-----              | Wetness-----                    | Wetness.                                    |
| Parnell-----             | Slight-----                     | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly. | Ponding,<br>percs slowly.       | Wetness,<br>percs slowly.                   |
| 814:<br>Hamerly-----     | Slight-----                     | Severe:<br>piping.                   | Frost action---                            | Wetness-----              | Erodes easily,<br>wetness.      | Erodes easily.                              |
| Lindaas-----             | Moderate:<br>seepage.           | Severe:<br>thin layer,<br>ponding.   | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly. | Erodes easily,<br>ponding.      | Wetness,<br>erodes easily,<br>percs slowly. |
| 827B:<br>Esmond-----     | Moderate:<br>seepage,<br>slope. | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Erodes easily                   | Erodes easily.                              |
| Heimdal-----             | Moderate:<br>seepage,<br>slope. | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Erodes easily                   | Erodes easily.                              |
| 827C2:<br>Esmond-----    | Severe:<br>slope.               | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Slope,<br>erodes easily.        | Slope,<br>erodes easily.                    |
| Heimdal-----             | Moderate:<br>seepage,<br>slope. | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Erodes easily                   | Erodes easily.                              |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Limitations for--                   |                                      | Features affecting--                       |                           |                            |   |
|--------------------------|-------------------------------------|--------------------------------------|--|---------------------------|----------------------------|---|
|                          | Pond reservoir areas                | Embankments, dikes, and levees       | Drainage                                   | Irrigation                | Terraces and diversions    | Grassed waterways                           |
| 900:<br>Hamerly-----     | Slight-----                         | Severe:<br>piping.                   | Frost action--                             | Wetness-----              | Erodes easily,<br>wetness. | Erodes easily.                              |
| Aazdahl-----             | Slight-----                         | Moderate:<br>wetness.                | Deep to water                              | Favorable-----            | Erodes easily              | Erodes easily.                              |
| Lindaas-----             | Moderate:<br>seepage.               | Severe:<br>thin layer,<br>ponding.   | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly. | Erodes easily,<br>ponding. | Wetness,<br>erodes easily,<br>percs slowly. |
| 915B:<br>Formdale-----   | Moderate:<br>slope.                 | Slight-----                          | Deep to water                              | Slope-----                | Erodes easily              | Erodes easily.                              |
| Buse-----                | Moderate:<br>slope.                 | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Erodes easily              | Erodes easily.                              |
| 915C2:<br>Buse-----      | Severe:<br>slope.                   | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Slope,<br>erodes easily.   | Slope,<br>erodes easily.                    |
| Formdale-----            | Severe:<br>slope.                   | Slight-----                          | Deep to water                              | Slope-----                | Slope,<br>erodes easily.   | Slope,<br>erodes easily.                    |
| 922:<br>Hamerly-----     | Slight-----                         | Severe:<br>piping.                   | Frost action--                             | Wetness-----              | Erodes easily,<br>wetness. | Erodes easily.                              |
| Parnell-----             | Slight-----                         | Severe:<br>hard to pack,<br>ponding. | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly. | Ponding,<br>percs slowly.  | Wetness,<br>percs slowly.                   |
| 923C:<br>Copaston-----   | Severe:<br>depth to rock,<br>slope. | Severe:<br>piping.                   | Deep to water                              | Slope,<br>depth to rock.  | Slope,<br>depth to rock.   | Slope,<br>depth to rock.                    |
| Rock outcrop.            |                                     |                                      |  |                           |                            |   |
| 1013.<br>Pits            |                                     |                                      |  |                           |                            |   |
| 1030:<br>Udorthents----- | ---                                 | ---                                  | Deep to water                              | ---                       | ---                        | ---   |
| Pits.                    |                                     |                                      |  |                           |                            |   |
| 1817F-----<br>Esmond     | Severe:<br>slope.                   | Severe:<br>piping.                   | Deep to water                              | Slope-----                | Slope,<br>erodes easily.   | Slope,<br>erodes easily.                    |
| 1916-----<br>Lindaas     | Moderate:<br>seepage.               | Severe:<br>thin layer,<br>ponding.   | Ponding,<br>percs slowly,<br>frost action. | Ponding,<br>percs slowly. | Erodes easily,<br>ponding. | Wetness,<br>erodes easily,<br>percs slowly. |
| 1940-----<br>Bigstone    | Moderate:<br>seepage.               | Severe:<br>ponding.                  | Ponding,<br>frost action.                  | Ponding-----              | Ponding-----               | Wetness.                                    |
| 1949-----<br>Gardena     | Moderate:<br>seepage.               | Severe:<br>piping.                   | Deep to water                              | Favorable-----            | Erodes easily              | Erodes easily.                              |

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and<br>map symbol | Limitations for--          |                                      | Features affecting-- |                |                               |                      |
|-----------------------------|----------------------------|--------------------------------------|----------------------|----------------|-------------------------------|----------------------|
|                             | Pond<br>reservoir<br>areas | Embankments,<br>dikes, and<br>levees | Drainage             | Irrigation     | Terraces<br>and<br>diversions | Grassed<br>waterways |
| 1994-----<br>Emden          | Severe:<br>seepage.        | Severe:<br>seepage,<br>piping.       | Deep to water        | Favorable----- | Favorable-----                | Favorable.           |

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol &lt; means less than; &gt; means more than. Absence of an entry indicates that data were not estimated)

| Soil name and<br>map symbol | Depth | USDA texture   | Classification          |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit | Plas-<br>ticity<br>index |
|-----------------------------|-------|--|-------------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|-----------------|--------------------------|
|                             |       |  | Unified                 | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                 |                          |
|                             | In    |  |                         |                  | Pct                            |                                      |        |        |        | Pct             |                          |
| 26-----<br>Aazdahl          | 0-11  | Clay loam-----   | CL                      | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-100 | 75-90  | 35-50           | 15-30                    |
|                             | 11-15 | Clay loam, silty<br>clay loam.                                       | CL                      | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50           | 15-30                    |
|                             | 15-60 | Clay loam, silty<br>clay loam, loam.                                 | CL                      | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50           | 15-30                    |
| 34-----<br>Parnell          | 0-20  | Silty clay loam  | CL, CH                  | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-100 | 40-60           | 15-30                    |
|                             | 20-50 | Clay loam, silty<br>clay loam, silty<br>clay.                        | CL, CH                  | A-7              | 0                              | 100                                  | 95-100 | 90-100 | 70-100 | 40-80           | 20-50                    |
|                             | 50-60 | Clay loam, silty<br>clay loam, silty<br>clay.                        | CL, CH                  | A-6, A-7         | 0                              | 95-100                               | 90-100 | 80-95  | 70-95  | 30-80           | 15-50                    |
| 36-----<br>Flom             | 0-14  | Silty clay loam  | CL                      | A-7, A-6         | 0                              | 95-100                               | 95-100 | 90-100 | 80-95  | 35-50           | 15-30                    |
|                             | 14-20 | Clay loam, silty<br>clay loam, loam.                                 | CL                      | A-6, A-7         | 0                              | 95-100                               | 95-100 | 90-100 | 70-95  | 30-50           | 10-30                    |
|                             | 20-60 | Loam, clay loam  | CL                      | A-6, A-7         | 0                              | 95-100                               | 90-100 | 80-95  | 60-90  | 20-50           | 10-30                    |
| 51-----<br>La Prairie       | 0-8   | Silt loam-----   | CL-ML, CL               | A-4, A-6         | 0                              | 100                                  | 100    | 85-95  | 70-80  | 25-40           | 5-15                     |
|                             | 8-16  | Silt loam, loam,<br>silty clay loam.                                 | CL-ML, CL               | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 85-100 | 50-90  | 25-50           | 5-25                     |
|                             | 16-29 | Silt loam, loam,<br>silty clay loam.                                 | CL-ML, CL               | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 85-100 | 70-90  | 25-50           | 5-25                     |
|                             | 29-60 | Stratified fine<br>sandy loam to<br>silty clay loam.                 | CL-ML, CL,<br>SC, SC-SM | A-4, A-6,<br>A-7 | 0                              | 100                                  | 95-100 | 75-100 | 45-90  | 25-50           | 5-25                     |
| 60-----<br>Glyndon          | 0-11  | Silty clay loam  | CL                      | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 80-95  | 30-45           | 10-25                    |
|                             | 11-24 | Silt loam, very<br>fine sandy loam,<br>loam.                         | ML, CL-ML,<br>CL        | A-4              | 0                              | 100                                  | 100    | 90-100 | 85-95  | 20-30           | NP-10                    |
|                             | 24-60 | Loamy very fine<br>sand, very fine<br>sand, very fine<br>sandy loam. | ML, SM,<br>SC, CL       | A-4              | 0                              | 100                                  | 100    | 85-100 | 35-75  | 10-30           | NP-10                    |
| 70-----<br>Svea             | 0-13  | Loam-----  | CL, CL-ML               | A-4, A-6         | 0-5                            | 95-100                               | 85-100 | 80-95  | 60-90  | 20-40           | 5-20                     |
|                             | 13-17 | Loam, silt loam,<br>clay loam.                                       | CL, CL-ML               | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 85-100 | 80-95  | 60-90  | 20-45           | 5-25                     |
|                             | 17-60 | Loam, silt loam,<br>clay loam.                                       | CL, CL-ML               | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 85-100 | 80-95  | 60-85  | 20-50           | 5-30                     |
| 127B-----<br>Sverdrup       | 0-8   | Fine sandy loam  | SM                      | A-4              | 0                              | 100                                  | 95-100 | 60-70  | 35-50  | 20-30           | NP-10                    |
|                             | 8-18  | Loam, fine sandy<br>loam, loamy<br>sand.                             | ML, SM                  | A-2, A-4         | 0                              | 100                                  | 95-100 | 50-75  | 30-70  | <30             | NP-5                     |
|                             | 18-60 | Sand, fine sand,<br>loamy sand.                                      | SP, SP-SM               | A-3, A-2         | 0                              | 100                                  | 95-100 | 50-90  | 2-10   | <20             | NP-5                     |
| 137-----<br>Dovray          | 0-8   | Silty clay-----  | CH, MH, OH              | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-95  | 50-80           | 25-40                    |
|                             | 8-24  | Clay, silty clay   | CH, MH                  | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-95  | 50-75           | 25-40                    |
|                             | 24-36 | Clay, silty clay   | CH, MH                  | A-7              | 0                              | 100                                  | 95-100 | 90-100 | 85-95  | 50-80           | 25-40                    |
|                             | 36-60 | Clay, silty clay,<br>clay loam.                                      | CH, MH,<br>CL, ML       | A-7              | 0                              | 100                                  | 95-100 | 80-100 | 70-95  | 40-75           | 20-40                    |

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture   | Classification      |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit<br>Pct | Plas-<br>ticity<br>index |
|--------------------------|-------|--|---------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|------------------------|--------------------------|
|                          |       |  | Unified             | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                        |                          |
| 141A-----<br>Egeland     | 0-8   | Fine sandy loam  | SM, SC-SM           | A-2, A-4         | 0                              | 100                                  | 95-100 | 75-100 | 30-50  | <25                    | NP-7                     |
|                          | 8-32  | Sandy loam, fine<br>sandy loam.                          | SM, SC-SM           | A-2, A-4         | 0                              | 95-100                               | 85-100 | 70-100 | 15-50  | <25                    | NP-7                     |
|                          | 32-60 | Loamy sand, loamy<br>fine sand, loamy<br>very fine sand. | SM, SP-SM,<br>SC-SM | A-2, A-4         | 0                              | 95-100                               | 85-100 | 70-100 | 10-45  | <25                    | NP-5                     |
| 141B-----<br>Egeland     | 0-8   | Fine sandy loam  | SM, SC-SM           | A-2, A-4         | 0                              | 100                                  | 95-100 | 75-100 | 30-50  | <25                    | NP-7                     |
|                          | 8-27  | Sandy loam, fine<br>sandy loam.                          | SM, SC-SM           | A-2, A-4         | 0                              | 95-100                               | 85-100 | 70-100 | 15-50  | <25                    | NP-7                     |
|                          | 27-60 | Loamy sand, loamy<br>fine sand, loamy<br>very fine sand. | SM, SP-SM,<br>SC-SM | A-2, A-4         | 0                              | 95-100                               | 85-100 | 70-100 | 10-45  | <25                    | NP-5                     |
| 171B-----<br>Formdale    | 0-10  | Clay loam-----   | CL                  | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-100 | 75-90  | 35-50                  | 15-30                    |
|                          | 10-14 | Clay loam, loam  | CL                  | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50                  | 15-30                    |
|                          | 14-60 | Clay loam, silty<br>clay loam, loam.                     | CL                  | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50                  | 15-30                    |
| 180-----<br>Gonvick      | 0-8   | Loam-----  | ML, CL,<br>CL-ML    | A-4, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 50-75  | 20-40                  | 3-20                     |
|                          | 8-25  | Loam, clay loam  | CL                  | A-6, A-7         | 0-3                            | 95-100                               | 90-100 | 75-95  | 50-85  | 20-50                  | 10-30                    |
|                          | 25-60 | Loam, clay loam  | CL-ML, CL           | A-4, A-6         | 0-3                            | 95-100                               | 90-100 | 70-95  | 50-80  | 15-40                  | 5-20                     |
| 184A-----<br>Hamerly     | 0-8   | Loam-----  | CL, CL-ML           | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-90  | 20-40                  | 5-20                     |
|                          | 8-28  | Loam, clay loam  | CL, CL-ML           | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-75  | 20-45                  | 5-25                     |
|                          | 28-60 | Loam, clay loam  | CL, CL-ML           | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 75-95  | 55-75  | 20-45                  | 5-25                     |
| 184B-----<br>Hamerly     | 0-8   | Loam-----  | CL, CL-ML           | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-90  | 20-40                  | 5-20                     |
|                          | 8-20  | Loam, clay loam  | CL, CL-ML           | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-75  | 20-45                  | 5-25                     |
|                          | 20-60 | Loam, clay loam  | CL, CL-ML           | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 75-95  | 55-75  | 20-45                  | 5-25                     |
| 185B-----<br>Hattie      | 0-15  | Silty clay-----  | CH, MH              | A-7              | 0                              | 95-100                               | 90-100 | 75-95  | 70-90  | 50-70                  | 23-43                    |
|                          | 15-60 | Silty clay loam,<br>silty clay.                          | CH, MH              | A-7              | 0                              | 95-100                               | 90-100 | 75-95  | 70-90  | 50-70                  | 23-43                    |
| 185C-----<br>Hattie      | 0-9   | Silty clay-----  | CH                  | A-7              | 0                              | 95-100                               | 90-100 | 75-100 | 70-95  | 50-70                  | 23-43                    |
|                          | 9-60  | Clay, silty clay   | CH                  | A-7              | 0                              | 95-100                               | 90-100 | 75-100 | 70-95  | 50-75                  | 23-45                    |
| 192A-----<br>Estelline   | 0-8   | Silt loam-----   | CL, ML              | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 95-100 | 80-100 | 30-45                  | 5-20                     |
|                          | 8-22  | Silty clay loam,<br>silt loam.                           | CL                  | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 90-100 | 35-50                  | 11-25                    |
|                          | 22-28 | Silt loam, loam,<br>silty clay loam.                     | CL, ML              | A-4, A-6         | 0                              | 100                                  | 100    | 80-100 | 70-100 | 30-40                  | 5-15                     |
|                          | 28-60 | Sand and gravel,<br>loamy sand,<br>sand.                 | SM, SW-SM,<br>SP-SM | A-1, A-2         | 0-5                            | 70-100                               | 50-85  | 10-50  | 5-25   | <25                    | NP-5                     |
| 192B-----<br>Estelline   | 0-8   | Silt loam-----   | CL, ML              | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 95-100 | 80-100 | 30-45                  | 5-20                     |
|                          | 8-18  | Silty clay loam,<br>silt loam.                           | CL                  | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 90-100 | 35-50                  | 11-25                    |
|                          | 18-24 | Silt loam, loam,<br>silty clay loam.                     | CL, ML              | A-4, A-6         | 0                              | 100                                  | 100    | 80-100 | 70-100 | 30-40                  | 5-15                     |
|                          | 24-60 | Sand and gravel,<br>loamy sand,<br>sand.                 | SM, SW-SM,<br>SP-SM | A-1, A-2         | 0-5                            | 70-100                               | 50-85  | 10-50  | 5-25   | <25                    | NP-5                     |

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and<br>map symbol | Depth | USDA texture   | Classification             |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit<br>Pct | Plas-<br>ticity<br>index |
|-----------------------------|-------|--|----------------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|------------------------|--------------------------|
|                             |       |  | Unified                    | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                        |                          |
|                             | In    |  |                            |                  | Pct                            |                                      |        |        |        | Pct                    |                          |
| 210-----<br>Fulda           | 0-13  | Silty clay-----  | OH, CH,<br>CL, MH          | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-95  | 40-70                  | 20-35                    |
|                             | 13-22 | Silty clay, clay,<br>silty clay loam.                    | CH, CL                     | A-7              | 0                              | 100                                  | 100    | 90-100 | 90-95  | 45-70                  | 25-50                    |
|                             | 22-60 | Silty clay loam,<br>silty clay.                          | CH, CL,<br>MH, ML          | A-7              | 0                              | 100                                  | 90-100 | 90-100 | 85-95  | 40-70                  | 15-30                    |
| 236-----<br>Vallers         | 0-13  | Clay loam-----   | OL, CL, ML                 | A-6, A-7         | 0                              | 95-100                               | 95-100 | 95-100 | 85-95  | 30-50                  | 11-20                    |
|                             | 13-26 | Clay loam, silty<br>clay loam, sandy<br>clay loam.       | CL                         | A-6              | 0                              | 95-100                               | 90-100 | 80-95  | 50-80  | 30-40                  | 11-20                    |
|                             | 26-60 | Loam, clay loam  | CL, CL-ML                  | A-4, A-6         | 0                              | 95-100                               | 90-100 | 85-95  | 60-85  | 20-40                  | 5-20                     |
| 246-----<br>Marysland       | 0-18  | Clay loam-----   | CL                         | A-6, A-7         | 0                              | 95-100                               | 95-100 | 85-95  | 50-80  | 30-50                  | 10-25                    |
|                             | 18-38 | Loam, clay loam,<br>sandy clay loam.                     | CL, SC                     | A-6              | 0                              | 90-100                               | 85-100 | 80-95  | 45-80  | 20-40                  | 10-20                    |
|                             | 38-60 | Stratified fine<br>sand to gravelly<br>coarse sand.      | SP-SM, SM                  | A-1, A-2,<br>A-3 | 0                              | 70-95                                | 50-90  | 35-70  | 5-20   | ---                    | NP                       |
| 276-----<br>Oldham          | 0-22  | Silty clay-----  | CL, CH,<br>MH, ML          | A-7              | 0                              | 100                                  | 95-100 | 90-100 | 85-100 | 40-60                  | 15-25                    |
|                             | 22-30 | Silty clay loam,<br>clay loam, silty<br>clay.            | CL, CH,<br>MH, ML          | A-7              | 0                              | 100                                  | 95-100 | 85-100 | 85-100 | 40-60                  | 15-25                    |
|                             | 30-60 | Silty clay loam,<br>silt loam, clay<br>loam.             | CL, CL-ML                  | A-4, A-6,<br>A-7 | 0                              | 100                                  | 95-100 | 85-100 | 70-100 | 25-45                  | 5-20                     |
| 288D-----<br>Esmond         | 0-8   | Loam-----  | ML                         | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                             | 8-60  | Loam, sandy loam,<br>fine sandy loam.                    | ML, SM,<br>SC, CL          | A-4, A-6         | 0-5                            | 90-100                               | 85-100 | 60-100 | 35-90  | 20-40                  | NP-15                    |
| 293A-----<br>Svenoda        | 0-14  | Sandy loam-----  | SM                         | A-2, A-4         | 0                              | 100                                  | 95-100 | 70-100 | 30-50  | 20-30                  | NP-7                     |
|                             | 14-33 | Fine sandy loam,<br>sandy loam.                          | SC-SM, SM,<br>ML, CL-ML    | A-2, A-4         | 0                              | 100                                  | 95-100 | 60-100 | 30-55  | 15-30                  | NP-10                    |
|                             | 33-60 | Silt loam, silty<br>clay loam, loam.                     | CL, CL-ML                  | A-4, A-6,<br>A-7 | 0-5                            | 90-100                               | 90-100 | 75-100 | 50-95  | 25-50                  | 5-30                     |
| 293B-----<br>Svenoda        | 0-13  | Sandy loam-----  | SM                         | A-2, A-4         | 0                              | 100                                  | 95-100 | 70-100 | 30-50  | 20-30                  | NP-7                     |
|                             | 13-23 | Fine sandy loam,<br>sandy loam.                          | SC-SM, SM,<br>ML, CL-ML    | A-2, A-4         | 0                              | 100                                  | 95-100 | 60-100 | 30-60  | 15-30                  | NP-10                    |
|                             | 23-60 | Silt loam, silty<br>clay loam, loam.                     | CL, CL-ML                  | A-4, A-6,<br>A-7 | 0-5                            | 90-100                               | 90-100 | 75-100 | 50-95  | 20-50                  | 5-30                     |
| 296B-----<br>Fram           | 0-8   | Loam-----  | ML                         | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                             | 8-60  | Sandy loam, fine<br>sandy loam,<br>loam.                 | SM, ML                     | A-4              | 0-1                            | 95-100                               | 95-100 | 60-100 | 35-90  | 20-40                  | NP-10                    |
| 314-----<br>Spottswood      | 0-8   | Loam-----  | CL-ML, CL                  | A-4, A-6         | 0                              | 95-100                               | 95-100 | 90-100 | 65-90  | 25-40                  | 5-15                     |
|                             | 8-32  | Clay loam, loam  | CL                         | A-6, A-7         | 0                              | 95-100                               | 95-100 | 85-100 | 55-80  | 30-45                  | 10-20                    |
|                             | 32-60 | Gravelly sand,<br>loamy sand,<br>gravelly loamy<br>sand. | SM, GM,<br>SP-SM,<br>GP-GM | A-1, A-2         | 0-5                            | 40-80                                | 25-75  | 15-70  | 10-30  | <20                    | NP-4                     |

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture   | Classification             |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit<br>Pct | Plas-<br>ticity<br>index |
|--------------------------|-------|--|----------------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|------------------------|--------------------------|
|                          |       |  | Unified                    | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                        |                          |
|                          | In    |  |                            |                  | Pct                            |                                      |        |        |        | Pct                    |                          |
| 339-----<br>Fordville    | 0-8   | Loam-----  | ML, CL                     | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 70-85  | 55-75  | 30-45                  | 5-20                     |
|                          | 8-26  | Loam, silt loam,<br>clay loam.   | CL, ML                     | A-4, A-6,<br>A-7 | 0                              | 100                                  | 95-100 | 70-95  | 55-80  | 30-45                  | 5-20                     |
|                          | 26-33 | Loam, clay loam,<br>fine sandy loam.   | CL, ML,<br>SM, SC          | A-4, A-6         | 0                              | 95-100                               | 90-100 | 65-90  | 40-55  | 25-40                  | 3-15                     |
|                          | 33-60 | Gravelly loamy<br>sand, gravelly<br>sand, very<br>gravelly sand.                   | SW, SW-SM,<br>SM           | A-1              | 0                              | 65-85                                | 45-70  | 15-45  | 0-15   | <25                    | NP-5                     |
| 341-----<br>Arvilla      | 0-10  | Loam-----  | ML, CL-ML,<br>CL           | A-4, A-6         | 0                              | 95-100                               | 90-100 | 70-90  | 50-65  | <30                    | NP-15                    |
|                          | 10-15 | Sandy loam, loam,<br>coarse sandy<br>loam.   | SM, SC,<br>SC-SM           | A-2, A-4,<br>A-6 | 0                              | 90-100                               | 85-100 | 50-80  | 20-45  | <40                    | NP-15                    |
|                          | 15-60 | Gravelly coarse<br>sand, coarse<br>sand, very<br>gravelly coarse<br>sand.          | SP-SM, GP,<br>SM, GP-GM    | A-1, A-2,<br>A-3 | 0                              | 35-100                               | 25-100 | 10-60  | 0-15   | ---                    | NP                       |
| 344-----<br>Bigstone     | 0-22  | Silty clay loam  | CL, ML, OL                 | A-7              | 0                              | 100                                  | 100    | 80-100 | 80-100 | 37-43                  | 15-21                    |
|                          | 22-45 | Silty clay loam,<br>silt loam.   | CL, ML                     | A-7, A-6         | 0                              | 100                                  | 95-98  | 45-90  | 50-90  | 30-43                  | 11-21                    |
|                          | 45-60 | Clay loam, loam  | CL, ML                     | A-7, A-6         | 0                              | 100                                  | 90-98  | 45-90  | 50-80  | 30-41                  | 11-20                    |
| 347-----<br>Malachy      | 0-19  | Loam-----  | ML                         | A-4              | 0                              | 100                                  | 95-100 | 80-95  | 50-75  | 25-35                  | 1-10                     |
|                          | 19-33 | Loam, fine sandy<br>loam, sandy<br>loam.   | SM, ML,<br>SC, CL          | A-4              | 0                              | 100                                  | 95-100 | 60-95  | 35-75  | 15-35                  | NP-10                    |
|                          | 33-60 | Fine sand, sand,<br>loamy coarse<br>sand.  | SM, SP-SM                  | A-1, A-2,<br>A-3 | 0                              | 95-100                               | 90-100 | 30-80  | 5-35   | <20                    | NP                       |
| 373B-----<br>Renshaw     | 0-10  | Loam-----  | ML, CL                     | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 70-100 | 50-75  | 30-40                  | 5-15                     |
|                          | 10-17 | Loam, sandy clay<br>loam, gravelly<br>loam.  | SC-SM, SC,<br>ML, CL       | A-4, A-6         | 0-5                            | 95-100                               | 55-100 | 45-90  | 35-70  | 20-40                  | 3-15                     |
|                          | 17-60 | Gravelly loamy<br>sand, very<br>gravelly loamy<br>sand, gravelly<br>sand.          | SW, SM,<br>SW-SM,<br>GW-GM | A-1, A-2         | 0-5                            | 45-95                                | 30-80  | 10-60  | 0-15   | <25                    | NP-5                     |
| 402B, 402E-----<br>Sioux | 0-8   | Loam-----  | ML, CL                     | A-4, A-6         | 0-5                            | 95-100                               | 85-100 | 70-90  | 55-75  | 30-40                  | 5-15                     |
|                          | 8-12  | Gravelly loam,<br>gravelly sandy<br>loam, gravelly<br>loamy sand.                  | SM, GM                     | A-4, A-2,<br>A-1 | 0-5                            | 60-90                                | 50-80  | 45-70  | 15-50  | 20-35                  | NP-7                     |
|                          | 12-60 | Extremely<br>gravelly sand,<br>very gravelly<br>loamy sand, very<br>gravelly sand. | GM, GP,<br>SM, SP          | A-1              | 0                              | 25-75                                | 20-60  | 5-35   | 0-25   | <25                    | NP-5                     |

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture   | Classification       |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit<br>Pct | Plas-<br>ticity<br>index |
|--------------------------|-------|--|----------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|------------------------|--------------------------|
|                          |       |  | Unified              | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                        |                          |
|                          | In    |  |                      |                  | Pct                            |                                      |        |        |        | Pct                    |                          |
| 410-----<br>Athelwold    | 0-18  | Silt loam-----   | CL, ML               | A-6, A-7,<br>A-4 | 0                              | 100                                  | 100    | 95-100 | 85-100 | 30-45                  | 5-20                     |
|                          | 18-25 | Silty clay loam,<br>silt loam.                                   | CL                   | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 85-100 | 30-50                  | 10-25                    |
|                          | 25-35 | Silty clay loam,<br>silt loam.                                   | CL                   | A-6, A-7         | 0                              | 100                                  | 95-100 | 90-100 | 85-100 | 30-50                  | 10-25                    |
|                          | 35-60 | Gravelly sand,<br>gravelly loamy<br>sand, very<br>gravelly sand. | SW, SM,<br>GW, GM    | A-1              | 0                              | 40-80                                | 30-70  | 20-50  | 0-15   | <25                    | NP-5                     |
| 418-----<br>Lamoure      | 0-8   | Silty clay loam  | CL, CH,<br>MH, ML    | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-100 | 40-70                  | 15-35                    |
|                          | 8-36  | Silty clay loam,<br>silt loam.                                   | CL, CH,<br>MH, ML    | A-7, A-6         | 0                              | 100                                  | 100    | 90-100 | 60-100 | 40-70                  | 15-35                    |
|                          | 36-45 | Silty clay loam,<br>silt loam, loam.                             | CL, ML               | A-6, A-7         | 0                              | 95-100                               | 95-100 | 90-100 | 60-100 | 30-70                  | 10-35                    |
|                          | 45-60 | Stratified sandy<br>loam to silty<br>clay loam.                  | CL, SC               | A-6, A-7         | 0                              | 95-100                               | 95-100 | 70-95  | 35-90  | 30-70                  | 10-35                    |
| 437D-----<br>Buse        | 0-8   | Clay loam-----   | CL, ML               | A-6, A-7         | 0                              | 90-100                               | 85-95  | 70-95  | 55-90  | 35-45                  | 10-20                    |
|                          | 8-60  | Loam, clay loam  | CL, CL-ML,<br>ML     | A-4, A-6,<br>A-7 | 0                              | 90-100                               | 85-100 | 70-90  | 55-85  | 25-45                  | 5-20                     |
| 450-----<br>Rauville     | 0-21  | Silty clay loam  | CL, CH, MH           | A-6, A-7         | 0                              | 100                                  | 100    | 90-100 | 85-100 | 35-60                  | 15-28                    |
|                          | 21-60 | Silty clay loam,<br>silt loam.                                   | CL, CH, MH           | A-6, A-7         | 0                              | 100                                  | 100    | 90-100 | 85-100 | 35-60                  | 15-28                    |
| 494B-----<br>Darnen      | 0-16  | Loam-----  | OL, ML,<br>CL, CL-ML | A-4              | 0                              | 100                                  | 100    | 85-100 | 60-90  | 20-35                  | 2-10                     |
|                          | 16-34 | Loam, clay loam  | CL, CL-ML            | A-4, A-6,<br>A-7 | 0                              | 100                                  | 100    | 85-100 | 60-90  | 20-45                  | 5-25                     |
|                          | 34-60 | Loam, clay loam  | CL, CL-ML            | A-4, A-6,<br>A-7 | 0                              | 90-100                               | 90-100 | 80-95  | 60-85  | 20-45                  | 5-25                     |
| 694B-----<br>Zell        | 0-8   | Silt loam-----   | CL, ML               | A-4, A-6         | 0                              | 100                                  | 95-100 | 85-100 | 80-100 | 30-40                  | 5-15                     |
|                          | 8-16  | Silt loam, very<br>fine sandy loam,<br>loam.                     | CL, CL-ML            | A-4, A-6         | 0                              | 100                                  | 95-100 | 85-100 | 70-100 | 25-40                  | 5-15                     |
|                          | 16-60 | Silt loam, very<br>fine sandy loam,<br>loam.                     | ML, CL-ML            | A-4              | 0                              | 100                                  | 95-100 | 85-100 | 60-100 | <25                    | NP-7                     |
| 698-----<br>Doran        | 0-8   | Clay loam-----   | CH, CL               | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 65-95  | 30-60                  | 11-35                    |
|                          | 8-20  | Clay, clay loam,<br>silty clay.                                  | CH, CL               | A-7, A-6         | 0                              | 100                                  | 95-100 | 90-100 | 70-95  | 35-75                  | 15-50                    |
|                          | 20-32 | Clay loam-----   | CL                   | A-6, A-7         | 0-3                            | 100                                  | 95-100 | 85-100 | 70-80  | 30-50                  | 11-30                    |
|                          | 32-60 | Clay loam, loam  | CL                   | A-6, A-7         | 0-3                            | 95-100                               | 85-100 | 70-100 | 50-80  | 25-50                  | 11-30                    |
| 787:<br>Fram-----        | 0-8   | Loam-----  | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                          | 8-60  | Sandy loam, fine<br>sandy loam,<br>loam.                         | SM, ML               | A-4              | 0-1                            | 95-100                               | 95-100 | 60-100 | 35-90  | 20-40                  | NP-10                    |
| Valliers-----            | 0-13  | Clay loam-----   | OL, CL, ML           | A-6, A-7         | 0                              | 95-100                               | 95-100 | 95-100 | 85-95  | 30-50                  | 11-20                    |
|                          | 13-26 | Clay loam, silty<br>clay loam, sandy<br>clay loam.               | CL                   | A-6              | 0                              | 95-100                               | 90-100 | 80-95  | 50-80  | 30-40                  | 11-20                    |
|                          | 26-60 | Loam, clay loam  | CL, CL-ML            | A-4, A-6         | 0                              | 95-100                               | 90-100 | 85-95  | 60-85  | 20-40                  | 5-20                     |

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture  | Classification       |                  | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |        |        |        | Liquid<br>limit<br>Pct | Plas-<br>ticity<br>index |
|--------------------------|-------|---|----------------------|------------------|--------------------------------|--------------------------------------|--------|--------|--------|------------------------|--------------------------|
|                          |       |   | Unified              | AASHTO           |                                | 4                                    | 10     | 40     | 200    |                        |                          |
|                          | In    |   |                      |                  | Pct                            |                                      |        |        |        | Pct                    |                          |
| 787:                     |       |   |                      |                  |                                |                                      |        |        |        |                        |                          |
| Parnell-----             | 0-20  | Silty clay loam   | CL, CH               | A-7              | 0                              | 100                                  | 100    | 95-100 | 85-100 | 40-60                  | 15-30                    |
|                          | 20-50 | Clay loam, silty<br>clay loam, silty<br>clay.           | CL, CH               | A-7              | 0                              | 100                                  | 95-100 | 90-100 | 70-100 | 40-80                  | 20-50                    |
|                          | 50-60 | Clay loam, silty<br>clay loam, silty<br>clay.           | CL, CH               | A-6, A-7         | 0                              | 95-100                               | 90-100 | 80-95  | 70-95  | 30-80                  | 15-50                    |
| 814:                     |       |   |                      |                  |                                |                                      |        |        |        |                        |                          |
| Hamerly-----             | 0-8   | Loam-----   | CL, CL-ML            | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-90  | 20-40                  | 5-20                     |
|                          | 8-28  | Loam, clay loam   | CL, CL-ML            | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-75  | 20-45                  | 5-25                     |
|                          | 28-60 | Loam, clay loam   | CL, CL-ML            | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 75-95  | 55-75  | 20-45                  | 5-25                     |
| Lindaas-----             | 0-12  | Silty clay loam   | CL                   | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 75-95  | 30-50                  | 11-25                    |
|                          | 12-26 | Silty clay, clay  | CH                   | A-7              | 0                              | 100                                  | 100    | 95-100 | 80-95  | 50-70                  | 25-45                    |
|                          | 26-36 | Silt loam, silty<br>clay loam, clay<br>loam.            | CL                   | A-6, A-7         | 0                              | 100                                  | 100    | 95-100 | 75-95  | 30-50                  | 11-25                    |
|                          | 36-60 | Silt loam, very<br>fine sandy loam,<br>silty clay loam. | CL, CL-ML            | A-4, A-6         | 0                              | 100                                  | 100    | 85-100 | 55-95  | 20-40                  | 5-20                     |
| 827B:                    |       |   |                      |                  |                                |                                      |        |        |        |                        |                          |
| Esmond-----              | 0-8   | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                          | 8-60  | Loam, sandy loam,<br>fine sandy loam.                   | ML, SM,<br>SC, CL    | A-4, A-6         | 0-5                            | 90-100                               | 85-100 | 60-100 | 35-90  | 20-40                  | NP-15                    |
| Heimdal-----             | 0-8   | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                          | 8-13  | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-95  | 60-75  | 20-40                  | NP-10                    |
|                          | 13-60 | Loam, sandy loam  | ML, SM,<br>CL, CL-ML | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 60-100 | 35-90  | 20-40                  | NP-15                    |
| 827C2:                   |       |   |                      |                  |                                |                                      |        |        |        |                        |                          |
| Esmond-----              | 0-8   | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                          | 8-60  | Loam, sandy loam,<br>fine sandy loam.                   | ML, SM,<br>SC, CL    | A-4, A-6         | 0-5                            | 90-100                               | 85-100 | 60-100 | 35-90  | 20-40                  | NP-15                    |
| Heimdal-----             | 0-8   | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-100 | 60-90  | 20-40                  | NP-10                    |
|                          | 8-10  | Loam-----   | ML                   | A-4              | 0-1                            | 95-100                               | 95-100 | 85-95  | 60-75  | 20-40                  | NP-10                    |
|                          | 10-60 | Loam, sandy loam  | ML, SM,<br>CL, CL-ML | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 60-100 | 35-90  | 20-40                  | NP-15                    |
| 900:                     |       |   |                      |                  |                                |                                      |        |        |        |                        |                          |
| Hamerly-----             | 0-8   | Loam-----   | CL, CL-ML            | A-4, A-6         | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-90  | 20-40                  | 5-20                     |
|                          | 8-28  | Loam, clay loam   | CL, CL-ML            | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 80-95  | 60-75  | 20-45                  | 5-25                     |
|                          | 28-60 | Loam, clay loam   | CL, CL-ML            | A-4, A-6,<br>A-7 | 0-5                            | 95-100                               | 90-100 | 75-95  | 55-75  | 20-45                  | 5-25                     |
| Aazdahl-----             | 0-11  | Clay loam-----  | CL                   | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-100 | 75-90  | 35-50                  | 15-30                    |
|                          | 11-15 | Clay loam, silty<br>clay loam.                          | CL                   | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50                  | 15-30                    |
|                          | 15-60 | Clay loam, silty<br>clay loam, loam.                    | CL                   | A-7, A-6         | 0-3                            | 95-100                               | 90-100 | 85-95  | 70-80  | 35-50                  | 15-30                    |



TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth                           | USDA texture   | Classification                   |   | Frag-<br>ments<br>>3<br>inches | Percentage passing<br>sieve number-- |                          |                                      |                                  | Liquid<br>limit<br>Pct           | Plas-<br>ticity<br>index        |
|--------------------------|---------------------------------|--|----------------------------------|---|--------------------------------|--------------------------------------|--------------------------|--------------------------------------|----------------------------------|----------------------------------|---------------------------------|
|                          |                                 |  | Unified                          | AASHTO                                  |                                | 4                                    | 10                       | 40                                   | 200                              |                                  |                                 |
| 1030:<br>Pits.           | In                              |  |                                  |   | Pct                            |                                      |                          |                                      |                                  | Pct                              |                                 |
| 1817F-----<br>Esmond     | 0-10<br>10-60                   | Loam-----<br>Loam, sandy loam,<br>fine sandy loam.   | ML<br>ML, SM,<br>SC, CL          | A-4<br>A-4, A-6                         | 1-15<br>1-10                   | 95-100<br>90-100                     | 95-100<br>85-100         | 85-100<br>60-100                     | 60-90<br>35-90                   | 20-40<br>20-40                   | NP-10<br>NP-15                  |
| 1916-----<br>Lindaas     | 0-12<br>12-26<br>26-36<br>36-60 | Silty clay loam<br>Silty clay, clay<br>Silt loam, silty<br>clay loam, clay<br>loam.<br>Silt loam, very<br>fine sandy loam,<br>silty clay loam. | CL<br>CH<br>CL<br>CL, CL-ML      | A-6, A-7<br>A-7<br>A-6, A-7<br>A-4, A-6 | 0<br>0<br>0<br>0               | 100<br>100<br>100<br>100             | 100<br>100<br>100<br>100 | 95-100<br>95-100<br>95-100<br>85-100 | 75-95<br>80-95<br>75-95<br>55-95 | 30-50<br>50-70<br>30-50<br>20-40 | 11-25<br>25-45<br>11-25<br>5-20 |
| 1940-----<br>Bigstone    | 0-30<br>30-36<br>36-60          | Silty clay loam<br>Silty clay loam,<br>silt loam.<br>Clay loam, loam   | CL, ML, OL<br>CL, ML<br>CL, ML   | A-7<br>A-7, A-6<br>A-7, A-6             | 0<br>0<br>0                    | 100<br>100<br>100                    | 100<br>95-98<br>90-98    | 80-100<br>45-90<br>45-90             | 80-100<br>50-90<br>50-80         | 37-43<br>30-43<br>30-41          | 15-21<br>11-21<br>11-20         |
| 1949-----<br>Gardena     | 0-21<br>21-60                   | Silt loam-----<br>Silt loam, very<br>fine sandy loam,<br>loam.   | ML, CL<br>ML, CL-ML,<br>CL       | A-4, A-6<br>A-4, A-6                    | 0<br>0                         | 100<br>100                           | 100<br>100               | 75-100<br>75-100                     | 60-100<br>55-100                 | 25-40<br>20-40                   | NP-15<br>NP-15                  |
| 1994-----<br>Embden      | 0-8<br>8-40<br>40-60            | Loam-----<br>Fine sandy loam,<br>sandy loam.<br>Fine sandy loam,<br>sandy loam,<br>loamy fine sand.  | ML, CL-ML,<br>CL<br>SM, ML<br>SM | A-4<br>A-2, A-4<br>A-2, A-4             | 0<br>0<br>0                    | 100<br>100<br>100                    | 100<br>100<br>100        | 85-95<br>60-85<br>50-80              | 55-70<br>30-50<br>15-50          | 15-35<br>---<br>---              | NP-10<br>NP<br>NP               |

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

| Soil name and<br>map symbol | Depth |       | Clay<br>Pct | Moist<br>bulk<br>density<br>g/cc | Permeability<br>in/hr | Available<br>water<br>capacity<br>In/in |          | Soil<br>reaction<br>pH | Shrink-swell<br>potential | Erosion<br>factors<br>K T |      | Wind<br>erodi-<br>bility<br>group | Organic<br>matter<br>Pct |
|-----------------------------|-------|-------|-------------|----------------------------------|-----------------------|---|----------|------------------------|---------------------------|---------------------------|------|-----------------------------------|--------------------------|
|                             | In    | Pct   |             |                                  |                       | In/in                                   | pH       |                        |                           | K                         | T    |                                   |                          |
| 26-----<br>Aazdahl          | 0-11  | 27-35 | 1.30-1.50   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.3                                 | Moderate | 0.24                   | 5                         | 6                         | 4-6  |                                   |                          |
|                             | 11-15 | 27-35 | 1.40-1.60   | 0.2-0.6                          | 0.17-0.19             | 6.6-7.8                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
|                             | 15-60 | 24-35 | 1.50-1.65   | 0.2-0.6                          | 0.14-0.17             | 7.4-8.4                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
| 34-----<br>Parnell          | 0-20  | 27-40 | 1.20-1.30   | 0.2-0.6                          | 0.18-0.22             | 6.1-7.8                                 | Moderate | 0.28                   | 5                         | 7                         | 6-10 |                                   |                          |
|                             | 20-50 | 35-60 | 1.20-1.30   | 0.06-0.2                         | 0.13-0.19             | 6.1-7.8                                 | High     | 0.28                   |                           |                           |      |                                   |                          |
|                             | 50-60 | 35-45 | 1.20-1.40   | 0.06-0.2                         | 0.11-0.19             | 6.6-8.4                                 | High     | 0.28                   |                           |                           |      |                                   |                          |
| 36-----<br>Flom             | 0-14  | 27-35 | 1.25-1.45   | 0.2-0.6                          | 0.18-0.22             | 6.1-7.8                                 | Moderate | 0.28                   | 5                         | 7                         | 5-8  |                                   |                          |
|                             | 14-20 | 24-35 | 1.45-1.60   | 0.2-0.6                          | 0.15-0.19             | 6.6-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 20-60 | 24-35 | 1.55-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
| 51-----<br>La Prairie       | 0-8   | 18-27 | 1.10-1.40   | 0.6-2.0                          | 0.17-0.22             | 6.6-8.4                                 | Low      | 0.28                   | 5                         | 6                         | 2-6  |                                   |                          |
|                             | 8-16  | 18-35 | 1.10-1.50   | 0.6-2.0                          | 0.17-0.22             | 6.6-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 16-29 | 18-35 | 1.30-1.70   | 0.6-2.0                          | 0.15-0.22             | 6.6-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 29-60 | 18-30 | 1.30-1.70   | 0.6-2.0                          | 0.15-0.22             | 6.6-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
| 60-----<br>Glyndon          | 0-11  | 27-35 | 1.25-1.40   | 0.6-2.0                          | 0.18-0.22             | 7.4-9.0                                 | Moderate | 0.28                   | 5                         | 4L                        | 4-8  |                                   |                          |
|                             | 11-24 | 10-18 | 1.30-1.50   | 0.6-6.0                          | 0.17-0.20             | 7.4-9.0                                 | Low      | 0.43                   |                           |                           |      |                                   |                          |
|                             | 24-60 | 5-18  | 1.35-1.65   | 2.0-6.0                          | 0.15-0.19             | 7.4-9.0                                 | Low      | 0.43                   |                           |                           |      |                                   |                          |
| 70-----<br>Svea             | 0-13  | 18-26 | 1.10-1.30   | 0.6-2.0                          | 0.20-0.24             | 6.1-7.8                                 | Low      | 0.28                   | 5                         | 6                         | 5-8  |                                   |                          |
|                             | 13-17 | 18-28 | 1.20-1.50   | 0.6-2.0                          | 0.17-0.22             | 6.6-7.8                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 17-60 | 18-28 | 1.20-1.50   | 0.2-2.0                          | 0.14-0.19             | 7.4-8.4                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
| 127B-----<br>Sverdrup       | 0-8   | 10-18 | 1.35-1.50   | 2.0-6.0                          | 0.13-0.15             | 6.1-7.3                                 | Low      | 0.20                   | 4                         | 3                         | 2-4  |                                   |                          |
|                             | 8-18  | 6-18  | 1.40-1.55   | 2.0-6.0                          | 0.08-0.14             | 6.1-7.8                                 | Low      | 0.20                   |                           |                           |      |                                   |                          |
|                             | 18-60 | 0-10  | 1.50-1.65   | 6.0-20                           | 0.02-0.06             | 7.4-8.4                                 | Low      | 0.15                   |                           |                           |      |                                   |                          |
| 137-----<br>Dovray          | 0-8   | 40-60 | 1.20-1.30   | 0.06-0.6                         | 0.14-0.18             | 6.1-7.8                                 | High     | 0.28                   | 5                         | 4                         | 5-15 |                                   |                          |
|                             | 8-24  | 40-60 | 1.20-1.30   | 0.06-0.2                         | 0.13-0.16             | 6.1-7.8                                 | High     | 0.28                   |                           |                           |      |                                   |                          |
|                             | 24-36 | 40-60 | 1.20-1.30   | <0.2                             | 0.10-0.14             | 6.6-7.8                                 | High     | 0.28                   |                           |                           |      |                                   |                          |
|                             | 36-60 | 25-60 | 1.20-1.60   | <0.6                             | 0.10-0.18             | 6.6-8.4                                 | High     | 0.28                   |                           |                           |      |                                   |                          |
| 141A-----<br>Egeland        | 0-8   | 10-18 | 1.25-1.35   | 2.0-6.0                          | 0.11-0.17             | 5.6-7.3                                 | Low      | 0.20                   | 5                         | 3                         | 1-3  |                                   |                          |
|                             | 8-32  | 10-18 | 1.30-1.45   | 2.0-6.0                          | 0.09-0.15             | 6.1-7.8                                 | Low      | 0.20                   |                           |                           |      |                                   |                          |
|                             | 32-60 | 5-10  | 1.40-1.65   | 2.0-6.0                          | 0.08-0.10             | 6.6-8.4                                 | Low      | 0.20                   |                           |                           |      |                                   |                          |
| 141B-----<br>Egeland        | 0-8   | 10-18 | 1.25-1.35   | 2.0-6.0                          | 0.11-0.17             | 5.6-7.3                                 | Low      | 0.20                   | 5                         | 3                         | 1-3  |                                   |                          |
|                             | 8-27  | 10-18 | 1.30-1.45   | 2.0-6.0                          | 0.09-0.15             | 6.1-7.8                                 | Low      | 0.20                   |                           |                           |      |                                   |                          |
|                             | 27-60 | 5-10  | 1.40-1.65   | 2.0-6.0                          | 0.08-0.10             | 6.6-8.4                                 | Low      | 0.20                   |                           |                           |      |                                   |                          |
| 171B-----<br>Formdale       | 0-10  | 27-35 | 1.30-1.50   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.3                                 | Moderate | 0.24                   | 5                         | 6                         | 2-5  |                                   |                          |
|                             | 10-14 | 24-35 | 1.40-1.60   | 0.2-0.6                          | 0.17-0.19             | 6.6-7.8                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
|                             | 14-60 | 18-35 | 1.50-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
| 180-----<br>Gonvick         | 0-8   | 10-27 | 1.30-1.45   | 0.6-2.0                          | 0.20-0.22             | 6.1-7.3                                 | Moderate | 0.24                   | 5                         | 6                         | 2-5  |                                   |                          |
|                             | 8-25  | 22-35 | 1.35-1.50   | 0.6-2.0                          | 0.15-0.19             | 6.6-7.3                                 | Moderate | 0.32                   |                           |                           |      |                                   |                          |
|                             | 25-60 | 18-35 | 1.40-1.65   | 0.6-2.0                          | 0.15-0.19             | 7.4-8.4                                 | Low      | 0.32                   |                           |                           |      |                                   |                          |
| 184A-----<br>Hamerly        | 0-8   | 18-27 | 1.30-1.60   | 0.6-2.0                          | 0.18-0.24             | 6.6-8.4                                 | Moderate | 0.28                   | 5                         | 4L                        | 4-7  |                                   |                          |
|                             | 8-28  | 18-35 | 1.20-1.60   | 0.6-2.0                          | 0.15-0.19             | 7.4-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 28-60 | 18-35 | 1.30-1.60   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |
| 184B-----<br>Hamerly        | 0-8   | 18-27 | 1.30-1.60   | 0.6-2.0                          | 0.18-0.24             | 6.6-8.4                                 | Moderate | 0.28                   | 5                         | 4L                        | 4-7  |                                   |                          |
|                             | 8-20  | 18-35 | 1.20-1.60   | 0.6-2.0                          | 0.15-0.19             | 7.4-8.4                                 | Moderate | 0.28                   |                           |                           |      |                                   |                          |
|                             | 20-60 | 18-35 | 1.30-1.60   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate | 0.37                   |                           |                           |      |                                   |                          |

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth |       | Clay<br>Pct | Moist<br>bulk<br>density<br>g/cc | Permeability<br>In/hr | Available<br>water<br>capacity<br>In/in | Soil<br>reaction<br>pH | Shrink-swell<br>potential | Erosion factors |    | Wind<br>erodi-<br>bility<br>group | Organic<br>matter<br>Pct |
|--------------------------|-------|-------|-------------|----------------------------------|-----------------------|---|------------------------|---------------------------|-----------------|----|-----------------------------------|--------------------------|
|                          | In    | Pct   |             |                                  |                       |   |                        |                           | K               | T  |                                   |                          |
| 185B-----<br>Hattie      | 0-15  | 40-60 | 1.30-1.40   | 0.06-0.2                         | 0.16-0.22             | 7.4-8.4                                 | High-----              | 0.28                      | 5               | 4  | 2-5                               |                          |
|                          | 15-60 | 35-60 | 1.30-1.45   | 0.06-0.2                         | 0.12-0.16             | 7.4-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |
| 185C-----<br>Hattie      | 0-9   | 40-60 | 1.30-1.40   | 0.06-0.2                         | 0.16-0.22             | 7.4-8.4                                 | High-----              | 0.28                      | 5               | 4  | 2-5                               |                          |
|                          | 9-60  | 40-60 | 1.30-1.45   | 0.06-0.2                         | 0.12-0.16             | 7.4-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |
| 192A-----<br>Estelline   | 0-8   | 20-27 | 1.10-1.25   | 0.6-2.0                          | 0.19-0.22             | 6.1-7.3                                 | Moderate----           | 0.32                      | 4               | 6  | 4-8                               |                          |
|                          | 8-22  | 22-30 | 1.20-1.35   | 0.6-2.0                          | 0.18-0.21             | 6.1-7.8                                 | Moderate----           | 0.32                      |                 |    |                                   |                          |
|                          | 22-28 | 20-30 | 1.25-1.40   | 0.6-2.0                          | 0.16-0.20             | 7.4-8.4                                 | Low-----               | 0.32                      |                 |    |                                   |                          |
|                          | 28-60 | 0-5   | 1.50-1.70   | 6.0-20                           | 0.03-0.06             | 7.4-8.4                                 | Low-----               | 0.10                      |                 |    |                                   |                          |
| 192B-----<br>Estelline   | 0-8   | 20-27 | 1.10-1.25   | 0.6-2.0                          | 0.19-0.22             | 6.1-7.3                                 | Moderate----           | 0.32                      | 4               | 6  | 4-8                               |                          |
|                          | 8-18  | 22-30 | 1.20-1.35   | 0.6-2.0                          | 0.18-0.21             | 6.1-7.8                                 | Moderate----           | 0.32                      |                 |    |                                   |                          |
|                          | 18-24 | 20-30 | 1.25-1.40   | 0.6-2.0                          | 0.16-0.20             | 7.4-8.4                                 | Low-----               | 0.32                      |                 |    |                                   |                          |
|                          | 24-60 | 0-5   | 1.50-1.70   | 6.0-20                           | 0.03-0.06             | 7.4-8.4                                 | Low-----               | 0.10                      |                 |    |                                   |                          |
| 210-----<br>Fulda        | 0-13  | 40-50 | 1.20-1.30   | 0.06-0.2                         | 0.14-0.20             | 6.6-7.3                                 | High-----              | 0.28                      | 5               | 4  | 5-10                              |                          |
|                          | 13-22 | 35-60 | 1.20-1.35   | 0.06-0.6                         | 0.13-0.16             | 7.4-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |
|                          | 22-60 | 30-50 | 1.20-1.40   | 0.2-0.6                          | 0.16-0.19             | 7.9-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |
| 236-----<br>Vallers      | 0-13  | 28-35 | 1.20-1.35   | 0.2-0.6                          | 0.18-0.22             | 7.4-8.4                                 | Moderate----           | 0.28                      | 5               | 4L | 5-8                               |                          |
|                          | 13-26 | 18-35 | 1.40-1.55   | 0.2-0.6                          | 0.15-0.19             | 7.4-8.4                                 | Moderate----           | 0.28                      |                 |    |                                   |                          |
|                          | 26-60 | 18-35 | 1.50-1.70   | 0.2-0.6                          | 0.17-0.19             | 7.4-8.4                                 | Low-----               | 0.28                      |                 |    |                                   |                          |
| 246-----<br>Marysland    | 0-18  | 27-30 | 1.20-1.30   | 0.6-2.0                          | 0.17-0.22             | 7.9-8.4                                 | Moderate----           | 0.28                      | 4               | 4L | 5-8                               |                          |
|                          | 18-38 | 18-30 | 1.35-1.50   | 0.6-2.0                          | 0.15-0.19             | 7.9-8.4                                 | Moderate----           | 0.28                      |                 |    |                                   |                          |
|                          | 38-60 | 1-5   | 1.55-1.65   | >6.0                             | 0.02-0.07             | 7.9-8.4                                 | Low-----               | 0.15                      |                 |    |                                   |                          |
| 276-----<br>Oldham       | 0-22  | 40-45 | 1.15-1.30   | 0.06-0.2                         | 0.13-0.19             | 6.6-7.8                                 | High-----              | 0.28                      | 5               | 4  | 4-7                               |                          |
|                          | 22-30 | 35-45 | 1.25-1.40   | 0.06-0.6                         | 0.14-0.20             | 7.4-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |
|                          | 30-60 | 20-40 | 1.30-1.50   | 0.06-0.6                         | 0.14-0.20             | 7.4-8.4                                 | Moderate----           | 0.43                      |                 |    |                                   |                          |
| 288D-----<br>Esmond      | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.22             | 7.4-8.4                                 | Low-----               | 0.28                      | 5               | 4L | 1-4                               |                          |
|                          | 8-60  | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.14-0.22             | 7.4-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| 293A-----<br>Swenoda     | 0-14  | 10-20 | 1.25-1.35   | 2.0-6.0                          | 0.11-0.17             | 6.1-7.3                                 | Low-----               | 0.20                      | 5               | 3  | 2-7                               |                          |
|                          | 14-33 | 10-18 | 1.30-1.45   | 2.0-6.0                          | 0.11-0.17             | 6.6-7.8                                 | Low-----               | 0.20                      |                 |    |                                   |                          |
|                          | 33-60 | 20-35 | 1.35-1.65   | 0.2-2.0                          | 0.17-0.20             | 7.4-8.4                                 | Moderate----           | 0.37                      |                 |    |                                   |                          |
| 293B-----<br>Swenoda     | 0-13  | 10-20 | 1.25-1.35   | 2.0-6.0                          | 0.11-0.17             | 6.1-7.3                                 | Low-----               | 0.20                      | 5               | 3  | 2-7                               |                          |
|                          | 13-23 | 10-18 | 1.30-1.45   | 2.0-6.0                          | 0.11-0.17             | 6.6-7.8                                 | Low-----               | 0.20                      |                 |    |                                   |                          |
|                          | 23-60 | 20-35 | 1.35-1.65   | 0.2-2.0                          | 0.17-0.20             | 7.4-7.8                                 | Moderate----           | 0.37                      |                 |    |                                   |                          |
| 296B-----<br>Fram        | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.24             | 7.4-8.4                                 | Low-----               | 0.28                      | 5               | 4L | 4-9                               |                          |
|                          | 8-60  | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.13-0.20             | 7.4-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| 314-----<br>Spottswood   | 0-8   | 20-26 | 1.15-1.30   | 0.6-2.0                          | 0.18-0.22             | 6.1-7.3                                 | Low-----               | 0.24                      | 4               | 6  | 4-8                               |                          |
|                          | 8-32  | 18-30 | 1.25-1.40   | 0.6-2.0                          | 0.18-0.22             | 6.6-7.8                                 | Moderate----           | 0.24                      |                 |    |                                   |                          |
|                          | 32-60 | 2-8   | 1.50-1.70   | 6.0-20                           | 0.03-0.06             | 7.4-9.0                                 | Low-----               | 0.10                      |                 |    |                                   |                          |
| 339-----<br>Fordville    | 0-8   | 18-25 | 1.20-1.30   | 0.6-2.0                          | 0.18-0.20             | 6.1-7.3                                 | Low-----               | 0.24                      | 4               | 6  | 3-7                               |                          |
|                          | 8-26  | 18-30 | 1.25-1.40   | 0.6-2.0                          | 0.18-0.21             | 6.1-7.8                                 | Moderate----           | 0.24                      |                 |    |                                   |                          |
|                          | 26-33 | 15-30 | 1.25-1.45   | 0.6-6.0                          | 0.12-0.18             | 6.1-8.4                                 | Low-----               | 0.24                      |                 |    |                                   |                          |
|                          | 33-60 | 0-5   | 1.60-1.80   | 6.0-20                           | 0.03-0.06             | 7.4-8.4                                 | Low-----               | 0.10                      |                 |    |                                   |                          |
| 341-----<br>Arvilla      | 0-10  | 10-18 | 1.40-1.60   | 2.0-6.0                          | 0.16-0.18             | 6.6-8.4                                 | Low-----               | 0.20                      | 3               | 5  | 1-4                               |                          |
|                          | 10-15 | 6-18  | 1.40-1.60   | 2.0-6.0                          | 0.11-0.14             | 6.6-8.4                                 | Low-----               | 0.20                      |                 |    |                                   |                          |
|                          | 15-60 | 2-10  | 1.40-1.60   | >6.0                             | 0.02-0.05             | 7.4-8.4                                 | Low-----               | 0.10                      |                 |    |                                   |                          |
| 344-----<br>Bigstone     | 0-22  | 28-35 | 1.00-1.35   | 0.2-0.6                          | 0.18-0.22             | 7.4-8.4                                 | Moderate----           | 0.28                      | 5               | 4L | 6-15                              |                          |
|                          | 22-45 | 20-35 | 1.35-1.50   | 0.2-2.0                          | 0.16-0.22             | 7.4-8.4                                 | Moderate----           | 0.28                      |                 |    |                                   |                          |
|                          | 45-60 | 20-32 | 1.35-1.50   | 0.2-2.0                          | 0.14-0.19             | 7.4-8.4                                 | Moderate----           | 0.37                      |                 |    |                                   |                          |

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and<br>map symbol | Depth |       | Moist<br>bulk<br>density | Permeability | Available<br>water<br>capacity | Soil<br>reaction<br>pH | Shrink-swell<br>potential | Erosion factors |   | Wind<br>erodi-<br>bility<br>group | Organic<br>matter<br>Pct |
|-----------------------------|-------|-------|--------------------------|--------------|--------------------------------|------------------------|---------------------------|-----------------|---|-----------------------------------|--------------------------|
|                             | In    | Pct   |                          |              |                                |                        |                           | K               | T |                                   |                          |
| 347-----<br>Malachy         | 0-19  | 10-22 | 1.25-1.40                | 0.6-2.0      | 0.20-0.22                      | 7.4-7.8                | Low-----                  | 0.20            | 4 | 5                                 | 3-6                      |
|                             | 19-33 | 10-18 | 1.35-1.50                | 0.6-6.0      | 0.12-0.19                      | 7.4-7.8                | Low-----                  | 0.20            |   |                                   |                          |
|                             | 33-60 | 2-10  | 1.45-1.65                | 6.0-20       | 0.02-0.07                      | 7.4-7.8                | Low-----                  | 0.20            |   |                                   |                          |
| 373B-----<br>Renshaw        | 0-10  | 20-26 | 1.20-1.30                | 0.6-2.0      | 0.18-0.20                      | 6.1-7.8                | Low-----                  | 0.28            | 3 | 6                                 | 2-4                      |
|                             | 10-17 | 18-27 | 1.30-1.45                | 0.6-6.0      | 0.11-0.18                      | 6.6-8.4                | Low-----                  | 0.28            |   |                                   |                          |
|                             | 17-60 | 0-5   | 1.45-1.65                | >6.0         | 0.03-0.06                      | 6.6-8.4                | Low-----                  | 0.10            |   |                                   |                          |
| 402B, 402E-----<br>Sioux    | 0-8   | 14-25 | 1.20-1.30                | 0.6-2.0      | 0.18-0.20                      | 6.6-8.4                | Low-----                  | 0.28            | 2 | 5                                 | 1-3                      |
|                             | 8-12  | 10-20 | 1.20-1.50                | 2.0-6.0      | 0.10-0.15                      | 7.4-8.4                | Low-----                  | 0.20            |   |                                   |                          |
|                             | 12-60 | 0-10  | 1.60-1.70                | >6.0         | 0.03-0.06                      | 7.4-8.4                | Low-----                  | 0.10            |   |                                   |                          |
| 410-----<br>Athelwold       | 0-18  | 22-27 | 1.10-1.25                | 0.6-2.0      | 0.19-0.22                      | 5.6-7.3                | Moderate----              | 0.28            | 4 | 6                                 | 4-8                      |
|                             | 18-25 | 25-35 | 1.20-1.35                | 0.6-2.0      | 0.18-0.21                      | 6.6-7.8                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 25-35 | 20-32 | 1.25-1.40                | 0.6-2.0      | 0.17-0.20                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 35-60 | 0-3   | 1.50-1.70                | 6.0-20       | 0.03-0.06                      | 7.4-8.4                | Low-----                  | 0.10            |   |                                   |                          |
| 418-----<br>Lamoure         | 0-8   | 27-34 | 1.15-1.25                | 0.2-2.0      | 0.19-0.22                      | 7.4-8.4                | Moderate----              | 0.28            | 5 | 4L                                | 4-8                      |
|                             | 8-36  | 20-34 | 1.20-1.35                | 0.2-2.0      | 0.17-0.20                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 36-45 | 20-34 | 1.20-1.35                | 0.2-2.0      | 0.17-0.20                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 45-60 | 20-34 | 1.25-1.40                | 0.2-2.0      | 0.09-0.18                      | 7.4-8.4                | Low-----                  | 0.28            |   |                                   |                          |
| 437D-----<br>Buse           | 0-8   | 27-35 | 1.40-1.50                | 0.2-0.6      | 0.17-0.22                      | 6.6-8.4                | Moderate----              | 0.28            | 5 | 4L                                | 1-3                      |
|                             | 8-60  | 18-35 | 1.55-1.65                | 0.2-0.6      | 0.14-0.19                      | 7.4-8.4                | Moderate----              | 0.37            |   |                                   |                          |
| 450-----<br>Rauville        | 0-21  | 27-35 | 1.10-1.25                | 0.2-2.0      | 0.19-0.22                      | 7.4-8.4                | Moderate----              | 0.28            | 5 | 8                                 | 4-7                      |
|                             | 21-60 | 20-35 | 1.10-1.30                | 0.2-2.0      | 0.17-0.20                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
| 494B-----<br>Darnen         | 0-16  | 18-27 | 1.25-1.40                | 0.6-2.0      | 0.20-0.24                      | 6.6-7.8                | Low-----                  | 0.28            | 5 | 6                                 | 4-9                      |
|                             | 16-34 | 18-30 | 1.40-1.60                | 0.6-2.0      | 0.15-0.19                      | 6.1-7.8                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 34-60 | 18-30 | 1.55-1.65                | 0.6-2.0      | 0.14-0.19                      | 7.4-8.4                | Moderate----              | 0.37            |   |                                   |                          |
| 694B-----<br>Zell           | 0-8   | 10-18 | 1.15-1.30                | 0.6-2.0      | 0.17-0.22                      | 6.6-8.4                | Low-----                  | 0.32            | 5 | 4L                                | 2-5                      |
|                             | 8-16  | 10-18 | 1.25-1.40                | 0.6-2.0      | 0.15-0.20                      | 7.4-8.4                | Low-----                  | 0.43            |   |                                   |                          |
|                             | 16-60 | 5-18  | 1.25-1.40                | 0.6-2.0      | 0.15-0.20                      | 7.4-8.4                | Low-----                  | 0.43            |   |                                   |                          |
| 698-----<br>Doran           | 0-8   | 27-35 | 1.25-1.45                | 0.2-0.6      | 0.18-0.23                      | 6.6-7.3                | Moderate----              | 0.28            | 5 | 6                                 | 4-8                      |
|                             | 8-20  | 35-50 | 1.30-1.60                | 0.06-0.6     | 0.15-0.19                      | 6.6-7.8                | High-----                 | 0.28            |   |                                   |                          |
|                             | 20-32 | 27-40 | 1.45-1.65                | 0.06-0.2     | 0.14-0.16                      | 7.4-8.4                | High-----                 | 0.37            |   |                                   |                          |
|                             | 32-60 | 20-40 | 1.45-1.65                | 0.2-2.0      | 0.14-0.16                      | 7.4-8.4                | High-----                 | 0.37            |   |                                   |                          |
| 787:                        |       |       |                          |              |                                |                        |                           |                 |   |                                   |                          |
| Fram-----                   | 0-8   | 10-18 | 1.30-1.60                | 0.6-2.0      | 0.20-0.24                      | 7.4-8.4                | Low-----                  | 0.28            | 5 | 4L                                | 4-9                      |
|                             | 8-60  | 7-18  | 1.40-1.60                | 0.6-2.0      | 0.13-0.20                      | 7.4-8.4                | Low-----                  | 0.37            |   |                                   |                          |
| Vallers-----                | 0-13  | 28-35 | 1.20-1.35                | 0.2-0.6      | 0.18-0.22                      | 7.4-8.4                | Moderate----              | 0.28            | 5 | 4L                                | 5-8                      |
|                             | 13-26 | 18-35 | 1.40-1.55                | 0.2-0.6      | 0.15-0.19                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 26-60 | 18-35 | 1.50-1.70                | 0.2-0.6      | 0.17-0.19                      | 7.4-8.4                | Low-----                  | 0.28            |   |                                   |                          |
| Parnell-----                | 0-20  | 27-40 | 1.20-1.30                | 0.2-0.6      | 0.18-0.22                      | 6.1-7.8                | Moderate----              | 0.28            | 5 | 7                                 | 6-10                     |
|                             | 20-50 | 35-60 | 1.20-1.30                | 0.06-0.2     | 0.13-0.19                      | 6.1-7.8                | High-----                 | 0.28            |   |                                   |                          |
|                             | 50-60 | 35-45 | 1.20-1.40                | 0.06-0.2     | 0.11-0.19                      | 6.6-8.4                | High-----                 | 0.28            |   |                                   |                          |
| 814:                        |       |       |                          |              |                                |                        |                           |                 |   |                                   |                          |
| Hamery-----                 | 0-8   | 18-27 | 1.30-1.60                | 0.6-2.0      | 0.18-0.24                      | 6.6-8.4                | Moderate----              | 0.28            | 5 | 4L                                | 4-7                      |
|                             | 8-28  | 18-35 | 1.20-1.60                | 0.6-2.0      | 0.15-0.19                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 28-60 | 18-35 | 1.30-1.60                | 0.2-0.6      | 0.14-0.19                      | 7.4-8.4                | Moderate----              | 0.37            |   |                                   |                          |

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth |       | Clay<br>Pct | Moist<br>bulk<br>density<br>g/cc | Permeability<br>In/hr | Available<br>water<br>capacity<br>In/in | Soil<br>reaction<br>pH | Shrink-swell<br>potential | Erosion factors |    | Wind<br>erodi-<br>bility<br>group | Organic<br>matter<br>Pct |
|--------------------------|-------|-------|-------------|----------------------------------|-----------------------|---|------------------------|---------------------------|-----------------|----|-----------------------------------|--------------------------|
|                          | In    | Pct   |             |                                  |                       |   |                        |                           | K               | T  |                                   |                          |
| 814:                     |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Lindaas-----             | 0-12  | 27-35 | 1.10-1.30   | 0.6-2.0                          | 0.18-0.23             | 6.6-7.3                                 | Moderate-----          | 0.32                      | 5               | 7  | 5-10                              |                          |
|                          | 12-26 | 40-50 | 1.20-1.40   | 0.06-0.2                         | 0.14-0.17             | 6.6-7.8                                 | High-----              | 0.32                      |                 |    |                                   |                          |
|                          | 26-36 | 25-40 | 1.20-1.50   | 0.2-0.6                          | 0.16-0.22             | 7.4-8.4                                 | Moderate-----          | 0.43                      |                 |    |                                   |                          |
|                          | 36-60 | 20-35 | 1.20-1.50   | 0.2-2.0                          | 0.17-0.22             | 7.4-8.4                                 | Moderate-----          | 0.43                      |                 |    |                                   |                          |
| 827B:                    |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Esmond-----              | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.22             | 7.4-8.4                                 | Low-----               | 0.28                      | 5               | 4L | 1-4                               |                          |
|                          | 8-60  | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.14-0.22             | 7.4-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| Heimdal-----             | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.24             | 6.1-7.3                                 | Low-----               | 0.28                      | 5               | 5  | 3-5                               |                          |
|                          | 8-13  | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.8                                 | Low-----               | 0.28                      |                 |    |                                   |                          |
|                          | 13-60 | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.11-0.21             | 7.9-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| 827C2:                   |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Esmond-----              | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.22             | 7.4-8.4                                 | Low-----               | 0.28                      | 5               | 4L | 1-4                               |                          |
|                          | 8-60  | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.14-0.22             | 7.4-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| Heimdal-----             | 0-8   | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.20-0.24             | 6.1-7.3                                 | Low-----               | 0.28                      | 5               | 5  | 3-5                               |                          |
|                          | 8-10  | 10-18 | 1.30-1.60   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.8                                 | Low-----               | 0.28                      |                 |    |                                   |                          |
|                          | 10-60 | 7-18  | 1.40-1.60   | 0.6-2.0                          | 0.11-0.21             | 7.9-8.4                                 | Low-----               | 0.37                      |                 |    |                                   |                          |
| 900:                     |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Hamerly-----             | 0-8   | 18-27 | 1.30-1.60   | 0.6-2.0                          | 0.18-0.24             | 6.6-8.4                                 | Moderate-----          | 0.28                      | 5               | 4L | 4-7                               |                          |
|                          | 8-28  | 18-35 | 1.20-1.60   | 0.6-2.0                          | 0.15-0.19             | 7.4-8.4                                 | Moderate-----          | 0.28                      |                 |    |                                   |                          |
|                          | 28-60 | 18-35 | 1.30-1.60   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| Aazdahl-----             | 0-11  | 27-35 | 1.30-1.50   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.3                                 | Moderate-----          | 0.24                      | 5               | 6  | 4-6                               |                          |
|                          | 11-15 | 27-35 | 1.40-1.60   | 0.2-0.6                          | 0.17-0.19             | 6.6-7.8                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
|                          | 15-60 | 24-35 | 1.50-1.65   | 0.2-0.6                          | 0.14-0.17             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| Lindaas-----             | 0-12  | 27-35 | 1.10-1.30   | 0.6-2.0                          | 0.18-0.23             | 6.6-7.3                                 | Moderate-----          | 0.32                      | 5               | 7  | 5-10                              |                          |
|                          | 12-26 | 40-50 | 1.20-1.40   | 0.06-0.2                         | 0.14-0.17             | 6.6-7.8                                 | High-----              | 0.32                      |                 |    |                                   |                          |
|                          | 26-36 | 25-40 | 1.20-1.50   | 0.2-0.6                          | 0.16-0.22             | 7.4-8.4                                 | Moderate-----          | 0.43                      |                 |    |                                   |                          |
|                          | 36-60 | 20-35 | 1.20-1.50   | 0.2-2.0                          | 0.17-0.22             | 7.4-8.4                                 | Moderate-----          | 0.43                      |                 |    |                                   |                          |
| 915B:                    |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Formdale-----            | 0-8   | 27-35 | 1.30-1.50   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.3                                 | Moderate-----          | 0.24                      | 5               | 6  | 2-5                               |                          |
|                          | 8-14  | 24-35 | 1.40-1.60   | 0.2-0.6                          | 0.17-0.19             | 6.6-7.8                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
|                          | 14-60 | 18-35 | 1.50-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| Buse-----                | 0-8   | 27-35 | 1.40-1.50   | 0.2-0.6                          | 0.17-0.22             | 6.6-8.4                                 | Moderate-----          | 0.28                      | 5               | 4L | 1-3                               |                          |
|                          | 8-60  | 18-35 | 1.55-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| 915C2:                   |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Buse-----                | 0-8   | 27-35 | 1.40-1.50   | 0.2-0.6                          | 0.17-0.22             | 6.6-8.4                                 | Moderate-----          | 0.28                      | 5               | 4L | 1-3                               |                          |
|                          | 8-60  | 18-35 | 1.55-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| Formdale-----            | 0-8   | 27-35 | 1.30-1.50   | 0.6-2.0                          | 0.17-0.19             | 6.6-7.3                                 | Moderate-----          | 0.24                      | 5               | 6  | 2-5                               |                          |
|                          | 8-11  | 24-35 | 1.40-1.60   | 0.2-0.6                          | 0.17-0.19             | 6.6-7.8                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
|                          | 11-60 | 18-35 | 1.50-1.65   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| 922:                     |       |       |             |                                  |                       |   |                        |                           |                 |    |                                   |                          |
| Hamerly-----             | 0-8   | 18-27 | 1.30-1.60   | 0.6-2.0                          | 0.18-0.24             | 6.6-8.4                                 | Moderate-----          | 0.28                      | 5               | 4L | 4-7                               |                          |
|                          | 8-28  | 18-35 | 1.20-1.60   | 0.6-2.0                          | 0.15-0.19             | 7.4-8.4                                 | Moderate-----          | 0.28                      |                 |    |                                   |                          |
|                          | 28-60 | 18-35 | 1.30-1.60   | 0.2-0.6                          | 0.14-0.19             | 7.4-8.4                                 | Moderate-----          | 0.37                      |                 |    |                                   |                          |
| Parnell-----             | 0-20  | 27-40 | 1.20-1.30   | 0.2-0.6                          | 0.18-0.22             | 6.1-7.8                                 | Moderate-----          | 0.28                      | 5               | 7  | 6-10                              |                          |
|                          | 20-50 | 35-60 | 1.20-1.30   | 0.06-0.2                         | 0.13-0.19             | 6.1-7.8                                 | High-----              | 0.28                      |                 |    |                                   |                          |
|                          | 50-60 | 35-45 | 1.20-1.40   | 0.06-0.2                         | 0.11-0.19             | 6.6-8.4                                 | High-----              | 0.28                      |                 |    |                                   |                          |

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and<br>map symbol | Depth |       | Moist<br>bulk<br>density | Permeability | Available<br>water<br>capacity | Soil<br>reaction<br>pH | Shrink-swell<br>potential | Erosion factors |   | Wind<br>erodi-<br>bility<br>group | Organic<br>matter<br>Pct |
|-----------------------------|-------|-------|--------------------------|--------------|--------------------------------|------------------------|---------------------------|-----------------|---|-----------------------------------|--------------------------|
|                             | In    | Pct   |                          |              |                                |                        |                           | K               | T |                                   |                          |
| 923C:<br>Copaston-----      | 0-9   | 14-23 | 1.30-1.45                | 0.6-2.0      | 0.20-0.22                      | 6.1-7.3                | Low-----                  | 0.28            | 2 | 5                                 | 2-5                      |
|                             | 9-14  | 14-20 | 1.40-1.60                | 0.6-6.0      | 0.15-0.17                      | 5.6-7.3                | Low-----                  | 0.28            |   |                                   |                          |
|                             | 14    | ---   | ---                      | 2.0-20       | ---                            | ---                    | -----                     | ---             |   |                                   |                          |
| Rock outcrop.               |       |       |                          |              |                                |                        |                           |                 |   |                                   |                          |
| 1013.<br>Pits               |       |       |                          |              |                                |                        |                           |                 |   |                                   |                          |
| 1030:<br>Udorthents-----    | 0-60  | 2-18  | 1.50-1.70                | 0.6-6.0      | 0.08-0.14                      | 6.6-9.0                | Low-----                  | 0.24            | 5 | 3                                 | <1                       |
|                             | 60-80 | ---   | ---                      | 0.06-6.0     | ---                            | ---                    | -----                     | ---             |   |                                   |                          |
| Pits.                       |       |       |                          |              |                                |                        |                           |                 |   |                                   |                          |
| 1817F-----<br>Esmond        | 0-10  | 10-18 | 1.30-1.60                | 0.6-2.0      | 0.20-0.22                      | 7.4-8.4                | Low-----                  | 0.20            | 5 | 8                                 | 1-4                      |
|                             | 10-60 | 7-18  | 1.40-1.60                | 0.6-2.0      | 0.14-0.22                      | 7.4-8.4                | Low-----                  | 0.37            |   |                                   |                          |
| 1916-----<br>Lindaas        | 0-12  | 27-35 | 1.10-1.30                | 0.6-2.0      | 0.18-0.23                      | 6.6-7.3                | Moderate----              | 0.32            | 5 | 7                                 | 5-10                     |
|                             | 12-26 | 40-50 | 1.20-1.40                | 0.06-0.2     | 0.14-0.17                      | 6.6-7.8                | High-----                 | 0.32            |   |                                   |                          |
|                             | 26-36 | 25-40 | 1.20-1.50                | 0.2-0.6      | 0.16-0.22                      | 7.4-8.4                | Moderate----              | 0.43            |   |                                   |                          |
|                             | 36-60 | 20-35 | 1.20-1.50                | 0.2-2.0      | 0.17-0.22                      | 7.4-8.4                | Moderate----              | 0.43            |   |                                   |                          |
| 1940-----<br>Bigstone       | 0-30  | 28-35 | 1.00-1.35                | 0.2-0.6      | 0.18-0.22                      | 7.4-8.4                | Moderate----              | 0.28            | 5 | 8                                 | 6-15                     |
|                             | 30-36 | 20-35 | 1.35-1.50                | 0.2-2.0      | 0.16-0.22                      | 7.4-8.4                | Moderate----              | 0.28            |   |                                   |                          |
|                             | 36-60 | 20-32 | 1.35-1.50                | 0.2-2.0      | 0.14-0.19                      | 7.4-8.4                | Moderate----              | 0.37            |   |                                   |                          |
| 1949-----<br>Gardena        | 0-21  | 12-18 | 1.10-1.40                | 0.6-2.0      | 0.20-0.24                      | 6.6-7.8                | Low-----                  | 0.28            | 5 | 5                                 | 4-8                      |
|                             | 21-60 | 10-18 | 1.20-1.70                | 0.6-2.0      | 0.17-0.22                      | 7.4-8.4                | Low-----                  | 0.43            |   |                                   |                          |
| 1994-----<br>Emlden         | 0-8   | 10-28 | 1.30-1.50                | 2.0-6.0      | 0.20-0.22                      | 6.6-7.3                | Low-----                  | 0.20            | 5 | 5                                 | 4-7                      |
|                             | 8-40  | 10-18 | 1.40-1.60                | 2.0-6.0      | 0.12-0.17                      | 6.6-7.8                | Low-----                  | 0.20            |   |                                   |                          |
|                             | 40-60 | 5-18  | 1.40-1.60                | 2.0-6.0      | 0.06-0.16                      | 7.4-8.4                | Low-----                  | 0.20            |   |                                   |                          |

TABLE 16.--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<br>map symbol  | Hydrologic<br>group | Flooding        |            |         | High water table |          |         |
|------------------------------|---------------------|-----------------|------------|---------|------------------|----------|---------|
|                              |                     | Frequency       | Duration   | Months  | Depth<br>Ft      | Kind     | Months  |
| 26-----<br>Aazdahl           | B                   | None-----       | ---        | ---     | 3.0-6.0          | Apparent | Mar-May |
| 34-----<br>Parnell           | C/D                 | None-----       | ---        | ---     | +1-1.0           | Apparent | Jan-Dec |
| 36-----<br>Flom              | B/D                 | None-----       | ---        | ---     | 1.0-3.0          | Apparent | Nov-Jun |
| 51-----<br>La Prairie        | B                   | Occasional----- | Brief----- | Mar-Jun | 3.5-6.0          | Apparent | Mar-Jun |
| 60-----<br>Glyndon           | B                   | None-----       | ---        | ---     | 2.5-6.0          | Apparent | Apr-Jul |
| 70-----<br>Svea              | B                   | None-----       | ---        | ---     | 4.0-6.0          | Apparent | Apr-Jun |
| 127B-----<br>Sverdrup        | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 137-----<br>Dovray           | C/D                 | None-----       | ---        | ---     | +2-1.0           | Apparent | Jan-Dec |
| 141A, 141B-----<br>Egeland   | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 171B-----<br>Formdale        | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 180-----<br>Gonvick          | B                   | None-----       | ---        | ---     | 2.5-4.0          | Apparent | Nov-Jun |
| 184A, 184B-----<br>Hamerly   | C                   | None-----       | ---        | ---     | 2.0-4.0          | Apparent | Apr-Jun |
| 185B-----<br>Hattie          | C                   | None-----       | ---        | ---     | 3.0-6.0          | Apparent | Nov-Jun |
| 185C-----<br>Hattie          | C                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 192A, 192B-----<br>Estelline | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 210-----<br>Fulda            | C/D                 | Rare-----       | ---        | ---     | 1.0-3.0          | Apparent | Mar-Jun |
| 236-----<br>Vallers          | C                   | None-----       | ---        | ---     | 1.0-2.5          | Apparent | Nov-Jun |
| 246-----<br>Marysland        | B/D                 | Rare-----       | ---        | ---     | 1.0-2.5          | Apparent | Nov-Jul |
| 276-----<br>Oldham           | C/D                 | None-----       | ---        | ---     | +0-1.0           | Apparent | Oct-Jun |

TABLE 16.--WATER FEATURES--Continued

| Soil name and<br>map symbol | Hydrologic<br>group | Flooding        |            |         | High water table |          |         |
|-----------------------------|---------------------|-----------------|------------|---------|------------------|----------|---------|
|                             |                     | Frequency       | Duration   | Months  | Depth<br>Ft      | Kind     | Months  |
| 288D-----<br>Esmond         | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 293A-----<br>Swenoda        | B                   | None-----       | ---        | ---     | 2.5-4.0          | Perched  | Mar-Jun |
| 293B-----<br>Swenoda        | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 296B-----<br>Fram           | B                   | None-----       | ---        | ---     | 2.0-6.0          | Apparent | Sep-Jun |
| 314-----<br>Spottswood      | B                   | None-----       | ---        | ---     | 3.0-6.0          | Apparent | Oct-Jun |
| 339-----<br>Fordville       | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 341-----<br>Arvilla         | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 344-----<br>Bigstone        | B/D                 | None-----       | ---        | ---     | +1-1.0           | Apparent | Mar-Jul |
| 347-----<br>Malachy         | B                   | None-----       | ---        | ---     | 3.0-5.0          | Apparent | Nov-Apr |
| 373B-----<br>Renshaw        | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 402B, 402E-----<br>Sioux    | A                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 410-----<br>Athelwold       | B                   | None-----       | ---        | ---     | 3.0-6.0          | Apparent | Mar-Jun |
| 418-----<br>Lamoure         | C                   | Occasional----- | Brief----- | Mar-Oct | 0-2.0            | Apparent | Oct-Jun |
| 437D-----<br>Buse           | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 450-----<br>Rauville        | D                   | Frequent-----   | Brief----- | Mar-Oct | +1-2.0           | Apparent | Jan-Dec |
| 494B-----<br>Darnen         | B                   | None-----       | ---        | ---     | 2.5-6.0          | Apparent | Nov-Jun |
| 694B-----<br>Zell           | B                   | None-----       | ---        | ---     | >6.0             | ---      | ---     |
| 698-----<br>Doran           | C                   | None-----       | ---        | ---     | 3.0-5.0          | Apparent | Apr-Jun |
| 787:<br>Fram-----           | B                   | None-----       | ---        | ---     | 2.0-6.0          | Apparent | Sep-Jun |
| Vallars-----                | C                   | None-----       | ---        | ---     | 1.0-2.5          | Apparent | Nov-Jun |
| Parnell-----                | C/D                 | None-----       | ---        | ---     | +1-1.0           | Apparent | Jan-Dec |

TABLE 16.--WATER FEATURES--Continued

| Soil name and<br>map symbol | Hydrologic<br>group | Flooding  |          |        | High water table |          |         |
|-----------------------------|---------------------|-----------|----------|--------|------------------|----------|---------|
|                             |                     | Frequency | Duration | Months | Depth<br>Ft      | Kind     | Months  |
| 814:<br>Hamerly-----        | C                   | None----- | ---      | ---    | 2.0-4.0          | Apparent | Apr-Jun |
| Lindaas-----                | C/D                 | None----- | ---      | ---    | +1-2.0           | Apparent | Apr-Jun |
| 827B, 827C2:<br>Esmond----- | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| Heimdal-----                | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| 900:<br>Hamerly-----        | C                   | None----- | ---      | ---    | 2.0-4.0          | Apparent | Apr-Jun |
| Aazdahl-----                | B                   | None----- | ---      | ---    | 3.0-6.0          | Apparent | Mar-May |
| Lindaas-----                | C/D                 | None----- | ---      | ---    | +1-2.0           | Apparent | Apr-Jun |
| 915B:<br>Formdale-----      | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| Buse-----                   | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| 915C2:<br>Buse-----         | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| Formdale-----               | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| 922:<br>Hamerly-----        | C                   | None----- | ---      | ---    | 2.0-4.0          | Apparent | Apr-Jun |
| Parnell-----                | C/D                 | None----- | ---      | ---    | +1-1.0           | Apparent | Jan-Dec |
| 923C:<br>Copaston-----      | D                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| Rock outcrop.               |                     |           |          |        |                  |          |         |
| 1013.<br>Pits               |                     |           |          |        |                  |          |         |
| 1030:<br>Udorthents-----    | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| Pits.                       |                     |           |          |        |                  |          |         |
| 1817F-----<br>Esmond        | B                   | None----- | ---      | ---    | >6.0             | ---      | ---     |
| 1916-----<br>Lindaas        | C/D                 | None----- | ---      | ---    | +1-2.0           | Apparent | Apr-Jun |
| 1940-----<br>Bigstone       | B/D                 | None----- | ---      | ---    | +3-0             | Apparent | Jan-Dec |
| 1949-----<br>Gardena        | B                   | None----- | ---      | ---    | 4.0-6.0          | Apparent | Apr-Jun |
| 1994-----<br>Embden         | B                   | None----- | ---      | ---    | 4.0-6.0          | Apparent | Apr-Jun |

TABLE 17.--SOIL FEATURES

(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<br>map symbol  | Bedrock |          | Potential frost action | Risk of corrosion |           |
|------------------------------|---------|----------|------------------------|-------------------|-----------|
|                              | Depth   | Hardness |                        | Uncoated steel    | Concrete  |
|                              | In      |          |                        |                   |           |
| 26-----<br>Aazdahl           | >60     | ---      | High-----              | Moderate-----     | Low.      |
| 34-----<br>Parnell           | >60     | ---      | High-----              | High-----         | Low.      |
| 36-----<br>Flom              | >60     | ---      | High-----              | High-----         | Low.      |
| 51-----<br>La Prairie        | >60     | ---      | Moderate-----          | Moderate-----     | Low.      |
| 60-----<br>Glyndon           | >60     | ---      | High-----              | High-----         | Low.      |
| 70-----<br>Svea              | >60     | ---      | Moderate-----          | High-----         | Low.      |
| 127B-----<br>Sverdrup        | >60     | ---      | Low-----               | Low-----          | Low.      |
| 137-----<br>Dovray           | >60     | ---      | Moderate-----          | High-----         | Low.      |
| 141A, 141B-----<br>Egeland   | >60     | ---      | Low-----               | Moderate-----     | Low.      |
| 171B-----<br>Formdale        | >60     | ---      | Moderate-----          | Moderate-----     | Low.      |
| 180-----<br>Gonvick          | >60     | ---      | High-----              | Moderate-----     | Low.      |
| 184A, 184B-----<br>Hamerly   | >60     | ---      | High-----              | High-----         | Low.      |
| 185B, 185C-----<br>Hattie    | >60     | ---      | Moderate-----          | High-----         | Low.      |
| 192A, 192B-----<br>Estelline | >60     | ---      | Low-----               | Moderate-----     | Low.      |
| 210-----<br>Fulda            | >60     | ---      | High-----              | High-----         | Low.      |
| 236-----<br>Vallers          | >60     | ---      | High-----              | High-----         | Low.      |
| 246-----<br>Marysland        | >60     | ---      | High-----              | High-----         | Low.      |
| 276-----<br>Oldham           | >60     | ---      | High-----              | Moderate-----     | High.     |
| 288D-----<br>Esmond          | >60     | ---      | Moderate-----          | High-----         | Low.      |
| 293A, 293B-----<br>Swenoda   | >60     | ---      | Moderate-----          | High-----         | Moderate. |

TABLE 17.--SOIL FEATURES--Continued

| Soil name and<br>map symbol | Bedrock     |          | Potential frost action | Risk of corrosion |           |
|-----------------------------|-------------|----------|------------------------|-------------------|-----------|
|                             | Depth<br>In | Hardness |                        | Uncoated steel    | Concrete  |
| 296B-----<br>Fram           | >60         | ---      | High-----              | High-----         | Low.      |
| 314-----<br>Spottswood      | >60         | ---      | Moderate-----          | High-----         | Low.      |
| 339-----<br>Fordville       | >60         | ---      | Low-----               | Moderate-----     | Low.      |
| 341-----<br>Arvilla         | >60         | ---      | Low-----               | Moderate-----     | Low.      |
| 344-----<br>Bigstone        | >60         | ---      | High-----              | High-----         | Low.      |
| 347-----<br>Malachy         | >60         | ---      | High-----              | Low-----          | Low.      |
| 373B-----<br>Renshaw        | >60         | ---      | Low-----               | Moderate-----     | Low.      |
| 402B, 402E-----<br>Sioux    | >60         | ---      | Low-----               | Low-----          | Low.      |
| 410-----<br>Athelwold       | >60         | ---      | High-----              | High-----         | Low.      |
| 418-----<br>Lamoure         | >60         | ---      | High-----              | High-----         | Moderate. |
| 437D-----<br>Buse           | >60         | ---      | Moderate-----          | Low-----          | Low.      |
| 450-----<br>Rauville        | >60         | ---      | High-----              | High-----         | Moderate. |
| 494B-----<br>Darnen         | >60         | ---      | Moderate-----          | High-----         | Low.      |
| 694B-----<br>Zell           | >60         | ---      | High-----              | High-----         | Moderate. |
| 698-----<br>Doran           | >60         | ---      | High-----              | High-----         | Low.      |
| 787:<br>Fram-----           | >60         | ---      | High-----              | High-----         | Low.      |
| Vallers-----                | >60         | ---      | High-----              | High-----         | Low.      |
| Parnell-----                | >60         | ---      | High-----              | High-----         | Low.      |
| 814:<br>Hamerly-----        | >60         | ---      | High-----              | High-----         | Low.      |
| Lindaas-----                | >60         | ---      | High-----              | High-----         | Low.      |
| 827B, 827C2:<br>Esmond----- | >60         | ---      | Moderate-----          | High-----         | Low.      |
| Heimdahl-----               | >60         | ---      | Moderate-----          | High-----         | Low.      |

TABLE 17.--SOIL FEATURES--Continued

| Soil name and<br>map symbol | Bedrock |          | Potential frost action | Risk of corrosion |           |
|-----------------------------|---------|----------|------------------------|-------------------|-----------|
|                             | Depth   | Hardness |                        | Uncoated steel    | Concrete  |
|                             | In      |          |                        |                   |           |
| 900:<br>Hamerly-----        | >60     | ---      | High-----              | High-----         | Low.      |
| Aazdahl-----                | >60     | ---      | High-----              | Moderate-----     | Low.      |
| Lindaas-----                | >60     | ---      | High-----              | High-----         | Low.      |
| 915B:<br>Formdale-----      | >60     | ---      | Moderate-----          | Moderate-----     | Low.      |
| Buse-----                   | >60     | ---      | Moderate-----          | Low-----          | Low.      |
| 915C2:<br>Buse-----         | >60     | ---      | Moderate-----          | Low-----          | Low.      |
| Formdale-----               | >60     | ---      | Moderate-----          | Moderate-----     | Low.      |
| 922:<br>Hamerly-----        | >60     | ---      | High-----              | High-----         | Low.      |
| Parnell-----                | >60     | ---      | High-----              | High-----         | Low.      |
| 923C:<br>Copaston-----      | 12-20   | Hard     | Moderate-----          | Low-----          | Low.      |
| Rock outcrop.               |         |          |                        |                   |           |
| 1013.<br>Pits               |         |          |                        |                   |           |
| 1030:<br>Udorthents-----    | >60     | ---      | Moderate-----          | High-----         | Moderate. |
| Pits.                       |         |          |                        |                   |           |
| 1817F-----<br>Esmond        | >60     | ---      | Moderate-----          | High-----         | Low.      |
| 1916-----<br>Lindaas        | >60     | ---      | High-----              | High-----         | Low.      |
| 1940-----<br>Bigstone       | >60     | ---      | High-----              | High-----         | Low.      |
| 1949-----<br>Gardena        | >60     | ---      | High-----              | Moderate-----     | Low.      |
| 1994-----<br>Embden         | >60     | ---      | Moderate-----          | High-----         | Low.      |

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  |
|-----------------|---|
| Aazdahl-----    | Fine-loamy, mixed Aquic Haploborolls                                    |
| Arvilla-----    | Sandy, mixed Udic Haploborolls  |
| Athelwold-----  | Fine-silty over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls |
| Bigstone-----   | Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls              |
| Buse-----       | Fine-loamy, mixed Udorthentic Haploborolls                              |
| *Copaston-----  | Loamy, mixed, mesic Lithic Hapludolls                                   |
| Darnen-----     | Fine-loamy, mixed Pachic Udic Haploborolls                              |
| Doran-----      | Fine, mixed Aquic Argiborolls   |
| Dovray-----     | Fine, montmorillonitic, frigid Cumulic Haplaquolls                      |
| Egeland-----    | Coarse-loamy, mixed Udic Haploborolls                                   |
| Embden-----     | Coarse-loamy, mixed Pachic Udic Haploborolls                            |
| Esmond-----     | Coarse-loamy, mixed Udorthentic Haploborolls                            |
| Estelline-----  | Fine-silty over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls |
| Flom-----       | Fine-loamy, mixed, frigid Typic Haplaquolls                             |
| Fordville-----  | Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls |
| Formdale-----   | Fine-loamy, mixed Udic Haploborolls                                     |
| Fram-----       | Coarse-loamy, frigid Aeric Calcicquolls                                 |
| Fulda-----      | Fine, montmorillonitic, frigid Typic Haplaquolls                        |
| Gardena-----    | Coarse-silty, mixed Pachic Udic Haploborolls                            |
| Glyndon-----    | Coarse-silty, frigid Aeric Calcicquolls                                 |
| Gonvick-----    | Fine-loamy, mixed Aquic Argiborolls                                     |
| Hamerly-----    | Fine-loamy, frigid Aeric Calcicquolls                                   |
| Hattie-----     | Fine, montmorillonitic Udertic Haploborolls                             |
| Heimdal-----    | Coarse-loamy, mixed Udic Haploborolls                                   |
| Lamoure-----    | Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls              |
| La Prairie----- | Fine-loamy, mixed Cumulic Udic Haploborolls                             |
| Lindaas-----    | Fine, montmorillonitic, frigid Typic Argiaquolls                        |
| Malachy-----    | Coarse-loamy, mixed Pachic Udic Haploborolls                            |
| Marysland-----  | Fine-loamy over sandy or sandy-skeletal, frigid Typic Calcicquolls      |
| Oldham-----     | Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls         |
| Parnell-----    | Fine, montmorillonitic, frigid Typic Argiaquolls                        |
| Rauville-----   | Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls              |
| Renshaw-----    | Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls        |
| Sioux-----      | Sandy-skeletal, mixed Udorthentic Haploborolls                          |
| Spottswood----- | Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls |
| Svea-----       | Fine-loamy, mixed Pachic Udic Haploborolls                              |
| Sverdrup-----   | Sandy, mixed Udic Haploborolls  |
| Swenoda-----    | Coarse-loamy, mixed Pachic Udic Haploborolls                            |
| Udorthents----- | Udorthents  |
| Valliers-----   | Fine-loamy, frigid Typic Calcicquolls                                   |
| Zell-----       | Coarse-silty, mixed Udorthentic Haploborolls                            |

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