United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with Iowa Agriculture and Home Economics Experiment Station; Cooperative Extension Service, Iowa State University; and Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

Soil Survey of Chickasaw County, Iowa

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How To Use This Soil Survey

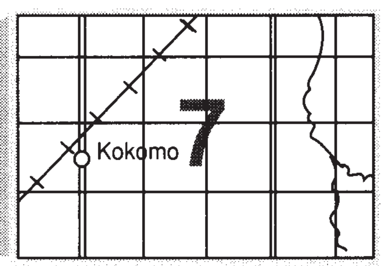
General Soil Map

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.

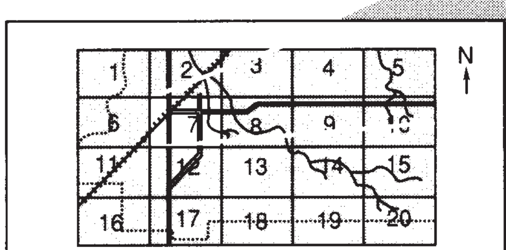
Detailed Soil Maps

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



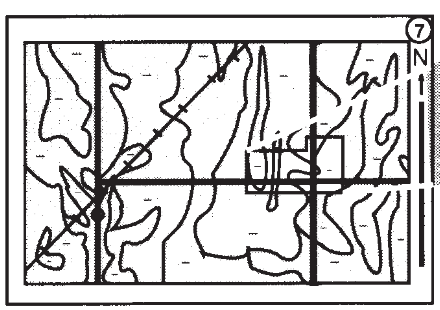
MAP SHEET

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



INDEX TO MAP SHEETS

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.



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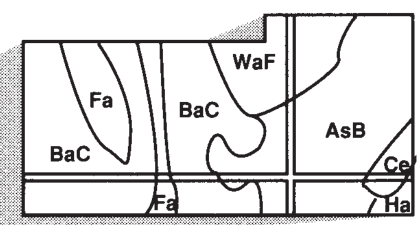

AREA OF INTEREST

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

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1988. 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 Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Chickasaw County Soil and Water Conservation District. Funds appropriated by Chickasaw County were used to defray part of the cost of the survey.

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

All programs and services of the 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: Contour stripcropping of grass, soybeans, and legume-hay in an area of the gently sloping and moderately sloping Kenyon soils.

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Issued July 1996

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Summary of Tables

Preface

This soil survey contains information that can be used in land-planning programs in Chickasaw 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.

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Soil Survey of
Chickasaw County, Iowa

By John Herbert Wilson, Natural Resources Conservation Service

Fieldwork by Joseph A. Falkenberg, Shannon Gomes, James A. Martzke, James C. Sanner, Jeff C. Talksy, Kermit K. Voy, and John Herbert Wilson, Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

CHICKASAW COUNTY is in northeastern Iowa (fig. 1). It has an area of about 323,300 acres, or about 505 square miles. New Hampton, the county seat, is in the central part of the county. It is about 145 miles northeast of Des Moines.

This survey updates the soil survey of Chickasaw County published in 1927 *(8)*. It provides additional information and larger maps, which show the soils in greater detail.

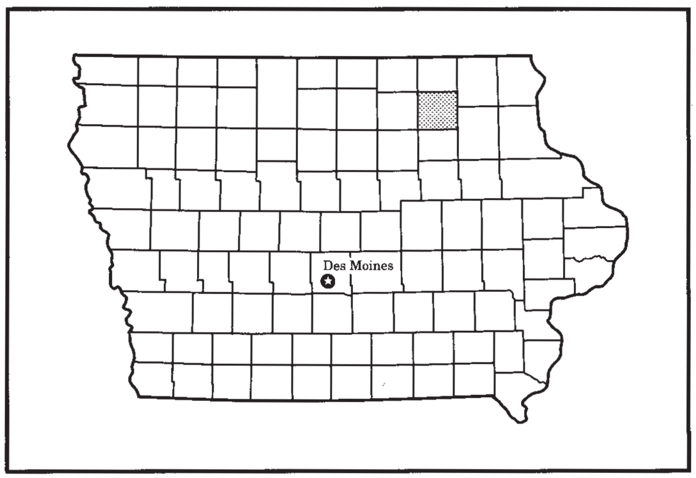

Figure 1.—Location of Chickasaw County in Iowa.

General Nature of the County

The topography of the county generally is gently undulating. It is nearly level in some areas on upland divides. The county is dissected by 5 rivers and 10 streams. The drainage system generally flows from the northwest to the southeast. Because of the abundance and density of rivers and streams in the county, most areas have adequate surface drainage.

A limited amount of timber is along the rivers and streams in the county. The largest concentrations of timber are along the Cedar, Little Cedar, and Wapsipinicon Rivers.

In 1980, the population of the county was 15,437, which was a 3.1 percent increase from 1970. It currently is stable *(4)*.

The paragraphs that follow describe the history and development of the county, transportation facilities, relief and drainage, natural resources, agriculture, and climate.

History and Development

Prior to settlement of Chickasaw County by pioneers, the land was occupied by the Chickasaw Tribe of Indians. The chief of the tribe was named Bradford. The county and the small town of Chickasaw were named for the tribe. The township of Bradford and the small town of Bradford were named after the chief of the tribe *(9)*.

In 1852, an early pioneer settlement was established in an area that is close to the current town of Bradford. J.A.J. and John Bird built the first residence, which was on the east side of the Little Cedar River above the junction with the Cedar River. A few immigrants settled in the area the following year. In 1854, several settlements were established in different parts of the county. They were located in New Hampton, Dayton, Deerfield, and Utica Townships *(3)*.

Chickasaw County, which was formerly part of Fayette County, was formally organized in 1853. The county seat was initially located in Bradford, but after much debate and legal battle, it was moved to New Hampton in 1858 *(3)*. The Little Brown Church in the Vale, a historic structure, was built in Bradford in 1859. The first railroad to pass through the county was built in 1868.

Transportation Facilities

U.S. Highway 63 runs north and south through the center of the county and through the center of New Hampton. State Highway 24 connects New Hampton to Lawler, a town to the east, and continues northeast to Calmar. U.S. Highway 18 goes west from New Hampton through Bassett and Charles City and south and east from New Hampton through Fredericksburg and West Union. U.S. Highway 218 runs north and south in the southwestern part of the county through the town of Nashua. These routes are the primary roads in the county. They are connected to all parts of the county by roads surfaced with concrete, asphalt, or crushed rock.

Two railway systems service the county. One of them enters the county north of Nashua from the west, follows U.S. Highway 18 south, and exits the southwest corner of the county. The other runs east and west midway through the county, near the towns of Bassett, New Hampton, and Lawler.

A small municipal airport is northwest of New Hampton. Scheduled airline service is available within a 50-mile radius at Waterloo and Mason City.

Bus transportation is available on U.S. Highway 63. The bus stops in New Hampton. Motor freight lines service all parts of the county.

Relief and Drainage

Chickasaw County is in one of the most complex landscape regions of the state. This region, known as the Iowan erosional surface, is described in more detail in the section "Formation of the Soils." It is characterized by a geologically eroded surface that formed on a glacial till plane overlain by a mantle of windblown or glacial sediments. A stone line or pebble band is one of the distinctive features of the Iowan erosional surface. It can be seen in some roadcuts as a line of angular pebbles between the loamy sediments and the underlying glacial till.

The underlying glacial till is generally consolidated and has a wide range of texture. The texture is predominantly loam or clay loam. A paleosol is in places. It is characterized by a high content of clay and very slow permeability. This soil is also known as gumbotil.

Many streams and tributaries, which are a result of extensive geologic erosion, dissect the uplands. The Wapsipinicon River and its tributaries drain the central part of the county, the Cedar and Little Cedar Rivers drain the southwestern part, and the Little Turkey River, Dry Run Creek, Crane Creek, and Simpson Creek drain the northeastern part.

The highest elevation in the county is about 1,325 feet above sea level. It is in an area near Alta Vista. The lowest elevation, which is near the town of Nashua, is about 940 feet.

Natural Resources

In addition to agricultural land, the natural resources in the county include limestone, sand, gravel, and trees.

Limestone is at or near the surface in several areas. Active quarries and a few abandoned quarries are in Bradford, Chickasaw, and Deerfield Townships and in Utica Township, close to the village of Little Turkey.

Extensive deposits of gravel and sand are along rivers and streams throughout the county. Excellent deposits of gravel are in the uplands, especially in areas of the Ostrander-Lilah association.

Several stands of planted or native woodland are in scattered areas throughout the county. Most of the areas are adjacent to rivers and their tributaries. The trees have commercial importance as well as esthetic value. They also provide dens and cover for the abundant wildlife in the county.

Agriculture

Farms in the county have been decreasing in number and increasing in size for several decades. In 1985, the average size of farms was 268 acres and the total number of farms in the county was 1,140 *(5)*.

Grain production and mixed livestock operations are the main agricultural enterprises in the county. In 1987, corn was planted on 110,000 acres. About 107,500 acres of the corn was harvested for grain, and 2,500 acres was planted for silage. The average yield for grain corn was 132.7 bushels per acre, and the average yield for silage was 13.8 tons per acre. About 54,400 acres was planted to soybeans, which had an average yield of 42.1 bushels per acre *(4)*.

Hogs are the most extensive livestock raised in the county. In 1985, about 210,000 hogs were marketed and about 12,000 cattle were fed and marketed. The livestock also included 6,500 milk cows, 700 grain-fed sheep and lambs, and 73,000 hens and pullets of laying age *(5)*.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at New Hampton, Iowa, in the period 1951 to 1986. 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 18 degrees F and the average daily minimum temperature is 9 degrees. The lowest temperature on record, which occurred at New Hampton on January 15, 1963, is -34 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred at New Hampton on June 8, 1985, is 100 degrees.

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

The total annual precipitation is about 33 inches. Of this, 24 inches, or more than 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 5 inches at New Hampton on August 10, 1980. Thunderstorms occur on about 43 days each year.

The average seasonal snowfall is about 41 inches. The greatest snow depth at any one time during the period of record was 40 inches. On the average, 51 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called 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

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.

1. Readlyn-Tripoli Association

Nearly level, somewhat poorly drained and poorly drained soils formed in loamy erosional sediments and the underlying firm, loamy glacial till; on uplands

This association consists of soils on broad, nearly level upland divides. Slopes range from 0 to 2 percent.

This association makes up about 21 percent of the county. It is about 48 percent Readlyn and similar soils, 35 percent Tripoli and similar soils, and 17 percent soils of minor extent (fig. 2).

Readlyn soils are somewhat poorly drained. They are on slightly convex, broad upland divides. Tripoli soils are poorly drained. They are in broad, flat areas on upland divides. Both soils formed under prairie vegetation.

Typically, the surface layer of the Readlyn soils is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown, friable loam, the next part is olive brown and dark grayish brown, mottled, friable loam, and the lower part is olive brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled dark yellowish brown, strong brown, and grayish brown loam.

Typically, the surface layer of the Tripoli soils is black, friable clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable clay loam about 9 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown, mottled, friable clay loam, the next part is yellowish brown and dark grayish brown, mottled, firm loam, and the lower part is yellowish brown and grayish brown, mottled, firm loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, calcareous loam.

Minor in this association are the Clyde, Havana, and Hoopeston soils. Clyde soils are in drainageways. They have firm till at a depth of more than 40 inches. The poorly drained Havana soils are adjacent to the Tripoli soils. Their surface layer is thinner and has a lower content of clay than the surface layer of the Tripoli soils. Hoopeston soils have more sand throughout than the major soils. They are on slightly elevated, rounded mounds.

This association is mainly used for cultivated crops. A few areas are used for hay or pasture. The cultivated areas are well suited to intensive row cropping. They are very productive if a subsurface drainage system is installed.

The main management concerns are poor drainage in the subsoil and the maintenance of tilth and fertility. A drainage system lowers the water table and improves the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

2. Oran-Bassett-Clyde Association

Nearly level to moderately sloping, moderately well drained to poorly drained, moderately dark and dark soils formed in loamy erosional sediments and the underlying firm, loamy glacial till; on uplands

This association consists of soils on narrow upland flats, convex ridges, and side slopes that have a well developed drainage system. The landscape is nearly

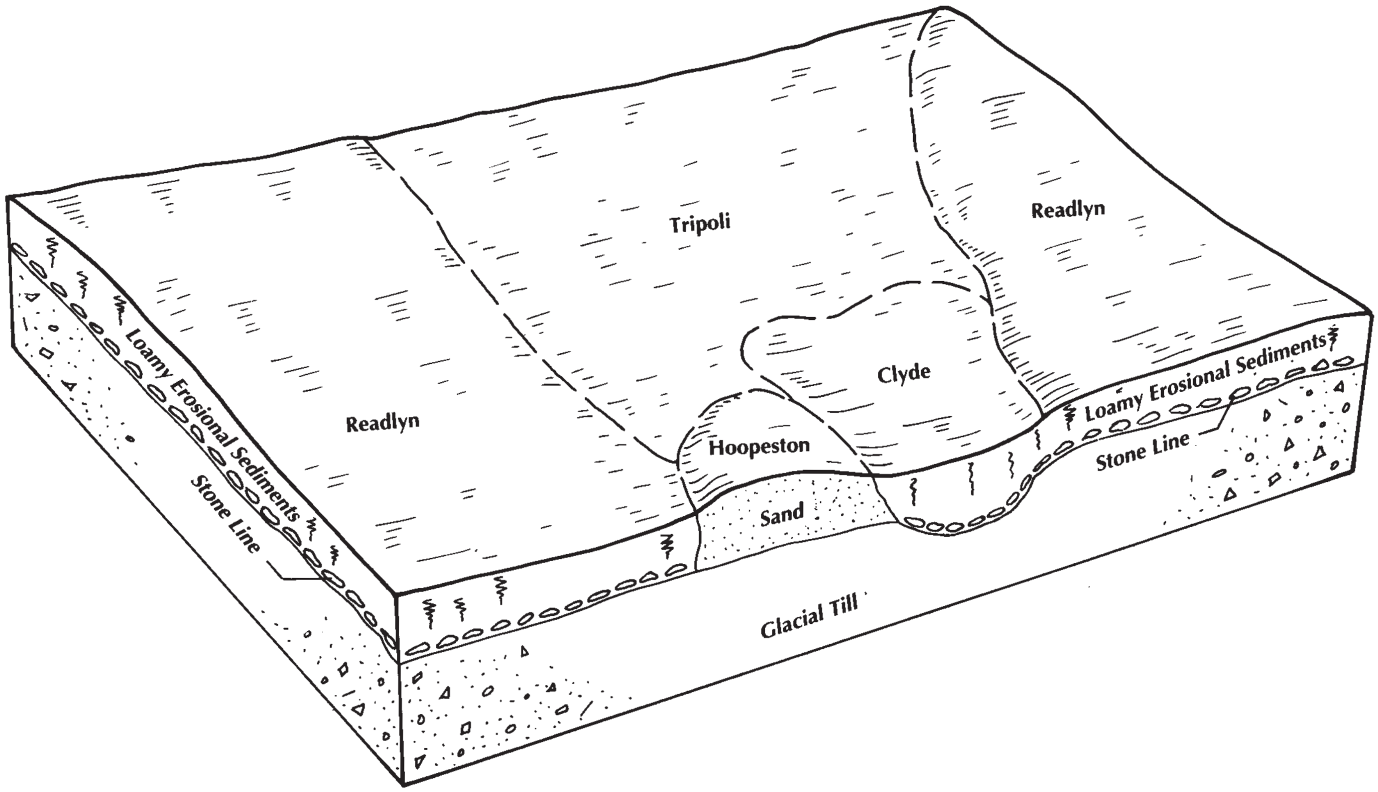

Figure 2.—Typical pattern of soils and underlying material in the Readlyn-Tripoli association.

level to gently rolling. Slopes range from 0 to 9 percent.

This association makes up about 24 percent of the county. It is about 22 percent Oran soils, 19 percent Bassett soils, 17 percent Clyde soils, and 42 percent soils of minor extent (fig. 3).

Oran soils are somewhat poorly drained. They are on narrow upland flats and side slopes. Bassett soils are moderately well drained. They are on convex divides and side slopes. Clyde soils are poorly drained. They are in the upland drainageways. All of these soils formed in loamy erosional sediments and the underlying firm, loamy glacial till.

Typically, the surface layer of the Oran soils is very dark gray, friable loam about 8 inches thick. The subsoil is about 41 inches thick. The upper part is dark grayish brown and olive brown, friable loam and clay loam, the next part is light olive brown, mottled, friable clay loam, and the lower part is yellowish brown, light brownish gray, and light olive brown, mottled, friable and firm clay loam and loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam.

Typically, the surface layer of the Bassett soils is very dark brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part is yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Typically, the surface layer of the Clyde soils is black, friable clay loam about 8 inches thick. The subsurface layer is about 12 inches thick. The upper part is black, friable clay loam, and the lower part is black, mottled, friable clay loam. The subsoil is about 32 inches thick. The upper part is gray and dark grayish brown, mottled, friable loam, the next part is gray, mottled, friable sandy loam, and the lower part is gray, mottled, firm loam. The substratum to a depth of about 60 inches is gray, mottled loam.

Minor in this association are the Havana, Lourdes, Racine, and Schley soils. Havana soils are poorly drained. They are in flat and slightly concave areas. They are lower on the landscape than the Oran soils. Lourdes soils formed in very firm till on upland side slopes. They have a higher content of clay in the subsoil than the major soils. The well drained Racine soils formed in friable till. They are on convex side slopes below the Bassett soils. The somewhat poorly drained Schley soils formed in stratified loamy erosional sediments and the underlying firm, loamy glacial till. They are on slightly concave foot slopes in the uplands below the Bassett and Racine soils.

Most of the acreage in this association is used for cultivated crops. Some small areas are used for hay, pasture, or woodland. The soils in this association are well suited, moderately well suited, or moderately suited to cultivated crops. A subsurface tile drainage system lowers the water table in the Clyde soils.

The main management concerns are controlling erosion, reducing the wetness, and maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, and grassed waterways help to prevent excessive soil loss. The underlying material of most of the soils in this association is more dense and less permeable than the overlying material. As a result, subsurface water moves laterally down the side slopes and often surfaces as hillside seepage. A subsurface tile drainage system helps to remove excess water and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

3. Kenyon-Clyde-Floyd Association

Nearly level to moderately sloping, moderately well drained to poorly drained, dark soils formed in loamy erosional sediments and the underlying firm, loamy glacial till; on uplands

This association consists of soils on long, convex slopes and divides that have a well developed network of wide, low-gradient drainageways. The landscape is nearly level to gently rolling. Slopes range from 0 to 9 percent.

This association makes up about 31 percent of the county. It is about 33 percent Kenyon and similar soils, 20 percent Clyde soils, 15 percent Floyd soils, and 32 percent soils of minor extent (fig. 4).

Kenyon soils are moderately well drained. They are on convex ridgetops and side slopes. Clyde soils are

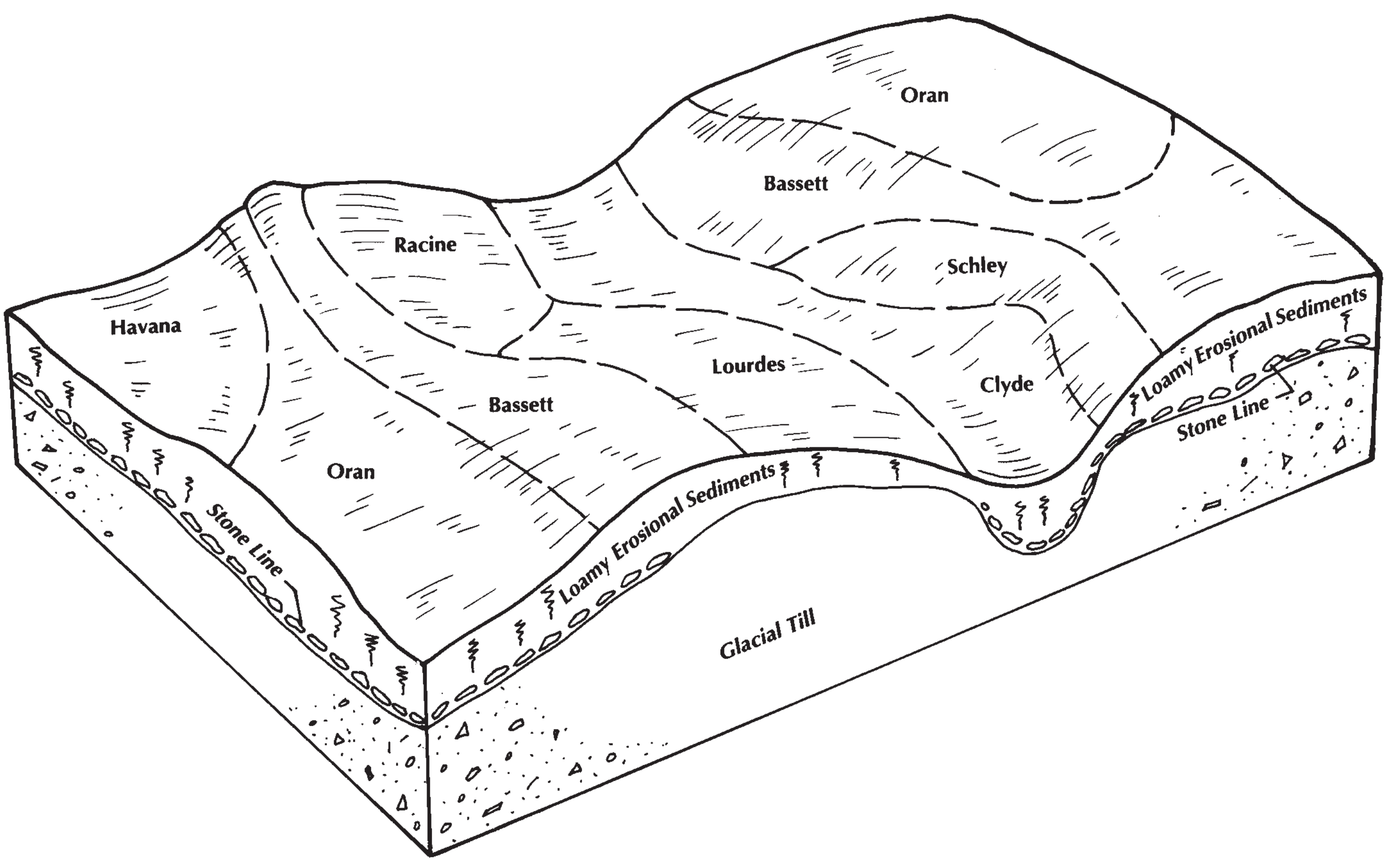

Figure 3.—Typical pattern of soils and underlying material in the Oran-Bassett-Clyde association.

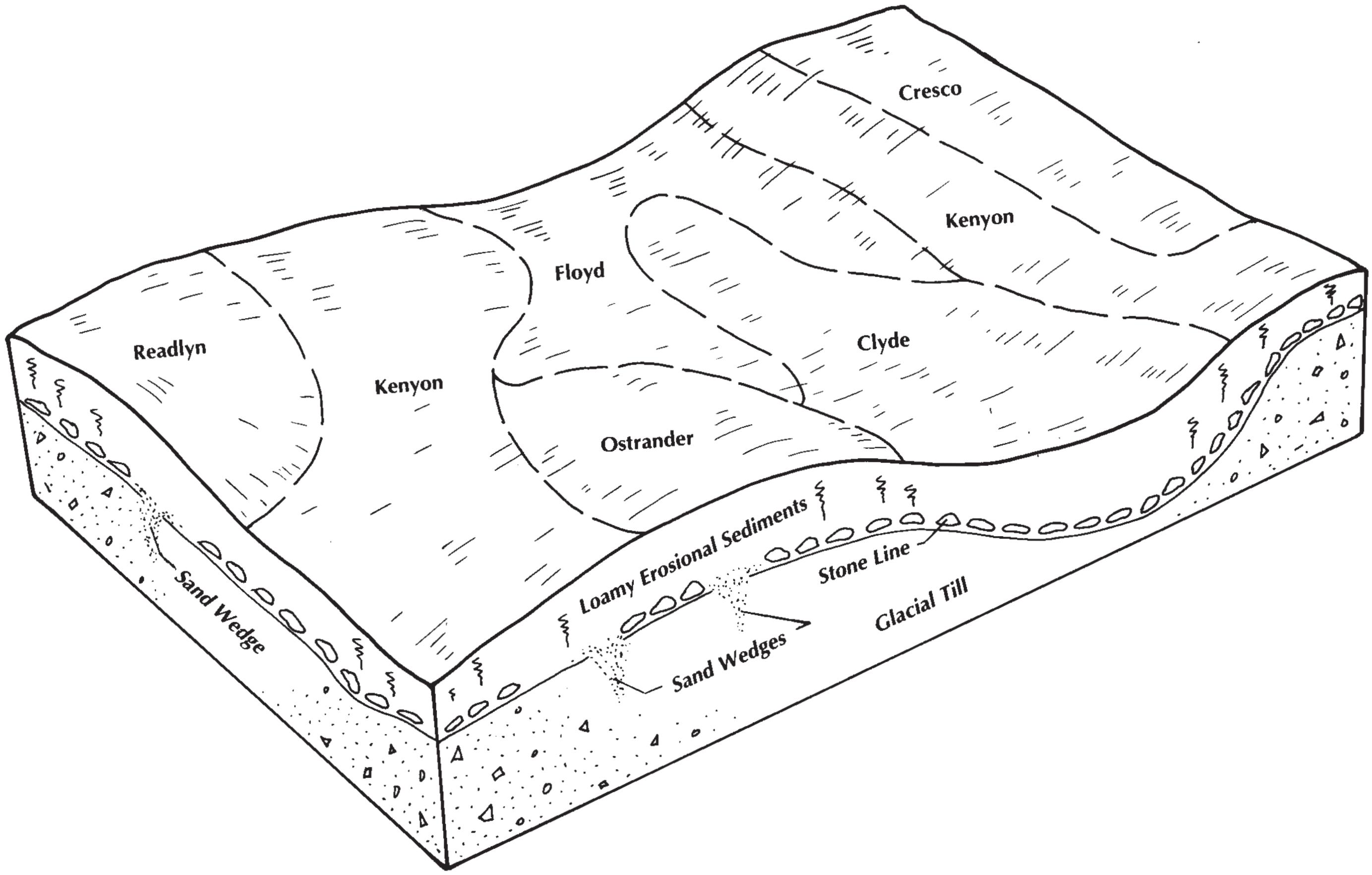

Figure 4.—Typical pattern of soils and underlying material in the Kenyon-Clyde-Floyd association.

poorly drained and are in intermittent upland drainageways. Floyd soils are somewhat poorly drained and are on concave foot slopes below the Kenyon soils and above the Clyde soils.

Typically, the surface layer of the Kenyon soils is black, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable loam about 6 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is brown and dark yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is yellowish brown, grayish brown, and strong brown, mottled, firm loam.

Typically, the surface layer of the Clyde soils is black, friable clay loam about 8 inches thick. The subsurface layer is about 12 inches thick. The upper part is black, friable clay loam, and the lower part is black, mottled, friable clay loam. The subsoil is about 32 inches thick. The upper part is gray and dark grayish brown, mottled, friable loam, the next part is gray, mottled, friable sandy loam, and the lower part is gray, mottled, firm loam. The substratum to a depth of about 60 inches is gray, mottled loam.

Typically, the surface layer of the Floyd soils is black, friable loam about 8 inches thick. The subsurface layer is black, very dark grayish brown, and dark grayish brown, friable loam about 11 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is olive brown and light olive brown, mottled, friable loam, the next part is dark yellowish brown and yellowish brown, mottled, friable sandy loam, and the lower part is grayish brown and yellowish brown, mottled, firm loam.

Minor in this association are the Cresco, Ostrander, and Readlyn soils. Cresco soils have more clay in the subsoil than the major soils. They are moderately slowly permeable. Ostrander soils are well drained. They formed in 36 or more inches of friable loamy sediments. They are on convex slopes. They are lower on the landscape than the Kenyon soils. Readlyn soils are somewhat poorly drained. They are on broad upland flats or in slightly convex areas. They are higher on the landscape than the Kenyon soils.

Most of the acreage in this association is used for cultivated crops. Some of the acreage in the very gently sloping areas is used for unimproved pasture or is idle land. If managed properly, most of the major soils are well suited, moderately well suited, or moderately suited to intensive row cropping.

The main management concerns are reducing the wetness, controlling erosion, and maintaining tilth and fertility. Contour farming and terraces help to control erosion but tend to increase the wetness. Terraces, contour farming, a subsurface drainage system, a conservation tillage system, and grassed waterways help to control erosion, improve drainage, and prevent gullying in areas of concentrated runoff.

4. Ostrander-Lilah Association

Gently sloping to strongly sloping, excessively drained and well drained soils formed in loamy erosional sediments and the underlying friable, loamy glacial till and underlying gravelly and sandy glacial outwash; on uplands and high benches

This association consists of soils on convex ridgetops and side slopes. The landscape is gently undulating to rolling. Slopes range from 2 to 14 percent.

This association makes up about 3 percent of the county. It is about 50 percent Ostrander soils, 15 percent Lilah soils, and 35 percent soils of minor extent.

Ostrander soils are well drained. They formed in loamy erosional sediments overlying glacial till. Lilah soils are excessively drained. They formed in loamy glacial outwash sediments overlying sand and gravel.

Typically, the surface layer of the Ostrander soils is black and very dark brown, friable loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 7 inches thick. The subsoil is friable loam about 33 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown loam.

Typically, the surface layer of the Lilah soils is very dark grayish brown, very friable sandy loam about 8 inches thick. It has about 10 to 15 percent gravel. The subsoil extends to a depth of about 60 inches. The upper part is brown, very friable sandy loam, the next part is strong brown and brown, very friable gravelly sandy loam, and the lower part is strong brown, loose coarse sand. Alternating bands of reddish brown loamy sand are between depths of 30 and 60 inches.

Minor in this association are the Donnan and Floyd soils. Donnan soils have a clayey paleosol at a depth of 20 to 40 inches. They are lower on the landscape than the Ostrander soils. Floyd soils are in drainageways. They are on foot slopes below the Ostrander and Lilah soils.

The main management concerns in areas of the Ostrander soils are controlling erosion and maintaining tilth and fertility. The major management concern in areas of the Lilah soils is droughtiness, but controlling erosion and maintaining tilth and fertility are concerns. A system of conservation tillage, grassed waterways, contour farming, and terraces help to control erosion and conserve moisture. Water tends to accumulate at the contact of the glacial till and the coarse material of the substratum in the Lilah soils. It seeps out further downslope and generally results in the formation of areas of muck or mucky peat, which hinder fieldwork.

5. Dickinson-Rockton Association

Gently sloping and moderately sloping, somewhat excessively drained and well drained soils formed in loamy eolian or erosional sediments over sand or the underlying residuum and limestone; on uplands

This association consists of soils on short, convex ridgetops and side slopes. The landscape is gently undulating to hilly and has well defined valleys and ridges. Slopes range from 2 to 9 percent.

This association makes up about 2 percent of the county. It is about 30 percent Dickinson soils, 25 percent Rockton and similar soils, and 45 percent soils of minor extent.

Dickinson soils are somewhat excessively drained. They are on ridges and side slopes. They formed in loamy eolian or erosional sediments over sand. Rockton soils are well drained. They are on short, convex side slopes. They formed in loamy sediments underlain by residuum and limestone bedrock.

Typically, the surface layer of the Dickinson soils is black and very dark brown, friable sandy loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown, friable sandy loam about 14 inches thick. The subsoil extends to a depth of 60 inches. The upper part is dark yellowish brown, very friable sandy loam, the next part is yellowish brown, very friable loamy sand, and the lower part is yellowish brown sand. A few alternating bands of dark brown sandy loam are between depths of 38 and 60 inches.

Typically, the surface layer of the Rockton soils is black, friable loam about 10 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 4 inches thick. The subsoil is friable clay loam about 10 inches thick. The upper part is brown, and the lower part is dark yellowish and yellowish brown. Hard, fractured limestone bedrock is at a depth of about 24 inches.

Minor in this association are the Bertram, Emeline, and Ostrander soils. Bertram soils formed in loamy material. They are underlain by limestone bedrock at a depth of 20 to 36 inches. Emeline soils have a thinner surface layer than the major soils. They are underlain by limestone bedrock at a depth of 4 to 20 inches. Ostrander soils formed in more than 60 inches of loamy sediments and glacial till. They have a high available water capacity.

Most of the gently sloping and moderately sloping soils are cultivated or are used for hay, pasture, or woodland. Most of the acreage of moderately sloping soils that have outcrops of limestone bedrock is pastured or wooded or is idle land.

The main management concerns are controlling erosion and maintaining tilth and fertility. A conservation tillage system and grassed waterways help to control erosion, prevent gullying in areas of concentrated runoff, and conserve moisture.

6. Cresco-Protivin-Jameston Association

Nearly level to moderately sloping, moderately well drained to poorly drained soils formed in loamy erosional sediments and the underlying very firm, loamy glacial till; on uplands

This association consists of soils on long, convex slopes and divides. The landscape is nearly level to gently rolling. Slopes range from 0 to 9 percent.

This association makes up about 5 percent of the county. It is about 22 percent Cresco soils, 20 percent Protivin soils, 20 percent Jameston and similar soils, and 38 percent soils of minor extent.

Cresco soils are moderately well drained. They are on convex ridgetops and side slopes. Protivin soils are somewhat poorly drained. They are on straight or slightly convex foot slopes and side slopes. Jameston soils are poorly drained. They are on slightly concave foot slopes and in the upper part of intermittent drainageways on uplands.

Typically, the surface layer of the Cresco soils is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 5 inches thick. The subsoil is about 41 inches thick. The upper part is brown and dark yellowish brown, friable clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam.

Typically, the surface layer of the Protivin soils is black, friable loam about 8 inches thick. The subsurface layer is black, friable clay loam about 7 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is dark grayish brown, mottled, firm clay loam, and the lower part is mottled strong brown and gray, very firm clay loam.

Typically, the surface layer of the Jameston soils is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and dark olive gray, mottled, friable silty clay loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is dark gray, mottled, friable silty clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam.

Minor in this association are the Clyde, Donnan, Kenyon, and Lourdes soils. Clyde soils formed in friable loamy sediments over firm glacial till. They are in landscape positions similar to those of the Jameston soils. They are moderately permeable, and the texture of their subsurface layer typically varies more than that of the Jameston soils. Donnan soils formed in friable loamy sediments over a very firm, gray clayey paleosol. They are on convex side slopes and ridgetops that are typically lower on the landscape than the Cresco soils. Kenyon soils formed in loamy erosional sediments over firm glacial till. They are in landscape positions similar to those of the Cresco soils. They are moderately permeable. Lourdes soils are in landscape positions similar to those of the Cresco soils. They have a thinner, lighter colored surface horizon than the Cresco soils.

Most of the soils in this association are used for cultivated crops. Corn and soybeans are the major crops. Some smaller fields are planted to oats. Other areas are used for hay or pasture. Erosion and wetness are the major management concerns. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. Since most conservation tillage systems will compound the wetness, a tile drainage system will help to overcome the wetness, improve yields, and improve the timeliness of fieldwork.

7. Coland-Marshan-Hayfield Association

Nearly level, poorly drained and somewhat poorly drained soils formed in loamy alluvial deposits and in the underlying sandy and gravelly glacial outwash; on flood plains and stream terraces

This association consists of soils on broad, nearly level flood plains and slightly elevated stream terraces along the major streams and their tributaries. The stream terraces are not subject to flooding. The flood plains generally include old stream channels and oxbows that commonly are ponded. Slopes range from 0 to 2 percent.

This association makes up about 7 percent of the county. It is about 40 percent Coland soils, 25 percent Marshan and similar soils, 22 percent Hayfield soils, and 13 percent soils of minor extent (fig. 5).

Coland soils are poorly drained. They are on flood plains and in channeled areas adjacent to streams. Marshan soils are poorly drained. They are in plane or

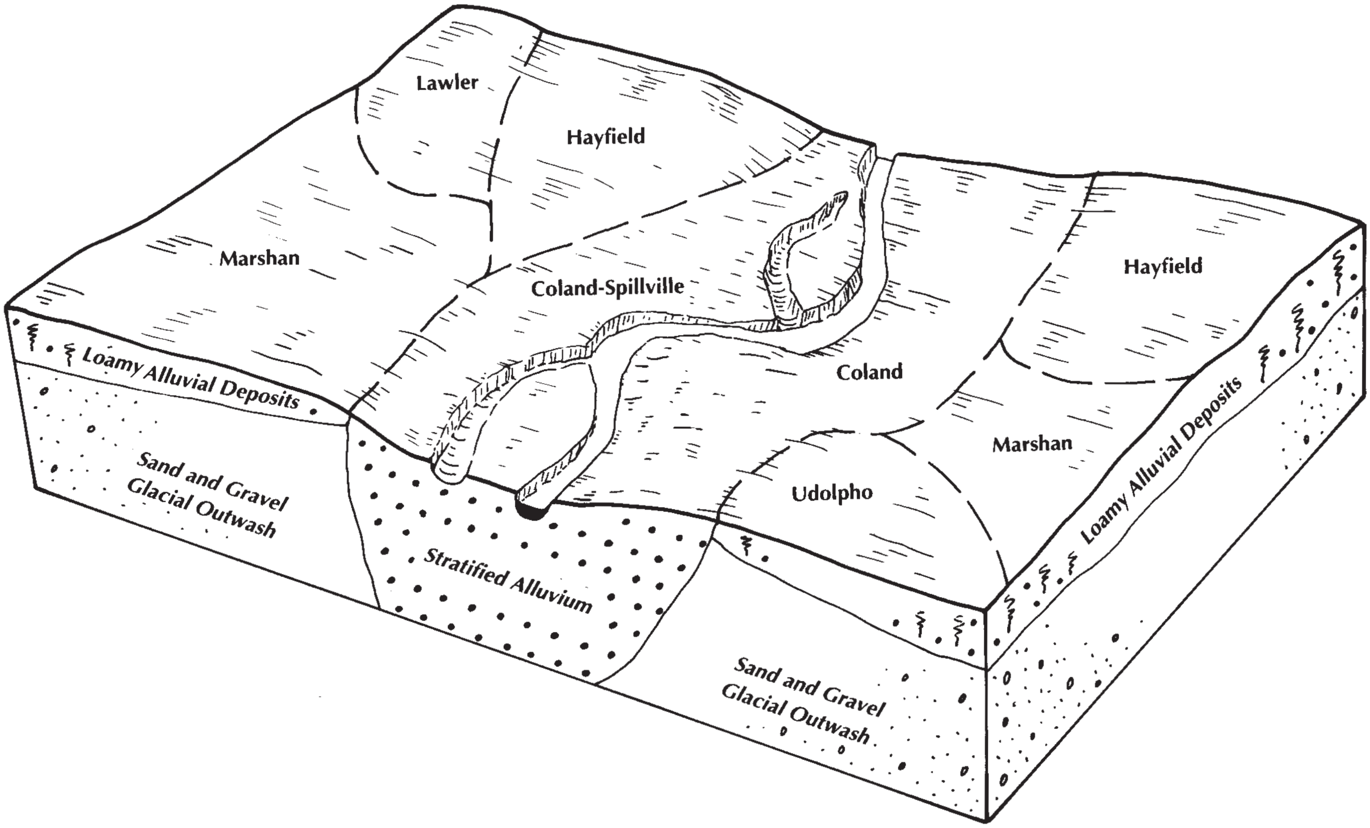

Figure 5.—Typical pattern of soils and underlying material in the Coland-Marshan-Hayfield association.

slightly concave areas on slightly elevated stream terraces. Hayfield soils are somewhat poorly drained. They are in slightly convex or plane areas on elevated stream terraces. All of the major soils in this association have a seasonal high water table.

Typically, the surface layer of the Coland soils is black, friable clay loam about 8 inches thick. The subsurface layer is friable clay loam about 30 inches thick. The upper part is black, and the lower part is black and mottled. The next layer is black and dark grayish brown, mottled, friable clay loam. The upper part of the substratum is grayish brown, mottled clay loam. The lower part to a depth of about 60 inches is grayish brown, mottled, stratified loam, clay loam, and silt loam.

Typically, the surface layer of the Marshan soils is black, friable clay loam about 8 inches thick. The subsurface layer is about 9 inches thick. The upper part is black, friable clay loam, and the lower part is olive gray and dark gray, friable silty clay loam. The subsoil is about 9 inches thick. The upper part is grayish brown, mottled, friable clay loam, and the lower part is grayish brown, light brownish gray, yellowish brown, and strong brown, mottled, very friable sandy loam. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled gravelly coarse sand.

Typically, the surface layer of the Hayfield soils is very dark grayish brown, friable loam about 7 inches thick. The subsoil is about 17 inches thick. The upper part is brown and dark yellowish brown, mottled, friable loam, the next part is olive brown, mottled, friable loam, and the lower part is dark yellowish brown, mottled, very friable loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loamy coarse sand and gravelly coarse sand.

Minor in this association are the Lawler, Spillville, and Udolpho soils. Lawler soils are in landscape positions similar to those of the Hayfield soils. They have a thicker, darker surface layer and contain more organic matter than the Hayfield soils. Spillville soils are somewhat poorly drained. They are on flood plains. They are slightly higher on the landscape than the Coland soils and have less clay. Udolpho soils are in landscape positions similar to those of the Marshan soils. They have a thinner, lighter colored surface layer than the Marshan soils.

Coland and Spillville soils occur as areas so closely intermingled that they could not be separated in mapping. Coland soils are used for cultivated crops or as woodland, pasture, or wildlife habitat. Marshan and Hayfield soils generally are used for cultivated crops.

The major management concern in cultivated areas of the Coland and Marshan soils is wetness. Coland soils also are subject to flooding. Droughtiness is a limitation in areas of the Hayfield soils. A system of conservation tillage that leaves crop residue on the surface helps to maintain tilth and conserve moisture.

8. Spillville-Wapsie Association

Nearly level to gently sloping, somewhat poorly drained and well drained soils formed in loamy alluvium; on flood plains and stream terraces

This association consists of soils on nearly level flood plains and the slightly higher stream terraces that border major streams. The soils on flood plains are subject to flooding, while the soils on terraces generally are not flooded. The soils on flood plains generally are characterized by old stream channels and oxbows. Slopes range from 0 to 5 percent.

This association makes up about 7 percent of the county. It is about 30 percent Spillville soils, 25 percent Wapsie soils, and 45 percent soils of minor extent.

Spillville soils are somewhat poorly drained. They are on flood plains. They are intricately mixed with recent deposits of loamy material that have not had sufficient time to develop a soil profile. Wapsie soils are well drained. They are on plane or slightly convex slopes on high stream terraces that border flood plains.

Typically, the surface layer of the Spillville soils is black and very dark gray, friable loam about 8 inches thick. The subsurface layer is friable loam about 40 inches thick. The upper part is black and very dark gray, and the lower part is black. Next is a transitional layer of very dark grayish brown and black, mottled, friable sandy loam. The substratum to a depth of about 60 inches is brown and dark yellowish brown sandy loam.

Typically, the surface layer of the Wapsie soils is very dark brown, friable loam about 8 inches thick. The subsurface layer is brown, friable loam about 5 inches thick. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown and dark yellowish brown, very friable sandy loam that has about 5 percent gravel. The substratum to a depth of about 60 inches is yellowish brown gravelly sand and gravelly coarse sand.

Minor in this association are the Burkhardt, Lawler, and Saude soils. Burkhardt soils have more sand in the surface layer than the major soils. They are somewhat excessively drained. Lawler soils are somewhat poorly drained. They are slightly lower on the landscape than the Wapsie soils. Saude soils are in landscape positions similar to those of the Wapsie soils. They have a thicker, darker surface layer and a higher content of organic matter than the Wapsie soils.

Spillville soils are used for cultivated crops or as woodland, pasture, or wildlife habitat. Wapsie soils are used for cultivated crops.

The main management concerns in areas of the Spillville soils are improving the stand of vegetation in pastures and woodlots and protecting the soils from flooding in cultivated areas. The main management concerns in areas of the Wapsie soils are maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture in areas of the Wapsie soils, which are subject to droughtiness.

Detailed Soil Map Units

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

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

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

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, 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 substratum. 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, Kenyon loam, 2 to 5 percent slopes, is a phase of the Kenyon 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. Clyde-Floyd complex, 1 to 4 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. The map unit Pits, sand and gravel, 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

63C—Chelsea loamy sand, 2 to 9 percent slopes. This gently sloping and moderately sloping, excessively drained soil dominantly is on moundlike ridges and convex side slopes in the uplands. These areas generally are adjacent to stream valleys. In places this soil is on alluvial terraces. Areas range from 3 to 20 acres in size. They are irregularly shaped or round.

Typically, the surface layer is dark brown, very friable loamy sand about 6 inches thick. The subsurface layer is dark yellowish brown, very friable loamy fine sand about 16 inches thick. The subsoil to a depth of about 60 inches is brown and yellowish brown, loose sand that has alternate bands of dark brown loamy sand. In some areas the sandy material is coarser textured. In other areas the subsoil does not have lamellae.

Included with this soil in mapping are small areas of the well drained Billett soils in landscape positions similar to those of the Chelsea soil. These soils have a slightly higher available water capacity than the Chelsea soil. They make up less than 5 percent of the unit.

Permeability of this Chelsea soil is rapid, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is 0.5 to 1.5 percent. The subsurface layer generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for pasture. A few small areas of this soil are cultivated along with larger areas of adjacent soils that are well suited to crops. This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses and legumes for hay and pasture. Droughtiness is a limitation. Soil blowing dominantly occurs on the round, convex shoulder slopes. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface or cover crops help to prevent excessive soil loss and conserve moisture. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Tilth generally is poor. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to maintain the organic matter content, and helps to provide a good seedbed.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet or too dry reduces the extent of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Since seedling mortality is a moderate limitation, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The land capability classification is IVs.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on long, convex ridgetops and side slopes in the uplands. Areas range from 2 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable loam about 6 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is brown and dark yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is yellowish brown, grayish brown, and strong brown, mottled, firm loam. In places the soils are moderately sloping.

Included with this soil in mapping are small areas of the somewhat poorly drained Floyd and Readlyn soils. Floyd soils are on foot slopes below the Kenyon soil. Readlyn soils are in the higher, nearly level areas. Floyd and Readlyn soils are wetter than the Kenyon soil. As a result, fieldwork is delayed unless the Floyd and Readlyn soils are drained. Included soils make up about 5 percent of the unit.

Permeability of this Kenyon soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

83C—Kenyon loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 30 acres in size. They are commonly somewhat narrow, irregularly shaped bands.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is brown and dark yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is yellowish brown, grayish brown, and strong brown, firm loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown loam.

Permeability of this Kenyon soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is moderately suited to corn and soybeans. It is well suited to small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on side slopes in the uplands. Areas range from 3 to 30 acres in size. They are commonly somewhat narrow, irregularly shaped bands.

Typically, the surface layer is dominantly black, friable loam about 7 inches thick. It is mixed with streaks and pockets of brown and dark yellowish brown material from the subsoil. The subsoil is about 35 inches thick. The upper part is brown and dark yellowish brown, friable loam, and the lower part is yellowish brown, grayish brown, and strong brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. In places the surface layer has a lower content of organic matter and a higher content of clay because of severe erosion.

Permeability of this Kenyon soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.2 to 3.2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately suited to corn and soybeans. It is well suited to small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. Terraces and a system of conservation tillage that leaves crop residue on the surface help to prevent excessive soil loss. Grassed waterways help to prevent gully erosion. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Tilth is fair in the surface layer. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed on this soil than on the Kenyon soils that are not so eroded. Also, more intensive management is needed to maintain productivity and tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

84—Clyde clay loam, 0 to 3 percent slopes. This nearly level and very gently sloping, poorly drained soil is in intermittent upland drainageways. It receives runoff from adjacent upland slopes. Areas range from 10 to more than 100 acres in size. They are elongated and irregularly shaped.

Typically, the surface layer is black, friable clay loam about 8 inches thick. The subsurface layer is black, friable clay loam about 12 inches thick. It is mottled in the lower part. The subsoil is about 32 inches thick. The upper part is gray and dark grayish brown, mottled, friable loam, the next part is gray, mottled, friable sandy loam, and the lower part is gray, mottled, firm loam. The substratum to a depth of about 60 inches is gray, mottled loam. In places the surface layer is loam.

Included with this soil in mapping are small areas of the Marshan and Palms soils. Marshan soils contain more sand and gravel and less clay in the lower part of the subsoil than the Clyde soils. They are on the lower part of the landscape. Palms soils are very poorly drained. They have a surface layer and subsurface layer of muck. They are in adjacent landscape positions similar to those of the Clyde soil. Included soils make up about 10 percent of the unit.

Permeability of this Clyde soil is moderate, and runoff is slow. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter in the surface layer is 6 to 9 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some areas are used for pasture. If drained and protected against runoff from adjacent upland slopes, this soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Glacial stones and boulders are common in many unimproved, undrained areas. A drainage system lowers the water table and improves the timeliness of fieldwork. Installing the tile is difficult in some areas because of the very friable, water-bearing sandy sediments. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Grassed waterways help to remove excess water from adjacent upland slopes. In areas where the soil is drained, good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is saturated causes surface compaction and poor tilth, increases the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

135—Coland clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains. It is subject to occasional flooding. Areas range from 4 to 50 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable clay loam about 8 inches thick. The subsurface layer is black, friable clay loam about 30 inches thick. It is mottled in the lower part. The next layer is black and dark grayish brown, mottled, friable clay loam. The upper part of the substratum is grayish brown, mottled clay loam, and the lower part to a depth of about 60 inches is grayish brown, mottled stratified loam, clay loam, and silt loam. In places the surface layer is loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 5 to 7 percent. The soil has a seasonal high water table. The subsurface layer and substratum generally have a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Some areas that are not protected from flooding or that are isolated by a meandering stream are used for pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained and if flooding is controlled. Good tilth generally can be easily maintained. Chisel plowing improves the rate of water infiltration by making the surface more pervious to water. Cultivating when the soil is too wet causes surface compaction and cloddiness. Returning crop residue to the soil or regularly adding other organic material helps to prevent surface crusting and increases the rate of water infiltration. Water-tolerant grasses and legumes should be selected for planting in pastures.

The seasonal high water table and the flooding are the main limitations if this soil is used for trees and shrubs grown as windbreaks or ornamental plantings. Only the species that can tolerate the wetness and the flooding should be selected for planting.

The land capability classification is IIw.

151—Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, poorly drained soil is on stream terraces. Areas range from 10 to more than 160 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable clay loam about 8 inches thick. The subsurface layer is about 9 inches thick. The upper part is black, friable clay loam, and the lower part is olive gray and dark gray, friable silty clay loam. The subsoil is about 9 inches thick. The upper part is grayish brown, mottled, friable clay loam, and the lower part is grayish brown, light brownish gray, yellowish brown, and strong brown, mottled, very friable sandy loam. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled gravelly coarse sand. In some places the surface layer is loam. In other places the depth to the gravelly substratum is less than 24 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Lawler and very poorly drained Shandep soils. Lawler soils are in the slightly higher areas. Shandep soils are in depressions. They are subject to ponding. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of this Marshan soil and rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 5 to 6 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. When drained, this soil is well suited to intensive row cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Measures that help to control runoff from the higher elevations may be needed. Establishing adequate drainage outlets and installing drainage tile are difficult in some areas because of the level topography. Installing drainage tile also may be difficult because in some areas water-bearing sand and gravel is at a depth of less than 24 inches. In areas where the soil is drained, good tilth generally can easily be maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, poorly drained soil is on stream terraces. Areas range from 10 to more than 160 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable clay loam about 8 inches thick. The subsurface layer is about 14 inches thick. The upper part is black, friable clay loam, and the lower part is olive gray and dark gray, friable silty clay loam. The subsoil is about 14 inches thick. The upper part is grayish brown, mottled, friable clay loam, and the lower part is grayish brown, light brownish gray, yellowish brown, and strong brown, mottled, very friable sandy loam. The substratum to a depth of about 60 inches is light brownish gray and yellowish brown, mottled gravelly coarse sand. In some places the surface layer is loam. In other places the depth to the gravelly substratum is more than 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Lawler and very poorly drained Shandep soils. Lawler soils are in the slightly higher areas. Shandep soils are in depressions. They are subject to ponding. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of this Marshan soil and rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 5 to 6 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. When drained, this soil is well suited to intensive row cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Measures that help to control runoff from the higher elevations may be needed. Establishing adequate drainage outlets and installing drainage tile are difficult in some areas because of the level topography and the water-bearing sand and gravel. In areas where the soil is drained, good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

153—Shandep clay loam, 0 to 1 percent slopes. This level, very poorly drained soil is in depressions on alluvial terraces. Areas range from about 2 to 7 acres in size. They are round or elliptical.

Typically, the surface layer and subsurface layer are black, friable clay loam. The combined thickness of these layers is about 33 inches. The subsoil is gray, mottled, friable silty clay loam about 16 inches thick. The substratum to a depth of about 60 inches is grayish brown and gray gravelly coarse sand.

Permeability is moderate in the subsoil and rapid in the substratum. This soil is subject to ponding. It has a seasonal high water table. Available water capacity is high. The content of organic matter in the surface layer is 7 to 9 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas of this soil are not drained. These areas are unsuited to cultivated crops, hay, pasture, and trees. They typically contain hydrophytic vegetation, such as cattail, sedges, and water-tolerant grasses. If properly drained, the soil is moderately suited to corn, soybeans, and small grain and to water-tolerant grasses and legumes for hay and pasture. Installing a tile drainage system may be difficult because adequate outlets are often not available.

Drained areas of this soil can be used for pasture.

Overgrazing or grazing when the soil is too wet causes surface compaction and results in deterioration of tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is Vw.

171B—Bassett loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges and side slopes in the uplands. Areas range from 5 to 50 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part is yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Oran soils. These soils are in the higher, nearly level areas. The increased wetness can interfere with the timeliness of fieldwork. These soils make up less than 5 percent of the unit.

Permeability of this Bassett soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Some small areas support native hardwoods. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIe.

171C—Bassett loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 3 inches thick. The subsoil is about 34 inches thick. The upper part is yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Included with this soil in mapping are small areas of sandy soils. These soils are droughty. They generally make up less than 5 percent of the unit.

Permeability of this Bassett soil is moderate, and runoff is medium. Available water capacity is high. The organic matter content of the surface layer is 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for pasture. Many are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can easily be maintained. Grassed waterways help to prevent gully erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Some small areas support native hardwoods. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIIe.

171C2—Bassett loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly very dark brown, friable loam about 6 inches thick. It is mixed with streaks and pockets of yellowish brown material from the subsoil. The subsoil is about 30 inches thick. The upper part is yellowish brown, friable loam, the next part is yellowish brown, firm loam, and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam. In places the surface layer has a lower content of organic matter and a higher content of clay because the soil has been severely eroded.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Grassed waterways help to prevent gully erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed in areas of this soil than in areas of Bassett soils that are not so eroded. Intensive management is needed to maintain productivity and tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Very few areas support native hardwoods. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIIe.

173—Hoopeston sandy loam, 0 to 3 percent slopes. This nearly level and very gently sloping, somewhat poorly drained soil is on broad upland flats. Areas range from 2 to 5 acres in size. They are circular or irregularly shaped.

Typically, the surface layer is black, friable sandy loam about 8 inches thick. The subsurface layer is black, friable sandy loam about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, mottled, friable sandy loam, and the lower part is grayish brown and light olive brown, mottled, very friable loamy sand. The substratum to a depth of about 60 inches is pale brown and olive brown, mottled loamy sand. In places, the subsoil is dark brown and dark yellowish brown and the soil is not so wet.

Permeability is moderately rapid, and runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 2 to 3 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Droughtiness is a limitation, and soil blowing is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and conserves moisture.

A cover of pasture plants or hay helps to control soil blowing. Soil blowing is a hazard if this soil is overgrazed.

The land capability classification is IIs.

175B—Dickinson sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on ridges and side slopes in the uplands and on stream terraces. Areas range from 2 to 60 acres in size. They are irregularly shaped or oval.

Typically, the surface layer is black and very dark brown, friable sandy loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown, friable sandy loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, very friable sandy loam, the next part is yellowish brown, very friable loamy sand, and the lower part is yellowish brown sand.

Between depths of 38 and 60 inches are a few alternating bands of dark brown sandy loam.

Included with this soil in mapping are small areas of excessively drained sandy soils. These soils are in landscape positions similar to those of the Dickinson soil. They make up about 10 percent of the unit.

Permeability of this Dickinson soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is very friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for pasture or hay. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Droughtiness is a limitation during periods of below average rainfall. Soil blowing is a hazard in areas where cultivated crops are grown. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface, cover crops, and grassed waterways help to prevent excessive soil loss from water erosion and soil blowing. The soil is poorly suited to terracing because ridging the moderately coarse textured material is difficult and the underlying coarse textured material is too close to the surface in places. The soil warms up quickly in the spring, thus stimulating early plant growth. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material conserves moisture, improves fertility, helps to prevent surface crusting and excessive soil loss, and helps to increase the available water capacity.

If this soil is used for pasture, overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during excessively dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

175C—Dickinson sandy loam, 5 to 9 percent slopes. This moderately sloping, somewhat excessively drained soil is on convex upland ridges and side slopes and on dunes on stream terraces. Areas range from 4 to 20 acres in size. They are irregularly shaped or oval.

Typically, the surface layer is black and very dark brown, friable sandy loam about 8 inches thick. The subsurface layer is black, very dark brown and dark brown, friable sandy loam about 10 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, very friable sandy loam, the next part is yellowish brown, very friable loamy sand, and the lower part is yellowish brown sand. Between depths of 32 and 60 inches are a few alternating bands of dark brown sandy loam.

Included with this soil in mapping are small areas of excessively drained sandy soils. These soils are in landscape positions similar to those of the Dickinson soil. They make up about 10 percent of the unit.

Permeability of this Dickinson soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Soil blowing and water erosion are hazards. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. The soil is droughty during periods of below average rainfall. Stripcropping, a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, or a combination of these practices help to prevent excessive soil loss from water erosion and soil blowing. The soil is poorly suited to terracing because ridging the moderately coarse textured material is difficult and the underlying coarse textured material is too close to the surface in places. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material conserves moisture, improves fertility, helps to prevent surface crusting and excessive soil loss, and helps to increase the available water capacity.

If this soil is used for pasture, overgrazing causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

177—Saude loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces. Areas range from 2 to 80 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark brown and black, friable loam about 5 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, friable loam, the next part is brown, friable loam, and the lower part is dark yellowish brown, very friable sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown gravelly coarse sand. In places sand and gravel is at a depth of less than 24 inches.

Permeability is moderate in the loamy material and very rapid in the gravelly substratum. Runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is 3.5 to 4.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The low available water capacity and droughtiness are limitations. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIs.

177B—Saude loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream terraces and convex upland ridges and side slopes. Areas range from 2 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark brown and black, friable loam about 4 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown and very dark brown, friable loam, and the lower part is dark yellowish brown and brown, very friable sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown gravelly coarse sand. In places sand and gravel is at a depth of less than 24 inches.

Permeability is moderate in the loamy material and very rapid in the gravelly substratum. Runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 3 to 4 percent. The surface layer generally has a very low supply of available phosphorus and potassium. It is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. The low available water capacity and droughtiness are limitations. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Contour farming generally is difficult because slopes are short and irregular. The soil is not well suited to terracing because the substratum is coarse textured. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIe.

198B—Floyd loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is on concave foot slopes and in intermittent upland drainageways. It receives runoff from adjacent upland slopes. Areas range from 2 to 80 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, very dark grayish brown, and dark grayish brown, friable loam about 11 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is olive brown and light olive brown, mottled, friable loam, the next part is dark yellowish brown and yellowish brown, mottled, friable sandy loam, and the lower part is grayish brown and yellowish brown, mottled, firm loam. In places the subsoil and substratum are sandy loam.

Permeability is moderate, and runoff is slow or medium. Available water capacity is high. The content of organic matter in the surface layer is 5 to 6 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Glacial stones and boulders are common in many unimproved, undrained areas. A tile drainage system can improve the timeliness of fieldwork. A system of conservation tillage that leaves crop residue on the surface helps to improve the rate of water infiltration. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas of this soil generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth, increases the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

213B—Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 10 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 4 inches thick. The subsoil is friable clay loam about 21 inches thick. The upper part is brown, and the lower part is dark yellowish brown and yellowish brown. Fractured limestone bedrock is at a depth of about 35 inches. In places the limestone bedrock is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Kenyon soils. They are on the ridges above the Rockton soil. They have a higher available water capacity and are not so droughty as the Rockton soil. They make up less than 10 percent of the unit.

Permeability of this Rockton soil is moderate, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are used for cultivated crops. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss and conserve moisture. The soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Plant growth is limited during the growing season because of the low available water capacity. Pastures should not be overgrazed during droughts. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIe.

214B—Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 5 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 10 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 4 inches thick. The subsoil is friable clay loam about 10 inches thick. The upper part is brown, and the lower part is dark yellowish brown and yellowish brown. Hard, fractured limestone bedrock is at a depth of about 24 inches.

Included with this soil in mapping are small areas of Emeline soils where the limestone bedrock is near or at the surface. These areas are on the lower part of side slopes. The bedrock hinders fieldwork. These soils make up less than 5 percent of the unit.

Permeability of this Rockton soil is moderate, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is subject to water erosion and is droughty. The root zone is limited by the depth to bedrock. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other material increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. The low available water capacity limits plant growth during the latter part of the growing season. Pastures should not be overgrazed during this time. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIe.

214C—Rockton loam, 20 to 30 inches to limestone, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 5 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 2 inches thick. The subsoil is friable clay loam about 10 inches thick. The upper part is brown, and the lower part is dark yellowish brown and yellowish brown. Hard, fractured limestone bedrock is at a depth of about 20 inches.

Included with this soil in mapping are small areas of Emeline soils where the limestone bedrock is near or at the surface. These areas are on the lower part of side slopes. The bedrock hinders fieldwork. These soils make up less than 10 percent of the unit.

Permeability of this Rockton soil is moderate, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. This soil is moderately suited to corn, soybeans, and small grain and well suited to grasses and legumes for hay and pasture. Water erosion is a hazard, and droughtiness is a limitation. The root zone is limited by the depth to bedrock. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. The soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other material increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Pastures should not be overgrazed at that time. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

221B—Palms muck, 1 to 4 percent slopes. This nearly level to gently sloping, very poorly drained soil is in seepy areas on hillsides and in intermittent upland drainageways. The seepy areas are fed by springs. Areas range from 2 to 25 acres in size. They are irregularly shaped.

Typically, the surface layer is black, nonsticky muck about 8 inches thick. The subsurface layer is black and very dark gray, slightly sticky muck about 26 inches thick. The substratum to a depth of about 60 inches is sandy loam. The upper part is greenish gray, and the lower part is olive gray and olive brown.

Included with this soil in mapping are small areas of Houghton soils. These soils cannot be drained as easily as the Palms soil because the organic layers are 60 or more inches thick. They typically are on the foot slope of hillsides. They make up less than 5 percent of the unit.

Permeability of this Palms soil is moderate, and runoff is very slow. Available water capacity is very high. The content of organic matter in the surface layer is more than 20 percent. The soil has a seasonal high water table that is near or at the surface. The substratum generally has a very low supply of available phosphorus and potassium.

Most of the acreage of this soil is in pasture or is idle land. Some areas are cultivated. The soil is wet because of the seasonal high water table and seepage. If tile is installed in the surface layer or subsurface layer, the organic material settles and shrinks. As a result, the tile is displaced and does not function properly. In some areas establishing an adequate outlet is difficult. In many areas surface tile inlets or shallow drainage ditches remove excess water. Tilth generally is poor in the surface layer.

In undrained areas, this soil is poorly suited to pasture and the acreage generally is idle land because the spongy surface layer cannot withstand grazing. In drained areas that are used as pasture, stocking and grazing should be limited during wet periods. Maintaining stands of legumes may be difficult because the plants are subject to winterkill and to root and crown diseases.

This soil is poorly suited to trees because of the seasonal high water table. The equipment limitation, seedling mortality, and the windthrow hazard are severe. Operating logging machinery is difficult because of the spongy surface layer. Ordinary logging equipment should be used only during the drier periods or during winter when the ground is frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees.

The land capability classification is Vw.

225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces. Areas range from 2 to more than 40 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 8 inches thick. The subsoil is about 10 inches thick. The upper part is dark grayish brown, mottled, friable loam, and the lower part is yellowish brown and brown, mottled, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown and grayish brown gravelly loamy sand. In places sand and gravel is at a depth of less than 24 inches.

Included with this soil in mapping are small areas of poorly drained Marshan soils in slight depressions. These soils make up about 5 percent of the unit.

Permeability is moderate in the loamy material and very rapid in the substratum. Runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is 4 to 5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth is limited during the latter part of the growing season because of the low available water capacity. The water table is moderately high in the spring but drops rapidly during the growing season. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to improve soil aeration and tilth. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIs.

226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 15 inches thick. The subsoil is about 13 inches thick. The upper part is dark grayish brown, mottled, friable loam, and the lower part is yellowish brown and brown, mottled, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown and grayish brown gravelly loamy sand. In some places sand and gravel is at a depth of more than 40 inches. In other places the subsoil is browner and better drained.

Included with this soil in mapping are small areas of poorly drained Marshan soils in slight depressions. These areas make up less than 5 percent of the unit.

Permeability is moderate in the loamy material and very rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 4 to 5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth is limited during the latter part of the growing season because of the moderate available water capacity. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to improve soil aeration and tilth. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIs.

284—Flagler sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on stream terraces. Areas range from 2 to 60 acres in size. They are irregularly shaped.

Typically, the surface layer is black, very friable sandy loam about 12 inches thick. The subsurface layer is black and very dark brown, very friable sandy loam about 11 inches thick. The subsoil is dark yellowish brown, very friable sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is yellowish brown stratified gravelly coarse sand and coarse sand.

Included with this soil in mapping are small areas of Burkhardt soils that are less than 18 inches to sand and gravel. These soils are on the slightly higher knolls. They make up less than 10 percent of the unit.

Permeability of this Flagler soil is moderately rapid, and runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. Many small areas of this soil are cropped along with larger areas of adjacent soils that are better suited to crops. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

If this soil is used for pasture, overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIIs.

284B—Flagler sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on stream terraces and on the convex summit and side slopes of high benches. Areas range from 2 to 30 acres in size. They generally are long and narrow, but some are irregularly shaped.

Typically, the surface layer is black, very friable sandy loam about 11 inches thick. The subsurface layer is black and very dark brown, very friable sandy loam about 10 inches thick. The subsoil is dark yellowish brown, very friable sandy loam about 9 inches thick. The substratum to a depth of about 60 inches is yellowish brown stratified gravelly coarse sand and coarse sand.

Included with this soil in mapping are small areas of Burkhardt soils that are less than 18 inches to sand and gravel. These soils are excessively drained. They are on the slightly higher knolls. They make up about 10 percent of the unit.

Permeability of this Flagler soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is very friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. Many small areas of this soil are cropped with large areas of adjacent soils that are better suited to crops. This soil is moderately well suited to corn and soybeans. It is suited to small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured, the underlying coarse textured material is too close to the surface, and the slopes are short and irregular. If terraces are built, cuts should not expose the coarse textured material. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

284C—Flagler sandy loam, 5 to 9 percent slopes. This moderately sloping, somewhat excessively drained soil is on the convex summit and side slopes of high benches. Areas range from 5 to more than 30 acres in size. They are irregularly shaped.

Typically, the surface layer is black, very friable sandy loam about 10 inches thick. The subsurface layer is black and very dark brown, very friable sandy loam about 8 inches thick. The subsoil is dark yellowish brown, very friable sandy loam about 9 inches thick. The substratum to a depth of about 60 inches is yellowish brown stratified gravelly coarse sand and coarse sand. In places the soil is more sloping.

Included with this soil in mapping are small areas of Burkhardt soils that are less than 18 inches to sand and gravel. These soils are excessively drained. They are on the more convex-shaped knolls. They make up about 10 percent of the unit.

Permeability of this Flagler soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is very friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. Many small areas of this soil are cropped with large areas of adjacent soils that are better suited to crops. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured and the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and excessive damage to plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

284C2—Flagler sandy loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat excessively drained soil is on the convex summit and side slopes of high benches. Areas range from 5 to more than 30 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly black, very friable sandy loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown material from the subsoil. The subsoil is dark yellowish brown, very friable sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is yellowish brown stratified gravelly coarse sand and coarse sand. In places the soil is more sloping.

Included with this soil in mapping are small areas of Burkhardt soils that are less than 18 inches to sand and gravel. These soils are excessively drained. They are on the more convex-shaped knolls. They make up about 10 percent of the unit.

Permeability of this Flagler soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is very friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. Many small areas of this soil are cultivated along with large areas of adjacent soils that are better suited to crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured and the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and excessive damage to plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

285—Burkhardt sandy loam, 0 to 2 percent slopes. This nearly level, excessively drained soil is on stream terraces. Areas range from 2 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable sandy loam about 10 inches thick. The subsoil is about 8 inches thick. The upper part is dark brown, friable sandy loam, and the lower part is dark brown, very friable and loose gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown gravelly coarse sand and extremely gravelly coarse sand. In places the surface layer is loamy sand or gravelly loamy sand.

Permeability is rapid, and runoff is slow. Available water capacity is very low. The content of organic matter in the surface layer is 2 to 3 percent. The soil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for hay or pasture. Some are cultivated. Many small areas of this soil are cropped along with large areas of adjacent soils that are better suited to crops. This soil is moderately suited to corn and soybeans. It is suited to small grain and to grasses and legumes for hay and pasture. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. Plant growth is limited throughout the growing season because of the very low available water capacity. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured and the underlying coarse textured material is too close to the surface. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Tilth generally is poor. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration and the available water capacity.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too dry causes deterioration of tilth and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is moderately suited to trees. Most of the trees are in groves or around farmsteads. Because of the droughtiness, seedlings do not survive and grow well. They should be planted at close intervals because the survival rate is limited. Thinning stands helps to provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting.

The land capability classification is IVs.

285B—Burkhardt sandy loam, 2 to 5 percent slopes. This gently sloping, excessively drained soil is on stream terraces and on ridges and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable sandy loam about 10 inches thick. The subsoil is about 8 inches thick. The upper part is dark brown, friable sandy loam, and the lower part is dark brown, very friable and loose gravelly loamy sand. The substratum to a depth of about 60 inches is strong brown gravelly coarse sand and extremely gravelly coarse sand. In places the surface layer is loamy sand or gravelly loamy sand.

Permeability is rapid, and runoff is medium. Available water capacity is very low. The content of organic matter is 1.5 to 2.5 percent in the surface layer. The soil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for hay or pasture. Some are cultivated. Many small areas of this soil are cropped along with large areas of adjacent soils that are better suited to crops. This soil is moderately suited to corn and soybeans. It is suited to small grain and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. Plant growth is limited during the growing season because of the very low available water capacity. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured and the underlying coarse textured material is too close to the surface. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and west-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration and the available water capacity.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too dry causes poor tilth and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is moderately suited to trees. The trees are around homesteads and in isolated groves. Because of the droughtiness, seedlings do not survive and grow well. They should be planted at close intervals because the survival rate is limited. Thinning stands helps to provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting.

The land capability classification is IVs.

285D—Burkhardt sandy loam, 5 to 14 percent slopes. This moderately sloping and strongly sloping, excessively drained soil is on terrace escarpments. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable sandy loam about 8 inches thick. The subsoil is dark brown, friable gravelly loamy sand about 6 inches thick. The substratum to a depth of 60 inches is strong brown extremely gravelly coarse sand. In places the surface layer is loamy sand or gravelly loamy sand.

Permeability is rapid, and runoff is medium or rapid. Available water capacity is very low. The content of organic matter is 1.5 to 2.5 percent in the surface layer. The soil generally has a very low supply of available phosphorus and a medium supply of available potassium.

Most areas are used for hay or pasture. A few are cultivated. Some of the acreage is idle land that has scattered areas of trees. Most of the cultivated areas of this soil are cropped along with large areas of adjacent soils that are better suited to crops. The very low available water capacity and droughtiness are limitations. This soil is unsuited to corn, soybeans, and small grain and is only moderately suited to grasses and legumes for hay and pasture. It is best suited to use as idle land. Seeding drought-tolerant grasses helps to prevent gully erosion and to control soil blowing.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too dry causes poor tilth and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is moderately suited to trees. The trees are in a few areas around homesteads and in isolated groves along terrace escarpments. Because of the droughtiness, seedlings do not survive and grow well. They should be planted at close intervals because the survival rate is limited. Thinning stands helps to provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting.

The land capability classification is VIe.

302B—Coggon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges and side slopes in the uplands. Areas range from 5 to 25 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 4 inches thick. The subsurface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 46 inches thick. The upper part is brown and yellowish brown, friable loam, the next part is yellowish brown, mottled, friable loam, and the lower part is yellowish brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. In places the surface layer is sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Oran soils. The increased wetness can interfere with the timeliness of fieldwork. These soils are in the higher, nearly level areas. They make up less than 5 percent of the unit.

Permeability of this Coggon soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used as woodland or pasture. Some are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. The soil generally has fair tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Some small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIe.

302C—Coggon loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 10 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 3 inches thick. The subsurface layer is grayish brown, friable loam about 4 inches thick. The subsoil is about 42 inches thick. The upper part is brown and yellowish brown, friable loam, the next part is yellowish brown, mottled, friable loam, and the lower part is yellowish brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. In places the surface layer is sandy loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used as woodland or pasture. Some are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. The soil generally has fair tilth. Grassed waterways help to prevent gully erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Some small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIIe.

323B—Terril loam, sandy substratum, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on concave foot slopes, in intermittent drainageways, and on alluvial fans. It receives runoff from adjacent upland slopes. Areas range from 5 to 80 acres in size. They generally are long and narrow.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black and very dark brown, friable loam about 27 inches thick. The subsoil is about 10 inches thick. The upper part is brown, friable loam, and the lower part is brown, very friable loamy sand and coarse sand. The substratum to a depth of about 60 inches is dark yellowish brown and brown sand and coarse sand.

Included with this soil in mapping are a few areas of somewhat poorly drained soils that have a dark grayish brown subsoil. The wetness delays fieldwork in the spring of some years. These soils are on concave foot slopes. They make up 10 percent or less of the unit.

Permeability is moderate in the upper part of this Terril soil and rapid in the substratum. Runoff is medium. Available water capacity is high. The content of organic matter is 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Because this soil generally occurs in long, narrow areas, the use of this soil tends to be determined by the use of the adjacent soils. Many areas of this soil are cropped along with areas of soils on flood plains downslope. Some are used as permanent pasture along with the steeper soils upslope. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Because it receives runoff from the soils upslope, it is subject to rill erosion and gully erosion. Diversion terraces help to control runoff. Reshaping and seeding waterways help to prevent gullying. Good tilth generally can be easily maintained.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

391B—Clyde-Floyd complex, 1 to 4 percent slopes. These very gently sloping and gently sloping soils are ir intermittent upland drainageways. The poorly drained Clyde soil is near the center of the drainageways. The somewhat poorly drained Floyd soil is on foot slopes above the Clyde soil. These soils receive runoff from adjacent upland slopes. Areas range from 5 to more than 100 acres in size. They are about 60 percent Clyde soil and 35 percent Floyd soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Clyde soil is black, friable clay loam about 8 inches thick. The subsurface layer is black, friable clay loam about 12 inches thick. It is mottled in the lower part. The subsoil is about 32 inches thick. The upper part is gray and dark grayish brown, mottled, friable loam, the next part is gray, mottled, friable sandy loam, and the lower part is gray, mottled, firm loam. The substratum to a depth of about 60 inches is gray, mottled loam. In places the surface layer is loam.

Typically, the surface layer of the Floyd soil is black, friable loam about 8 inches thick. The subsurface layer is black, very dark grayish brown, and dark grayish brown, friable loam about 11 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is olive brown and light olive brown, mottled, friable loam, the next part is dark yellowish brown and yellowish brown, mottled, friable sandy loam, and the lower part is grayish brown and yellowish brown, mottled, firm loam. In places the subsoil is sandy loam throughout.

Included with these soils in mapping are small areas of the very poorly drained Palms soils. Palms soils have 16 to 50 inches of well decomposed organic material overlying mineral soil material. They are in landscape positions similar to those of the Clyde soil. They make up less than 5 percent of the map unit.

Permeability of these Clyde and Floyd soils is moderate. Runoff is slow on the Clyde soil and medium on the Floyd soil. Available water capacity is high in both of the soils. The content of organic matter is 6 to 9 percent in the surface layer of the Clyde soil and 5 to 6 percent in the surface layer of the Floyd soil. The Clyde and Floyd soils have a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. If drained and protected against runoff from adjacent upland slopes, these soils are well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Glacial stones and boulders are common in unimproved, undrained areas. Installing the drainage tile is difficult in some areas because of the very friable, water-bearing sandy sediments. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Grassed waterways help to remove excess water from adjacent upland slopes. In areas where the soils have been drained, good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

In undrained areas these soils generally are used for pasture. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth, increases the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

394B—Ostrander loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on long, convex ridgetops and side slopes in the uplands. Areas range from 2 to more than 60 acres in size. They are irregularly shaped.

Typically, the surface layer is black and very dark brown, friable loam about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 7 inches thick. The subsoil is friable loam about 33 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown loam. In places the surface layer and subsurface layer are sandy loam and tend to be more droughty.

Included with this soil in mapping are small areas of Flagler soils. These soils are in landscape positions similar to those of the Ostrander soil. They have sand and gravel at a depth of 24 to 32 inches and are droughty. They make up about 5 percent of the unit.

Permeability of this Ostrander soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Stones from the subsoil interfere with tillage. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

394C—Ostrander loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black and very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable loam about 7 inches thick. The subsoil is friable loam about 32 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown loam. In places the surface layer and subsurface layer are sandy loam and tend to be droughty.

Included with this soil in mapping are small areas of Flagler soils. These soils are in landscape positions similar to those of the Ostrander soil. They have sand and gravel at a depth of 24 to 32 inches and are droughty. They make up about 5 to 10 percent of the unit.

Permeability of this Ostrander soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Some areas are cultivated. Most are used for hay or pasture. This soil is moderately well suited to corn and soybeans. It is well suited to small grain and to grasses and legumes for hay and pasture. Water erosion is a moderate or severe hazard. Terraces, a system of conservation tillage that leaves crop residue on the surface, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

394C2—Ostrander loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 2 to 30 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly black and very dark brown, friable loam about 8 inches thick. It is mixed with streaks and pockets of dark yellowish brown material from the subsoil. The subsoil is friable loam about 26 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown loam. In some places the surface layer is mostly dark yellowish brown material from the subsoil and has a lower content of organic matter and a higher content of clay because the soil has been severely eroded. In other places the surface layer is sandy loam and tends to be droughty.

Included with this soil in mapping are small areas of Flagler soils. These soils are in landscape positions similar to those of the Ostrander soil. They have sand and gravel at a depth of 24 to 32 inches and are droughty. They make up about 5 to 10 percent of the unit.

Permeability of this Ostrander soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.2 to 3.2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately suited to corn and soybeans. It is well suited to small grain and to grasses and legumes for hay and pasture. Stones from the subsoil interfere with tillage. Water erosion is a moderate or severe hazard. Terraces, a system of conservation tillage that leaves crop residue on the surface, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

398—Tripoli clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad flat upland divides. Areas range from 5 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable clay loam about 9 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown, mottled, friable clay loam, the next part is yellowish brown and dark grayish brown, mottled, firm loam, and the lower part is yellowish brown and grayish brown, mottled, firm loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, calcareous loam. In places the surface layer is thinner, is lighter colored loam, and has a lower content of organic matter.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 6 to 7 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated (fig. 6). This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If row crops are grown, a drainage system lowers the water table and improves the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

399—Readlyn loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad divides and in the slightly concave coves at the head of drainageways in the uplands. Areas range from 2 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown, friable loam, the next part is olive brown and dark grayish brown, mottled, friable loam, and the lower part is olive brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled dark yellowish brown, strong brown, and grayish brown loam.

Included with this soil in mapping are small areas of the poorly drained Tripoli soils. These soils are in small depressions. They have a higher content of clay in the surface layer than the Readlyn soil and a higher content of organic matter. They make up about 10 percent of the unit.

Permeability of this Readlyn soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 4.5 to 5.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for pasture or hay. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is I.

399B—Readlyn loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on slightly convex ridges and side slopes and in coves at the head of drainageways in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark grayish brown, friable loam, the next part is olive brown and dark grayish brown, mottled, friable loam, and the lower part is olive brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled dark yellowish brown, strong brown, and grayish brown loam. In places the subsoil is browner and better drained.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 4.5 to 5.5 percent. The soil has a seasonal high water table. The subsoil

Figure 6.—An area of Tripoli clay loam, 0 to 2 percent slopes, farmed intensively for row crops.

generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system improves the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

407B—Schley loam, 1 to 4 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on straight or slightly concave foot slopes on uplands. It receives runoff from adjacent upland slopes. Areas range from about 3 to 40 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark grayish brown and very dark brown, friable loam about 8 inches thick. The subsurface layer is brown and grayish brown, mottled, friable loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is grayish brown, dark yellowish brown, and brown, mottled, friable sandy loam, the next part is strong brown, mottled, firm loam, and the lower part is strong brown, mottled, firm sandy clay loam. In places the soil has a sandy substratum.

Included with this soil in mapping are small areas of poorly drained soils. These soils are in landscape positions similar to those of the Schley soil. They make up 10 percent or less of the map unit.

Permeability of this Schley soil is moderate, and runoff is slow or medium. Available water capacity is moderate. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Gully erosion is a hazard in areas where runoff concentrates. Grassed waterways help to prevent gullying. Glacial stones and boulders are common in many unimproved areas. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth, reduces the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Some areas support native hardwoods. A drainage system helps to lower the water table and reduce the seedling mortality rate. No other hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is IIw.

408B—Olin sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 3 to 30 acres in size. They are irregularly shaped or somewhat oval.

Typically, the surface layer is very dark brown, very friable sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, very friable sandy loam about 15 inches thick. The subsoil is about 19 inches thick. The upper part is brown, very friable sandy loam, and the lower part is dark yellowish brown, firm loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown loam. A stone line separates the surface sediments from the underlying firm glacial till.

Included with this soil in mapping are small areas of the moderately well drained Kenyon and well drained Dickinson soils. Kenyon soils are in landscape positions similar to those of the Olin soil. They have a higher available water capacity than the Olin soil. They make up about 5 percent of the unit. Dickinson soils have a loamy and sandy subsoil and have a lower available water capacity than the Olin soil. They are on the higher, slightly more convex mounds. They make up about 10 percent of the unit.

Permeability of this Olin soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil is not well suited to terracing because the less productive underlying glacial till is too close to the surface. If terraces are built, cuts should not expose the glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

408C—Olin sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 3 to 15 acres in size. They are irregularly shaped or somewhat oval.

Typically, the surface layer is very dark brown, very friable sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, very friable sandy loam about 13 inches thick. The subsoil is about 16 inches thick. The upper part is brown, very friable sandy loam, and the lower part is dark yellowish brown, firm loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown loam. A stone line separates the surface sediments from the underlying firm glacial till.

Included with this soil in mapping are small areas of the moderately well drained Kenyon and the well drained Dickinson soils. Kenyon soils are in landscape positions similar to those of the Olin soil. They have a higher available water capacity than the Olin soil. They make up about 5 percent of the unit. Dickinson soils have a loamy and sandy subsoil and have a lower available water capacity than the Olin soil. They are on the higher, slightly more convex ridges. They make up about 10 percent of the unit.

Permeability of this Olin soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil is not well suited to terracing because the less productive underlying glacial till is too close to the surface. If terraces are built, cuts should not expose the glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

412C—Emeline loam, 5 to 9 percent slopes. This moderately sloping, somewhat excessively drained soil is on convex side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped or somewhat elongated.

Typically, the surface layer is black, friable loam about 9 inches thick. Fractured limestone bedrock is at a depth of about 9 inches.

Included with this soil in mapping are areas of exposed bedrock. These areas cannot be tilled. The exposed bedrock is in landscape positions similar to those of the Emeline soil. Inclusions make up about 10 percent of the unit.

Permeability of this Emeline soil is moderate, and runoff is medium or rapid. Available water capacity is very low. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The solum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for hay or pasture. Some small areas of this soil are cropped along with larger areas of adjacent soils that are better suited to crops. This soil is poorly suited to cultivated crops because of a hazard of water erosion, severe droughtiness, low productivity, and very poor tilth. It is better suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, increases the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Some areas support native hardwoods. Plant competition is moderate. It can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. The hazard of windthrow is severe because the rooting depth is shallow. Thinning the stand so that the individual trees are widely spaced reduces the windthrow hazard by ensuring that the trees have adequate anchorage for their roots.

The land capability classification is IVs.

412E—Emeline loam, 9 to 18 percent slopes. This strongly sloping and moderately steep, somewhat excessively drained soil is on short side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped or somewhat elongated.

Typically, the surface layer is black, friable loam about 6 inches thick. Fractured limestone bedrock is at a depth of about 6 inches.

Included with this soil in mapping are areas of exposed bedrock. The bedrock is in landscape positions similar to those of the Emeline soil. Inclusions make up about 10 percent of the unit.

Permeability of this Emeline soil is moderate, and runoff is rapid. Available water capacity is very low. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The solum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for pasture. A few are used as woodland. This soil is unsuited to cultivated crops because of the slope and severe droughtiness. It should always be protected by vegetation. It is best suited to grasses for pasture or to native trees.

This soil is poorly suited to trees. Some areas support native hardwoods. Plant competition is moderate. It can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Carefully selecting sites for logging trails and roads helps to control erosion. The slope severely limits the use of equipment. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Thinning the stand so that the individual trees are widely spaced reduces the windthrow hazard by ensuring that the trees have adequate anchorage for their roots.

The land capability classification is VIIs.

457—Du Page loam, 0 to 2 percent slopes. This nearly level, well drained soil is on flood plains. It is subject to occasional flooding. Areas range from about 4 to 35 acres in size. They are long and narrow.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is friable loam about 22 inches thick. The upper part is black and very dark brown, and the lower part is very dark grayish brown and very dark gray. Next is a transitional layer of very dark grayish brown, friable loam about 24 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown and dark brown stratified loam and sandy loam. The solum and the substratum are calcareous throughout.

Included with this soil in mapping are areas of soils that are sandy loam or loamy sand. These soils are droughty. They make up about 10 percent of the unit.

Permeability of this Du Page soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 4 to 6 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Some of the areas that are not protected from flooding or that are isolated by a meandering stream are used for pasture. If protected from flooding, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The need for protection from floodwater varies from area to area because the pattern of stream overflow was modified when stream channels were deepened and roads and ditches were constructed.

Some areas are used for hay or pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

471—Oran loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on glacial upland divides. Areas range from 2 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsoil is about 41 inches thick. The upper part is dark grayish brown and olive brown, friable loam and clay loam, the next part is light olive brown, mottled, friable clay loam, and the lower part is yellowish brown, light brownish gray, and light olive brown, mottled, friable and firm clay loam and loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In places the surface layer is thicker and darker and has a higher content of organic matter.

Included with this soil in mapping are small areas of the nearly level, poorly drained Havana soils. These soils are adjacent to the Oran soil in slight depressions. They make up 10 percent or less of the map unit.

Permeability of this Oran soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Good tilth is generally easy to maintain. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Some areas support native hardwoods. Installing a drainage system lowers the water table and reduces the seedling mortality rate. No other hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is I.

471B—Oran loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on convex ridges and side slopes and in coves at the head of drainageways on glacial uplands. Areas range from about 2 to 50 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsoil is about 35 inches thick. The upper part is dark grayish brown and olive brown, friable loam and clay loam, the next part is light olive brown, mottled, friable clay loam, and the lower part is yellowish brown, light brownish gray, and light olive brown, mottled, friable and firm clay loam and loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In places the surface layer is thicker and darker and has a higher content of organic matter.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally is easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Some areas support native hardwoods. Installing a drainage system lowers the water table and reduces the seedling mortality rate. No other hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is IIe.

472—Havana loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on upland glacial divides. Areas range from 5 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is mottled, friable loam about 16 inches thick. The upper part is grayish brown, and the lower part is gray and dark gray. The subsoil is firm loam about 25 inches thick. The upper part is gray and yellowish brown, and the lower part is yellowish brown and gray. The substratum to a depth of about 60 inches is yellowish brown and gray, firm loam. In places the surface layer is thicker and darker and has a higher content of organic matter.

Permeability is moderately slow, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 4 to 5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately suited to trees. A few areas support native hardwoods. High flotation equipment can be used during wet periods; however, other equipment should be operated only when the soil is dry or frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Windthrow is a hazard because of the high water table. A drainage system reduces the windthrow hazard. Erosion is not a hazard during logging or when roads are constructed for logging.

The land capability classification is IIw.

482B—Racine loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 5 inches thick. The subsoil is about 35 inches thick. The upper part is brown and dark yellowish brown, friable loam, the next part is yellowish brown, friable sandy clay loam, and the lower part is yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In places the surface layer and subsurface layer are sandy loam and tend to be more droughty.

Included with this soil in mapping are small areas of Wapsie soils. These soils are in landscape positions similar to those of the Racine soil. They have sand and gravel at a depth of 24 to 32 inches and tend to be droughty. They make up about 5 percent of the unit.

Permeability of this Racine soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Stones from the subsoil interfere with tillage. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Some areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or by girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIe.

482C2—Racine loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly black, friable loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown material from the subsoil. The subsoil is about 31 inches thick. The upper part is brown and dark yellowish brown, friable loam, the next part is yellowish brown, friable sandy clay loam, and the lower part is yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loam. In some places the soil has been severely eroded and the surface layer is mostly dark yellowish brown material from the subsoil. In other places the surface layer and subsurface layer are sandy loam and tend to be more droughty.

Included with this soil in mapping are small areas of Wapsie soils. These soils are in landscape positions similar to those of the Racine soil. They have sand and gravel at a depth of 24 to 32 inches and tend to be droughty. They make up 5 to 10 percent of the unit.

Permeability of this Racine soil is moderate, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2 to 3 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Stones from the subsoil interfere with tillage. Water erosion is a moderate or severe hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. A few areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIIe.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flood plains. It is subject to occasional flooding. Areas range from about 4 to 50 acres in size. They are long and narrow.

Typically, the surface layer is black and very dark gray, friable loam about 8 inches thick. The subsurface layer is friable loam about 40 inches thick. The upper part is black and very dark gray, and the lower part is black. Next is a transitional layer of very dark grayish brown and black, mottled, friable sandy loam. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled sandy loam. In places the combined thickness of the surface layer and subsurface layer is less than 36 inches.

Included with this soil in mapping are areas of soils that are sandy loam or loamy sand. These soils are droughty. They make up about 5 to 10 percent of the unit.

Permeability of this Spillville soil is moderate, and runoff is slow. Available water capacity is high. The content of organic matter in the surface layer is 4 to 5 percent. The soil has a seasonal high water table. The subsurface layer and substratum generally have a very low supply of available phosphorus and potassium.

Most areas are cultivated. Some areas that are not protected from flooding or that are isolated by a meandering stream are used for pasture. If protected from flooding, this soil is well suited to intensive cropping of corn, soybeans, and small grain. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

585—Coland-Spillville complex, 0 to 2 percent slopes. These nearly level, poorly drained and somewhat poorly drained soils are on flood plains adjacent to perennial streams. The Coland soil is in low areas of old stream channels or in slack water areas, and the Spillville soil is on slight rises above the Coland soil. These soils are subject to occasional flooding. Areas range from 5 to more than 100 acres in size. They are elongated. They are about 65 percent Coland soil and 30 percent Spillville soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Coland soil is black, friable clay loam about 8 inches thick. The subsurface layer is black, friable clay loam about 30 inches thick. It is mottled in the lower part. The next layer is black and dark grayish brown, mottled, friable clay loam. The upper part of the substratum is grayish brown, mottled clay loam. The lower part to a depth of about 60 inches is grayish brown, mottled stratified loam, clay loam, and silt loam. In places the surface layer is loam.

Typically, the surface layer of the Spillville soil is black and very dark gray, friable loam about 8 inches thick. The subsurface layer is friable loam about 40 inches thick. The upper part is black and very dark gray, and the lower part is black. Next is a transitional layer of very dark grayish brown and black, mottled, friable sandy loam. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled sandy loam. In some places the surface layer and subsurface layer are sandy loam. In other places the combined thickness of the surface layer and subsurface layer is less than 36 inches.

Included with these soils in mapping are small areas of soils that have a surface layer and subsurface layer of loamy sand. These included soils have a lower content of organic matter and lower available water capacity than the Coland and Spillville soils. They are in landscape positions similar to those of the Coland and Spillville soils. They make up about 5 percent of the map unit.

Permeability is moderate in the Coland and Spillville soils, and runoff is slow. Available water capacity is high. The content of organic matter is 5 to 7 percent in the surface layer of the Coland soil and 4 to 5 percent in the surface layer of the Spillville soil. Both of the soils have a seasonal high water table. The substratum of the Coland soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The substratum of the Spillville soil generally has a very low supply of available phosphorus and potassium. The surface layer of both soils is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some areas that are not protected from flooding or are isolated by a meandering stream are used for pasture. These soils are well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if they are adequately drained and if flooding is controlled. Special care generally is needed to maintain good tilth in the surface layer. Chisel plowing improves the rate of water infiltration by making the surface more pervious to water. Cultivating when the soils are too wet causes surface compaction and cloddiness. Returning crop residue to the soils or regularly adding other organic material helps to control soil blowing and prevent surface crusting and increases the rate of water infiltration. Water-tolerant grasses and legumes should be selected for planting in pastures.

The seasonal high water table and the flooding are the main limitations if these soils are used for trees and shrubs grown as windbreaks or ornamental plantings. Only the species that can tolerate the wetness and flooding should be selected for planting.

The land capability classification is IIw.

621B—Houghton muck, 2 to 5 percent slopes. This gently sloping, very poorly drained soil is in seepy bogs on side slopes and foot slopes. The seepy areas are fed by springs. Areas range from 5 to 45 acres in size. They are elongated or circular.

Typically, the surface layer is black, slightly sticky muck about 6 inches thick. The subsurface layer to a depth of about 60 inches is black muck. It is slightly calcareous in the lower part. In places the soil is nearly level or moderately sloping.

Permeability ranges from moderately slow to moderately rapid, and runoff is medium or slow. Available water capacity is very high. The content of organic matter in the surface layer is more than 20 percent. The soil has a seasonal high water table near or at the surface. The subsurface layer generally has a very low supply of available phosphorus and potassium.

Most of the acreage of this soil is idle land. A few small areas are cultivated. Draining the soil is difficult, and suitable tile outlets are not readily available. If drained, this soil is moderately suited to corn, soybeans, and small grain. In undrained areas, the soil is unsuited to cultivated crops because the water table is at or near the surface. The load-bearing capacity for farm machinery is very low on this soil.

A few areas are used for pasture. Establishing pasture plants is difficult, especially in undrained areas, and the spongy surface layer cannot withstand grazing. Maintaining stands of legumes may be difficult because the plants are subject to winterkill and to root and crown diseases. If this soil is drained and used for pasture, stocking and grazing should be limited during wet periods.

The land capability classification is Vw.

713B—Winneshiek loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 6 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 4 inches thick. The subsoil is about 28 inches thick. The upper part is brown, friable loam, the next part is dark yellowish brown, friable clay loam, and the lower part is brown and strong brown, firm clay. Fractured limestone bedrock is at a depth of about 38 inches. In some places the bedrock is at a depth of more than 40 inches. In other places the soil is moderately sloping.

Included with this soil in mapping are small areas of Bassett soils. These soils are on ridges above the Winneshiek soil. They do not have bedrock within a depth of 60 inches. They have a higher available water capacity than the Winneshiek soil and are not so droughty. They make up less than 5 percent of the unit.

Permeability of this Winneshiek soil is moderate, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. A system of conservation tillage that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss and conserve moisture. The soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Pastures should not be overgrazed during droughty periods. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is well suited to trees. A few areas support native hardwoods. No particular hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is IIe.

714B—Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 40 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 6 inches thick. The subsurface layer is dark grayish brown and brown, friable loam about 4 inches thick. The subsoil is about 18 inches thick. The upper part is brown, friable loam, the next part is dark yellowish brown, friable clay loam, and the lower part is brown and strong brown, firm clay. Fractured limestone bedrock is at a depth of about 28 inches. In places the soil is moderately sloping.

Included with this soil in mapping are small areas of Emeline soils where limestone bedrock is near the surface. The bedrock hinders fieldwork. These soils are on the lower part of side slopes. They make up less than 5 percent of the unit.

Permeability of this Winneshiek soil is moderate, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Some are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. The root zone is limited by the depth to bedrock. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserve moisture. The soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Pastures should not be grazed during droughty periods. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. A few areas support native hardwoods. Windthrow is a moderate hazard because of the limited rooting depth. No other particular hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is IIe.

725—Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on stream terraces. Areas range from 5 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsoil is about 17 inches thick. The upper part is brown and dark yellowish brown, mottled, friable loam, the next part is olive brown, mottled, friable loam, and the lower part is dark yellowish brown, mottled, very friable loam. The substratum to a depth of about 60 inches is yellowish brown, mottled loamy coarse sand and gravelly coarse sand. In places the depth to sand and gravel is less than 24 inches.

Included with this soil in mapping are small areas of the nearly level, poorly drained Udolpho soils. These soils are adjacent to the Hayfield soil in slight depressions. They make up 10 percent or less of the map unit.

Permeability is moderate in the subsoil of this

Hayfield soil and very rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 3 to 4 percent. The soil has a seasonal high water table. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth may be limited during the latter part of the growing season because of the moderate available water capacity. A system of conservation tillage that leaves crop residue on the surface helps to conserve moisture. The water table is moderately high in the spring but drops rapidly during the growing season. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. A few small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIs.

728—Udolpho loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This level, poorly drained soil is on stream terraces. Areas range from 5 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, mottled, friable loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part is dark grayish brown, mottled, friable loam, and the lower part is grayish brown, mottled, friable and very friable loam. The substratum to a depth of about 60 inches is mottled grayish brown, yellowish brown, and light olive brown gravelly coarse sand and very gravelly coarse sand. In some places the surface layer is thicker and darker and has a higher content of organic matter. In other places the solum is less than 24 inches thick over sand and gravel.

Permeability is moderate in the solum and rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter in the surface layer is 3 to 4 percent. The soil has a seasonal high water table. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Establishing adequate drainage outlets and installing drainage tile are difficult in some areas because of the loose, water-bearing sand and gravel. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately suited to trees. A few areas support native hardwoods. High flotation equipment can be used during wet periods; however, other equipment should be operated only when the soil is dry or frozen. Seedlings do not survive well. As a result, they should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Windthrow is a hazard because of the high water table. A drainage system reduces the windthrow hazard. Erosion is not a hazard during logging or when roads are constructed for logging.

The land capability classification is IIw.

775B—Billett sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas range from about 2 to 15 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 8 inches thick. The subsoil is about 46 inches thick. The upper part is brown and dark yellowish brown, friable sandy loam, the next part is dark yellowish brown, very friable loamy coarse sand, and the lower part is dark yellowish brown, very friable loamy coarse sand. Between depths of 34 and 54 inches are alternating bands of dark brown sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown gravelly loamy coarse sand.

Included with this soil in mapping are small areas of excessively drained soils that are loamy sand or sand. These soils are in landscape positions similar to those of the Billett soil. They make up about 10 percent of the unit.

Permeability of this Billett soil is moderately rapid, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Some areas are cultivated. Most are used for hay or pasture. Many small areas of this soil are cropped along with larger areas of adjacent soils that are better suited to crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth is limited during the latter part of the growing season because of the moderate available water capacity. Soil blowing is a hazard in areas where cultivated crops are grown. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface, cover crops, and grassed waterways help to conserve moisture and prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

If this soil is used for pasture, overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during excessively dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. The trees generally are in small groves. The seedling survival rate is moderate because of droughtiness. Seedlings should be planted at close intervals, and the stand should be thinned later to help provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting.

The land capability classification is IIIs.

775C—Billett sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 15 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 7 inches thick. The subsoil is about 40 inches thick. The upper part is brown and dark yellowish brown, friable sandy loam, the next part is dark yellowish brown, very friable loamy coarse sand, and the lower part is dark yellowish brown, very friable loamy coarse sand. Between depths of 26 and 48 inches are alternating bands of dark brown sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown gravelly loamy coarse sand. In places the soil is strongly sloping.

Included with this soil in mapping are small areas of excessively drained soils that are loamy sand or sand. These soils are in landscape positions similar to those of the Billett soil. They make up about 10 percent of the unit.

Permeability of this Billett soil is moderately rapid, and runoff is medium. Available water capacity is moderate. The content of organic matter in the surface layer is 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

A few areas are cultivated. Most are used for pasture or hay. Many small areas of this soil are cropped along with larger areas of adjacent soils that are better suited to crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards. Plant growth is limited during the latter part of the growing season because of the moderate available water capacity. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface, cover crops, and grassed waterways help to prevent excessive soil loss and conserve moisture. Ridging for terraces is difficult because the surface layer is moderately coarse textured and the underlying coarse textured material is too close to the surface. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

If this soil is used for pasture, overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during excessively dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. The trees generally are in small groves. The seedling survival rate is moderate because of droughtiness. Seedlings should be planted at close intervals, and the stand should be thinned later to help provide adequate growing space for the surviving trees. No other hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

776B—Lilah sandy loam, 2 to 5 percent slopes. This gently sloping, excessively drained soil is on the convex summit and side slopes of high benches and on stream terraces. Areas range from 5 to 60 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark grayish brown, very friable sandy loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown, very friable sandy loam, the next part is strong brown and brown, very friable gravelly sandy loam and very gravelly coarse sand, and the lower part is strong brown, very friable and loose coarse sand. Between depths of 30 and 60 inches are alternating bands of reddish brown loamy sand. In places the surface layer is gravelly loamy sand.

Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Runoff is slow. Available water capacity is very low. The content of organic matter in the surface layer is 1 to 2 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated or used as permanent pasture. A few are irrigated. This soil is poorly suited to corn, soybeans, and oats and to grasses and legumes for hay and pasture because it has low fertility and very low available water capacity. Plant growth is restricted throughout the growing season because of the very low available water capacity. The soil responds poorly to fertilizer. Soil blowing and water erosion are hazards. The sandy windblown material sometimes damages newly seeded crops on this soil and on adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserve moisture. Tilth generally is poor in the surface layer.

A cover of pasture plants or hay helps to control erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture in fairly good condition.

A few areas are wooded. This soil is moderately suited to trees. Establishing seedlings is difficult, and the seedling mortality rate is severe. The rooting depth of seedlings is restricted by the sand and gravel, which is close to the surface. Because they do not survive well, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Supplemental water generally is needed.

The land capability classification is IVs.

776D2—Lilah sandy loam, 5 to 14 percent slopes, moderately eroded. This moderately sloping and strongly sloping, excessively drained soil is on convex side slopes on high benches and on stream terraces. Areas range from 5 to 40 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly very dark grayish brown, very friable sandy loam about 7 inches thick. It is mixed with streaks and pockets of brown sandy loam from the subsoil. The subsoil is about 45 inches thick. The upper part is brown, very friable sandy loam, the next part is strong brown and brown, very friable gravelly sandy loam and very gravelly coarse sand, and the lower part is strong brown, very friable and loose coarse sand. Between depths of 25 and 50 inches are alternating bands of reddish brown loamy sand. The substratum to a depth of about 60 inches is strong brown coarse sand. In places the surface layer is gravelly loamy sand.

Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Runoff is rapid. Available water capacity is very low. The content of organic matter in the surface layer is 0.5 to 1.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

A few areas are cultivated. Most are used for hay or pasture. A few are irrigated. This soil is unsuited to corn, soybeans, and small grain. It is low in fertility, very low in available water capacity, and subject to water erosion. It also responds poorly to fertilizer. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on adjoining soils.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet or too dry reduces the extent of the plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture in fairly good condition.

A few areas are wooded. This soil is moderately suited to trees. Establishing seedlings is difficult, and the seedling mortality rate is severe. The rooting depth of seedlings is restricted by the sand and gravel, which is close to the surface. The seedling survival rate is poor. Seedlings should be planted at close intervals, and the stand should be thinned later to help provide adequate growing space for the surviving trees. Supplemental water generally is needed.

The land capability classification is VIs.

777—Wapsie loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces. Areas range from 2 to more than 100 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is brown, friable loam about 5 inches thick. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown and dark yellowish brown, very friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown gravelly sand and gravelly coarse sand. In some places the solum is less than 24 inches thick over sand and gravel. In other places the surface layer is sandy loam.

Permeability is moderate in the loamy material and very rapid in the sandy and gravelly substratum. Runoff is slow. Available water capacity is low. The content of organic matter in the surface layer is 3 to 4 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay, pasture, or woodland. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Plant growth is limited during the latter part of the growing season because of the low available water capacity. Soil blowing is a hazard in areas that are plowed in the fall and are not protected. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserve moisture. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. A few areas support native hardwoods. The low available water capacity limits the growth of trees, and the sandy and gravelly substratum restricts root penetration. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIs.

777B—Wapsie loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream terraces. Areas range from 5 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is brown, friable loam about 3 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown and dark yellowish brown, very friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown gravelly sand and gravelly coarse sand. In some places the solum is less than 24 inches thick over sand and gravel. In other places the surface layer is sandy loam.

Permeability is moderate in the loamy material and very rapid in the sandy and gravelly substratum. Runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay, pasture, or woodland. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. Plant growth is limited during the latter part of the growing season because of the low available water capacity. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss and conserve moisture. Contour farming is difficult because the slopes generally are short and irregular. The soil is not well suited to terracing because of the coarse textured substratum. Good tilth generally can be easily maintained.

Pastures can be easily overstocked because the available water capacity is low. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet and dry periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. A few areas support native hardwoods. The low available water capacity limits the growth of trees, and the sandy and gravelly substratum restricts root penetration. Seedlings survive and grow well if competing vegetation is controlled by careful site preparation or by spraying or cutting. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIe.

781B—Lourdes loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges and side slopes in the uplands. Areas range from 3 to 50 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is brown, friable loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark yellowish brown, mottled, firm loam, the next part is yellowish brown, grayish brown, and strong brown, mottled, very firm clay loam, and the lower part is grayish brown and strong brown, mottled, very firm clay loam.

Included with this soil in mapping are small areas of sandy soils. These soils are droughty. They generally make up less than 5 percent of the unit.

Permeability of this Lourdes soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. This soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Many are used for hay or pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the underlying very firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Some small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIe.

781C2—Lourdes loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly very dark brown, friable loam about 6 inches thick. It is mixed with streaks and pockets of dark yellowish brown material from the subsoil. The subsoil is about 45 inches thick. The upper part is dark yellowish brown, mottled, firm loam, the next part is yellowish brown, grayish brown, and strong brown, mottled, very firm clay loam, and the lower part is grayish brown and strong brown, mottled, very firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and strong brown loam. In places the surface layer has a higher content of clay and a lower content of organic matter because the soil has been severely eroded.

Included with these soils in mapping are small areas of sandy soils. These sandy soils are droughty. They generally make up less than 5 percent of the unit.

Permeability of this Lourdes soil is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the very firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Grassed waterways help to prevent gully erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. Intensive management is needed to maintain productivity and tilth.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Some small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The land capability classification is IIIe.

782B—Donnan loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 30 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 7 inches thick. The subsurface layer is brown and dark grayish brown, friable loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. In sequence downward, it is brown, dark yellowish brown, and yellowish brown, mottled, friable loam; yellowish brown and grayish brown, mottled, friable loam; dark gray and gray, mottled, firm and very firm silty clay and clay; and dark grayish brown, mottled, very firm clay loam.

Permeability is moderate in the loamy material and very slow in the clayey material. Runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.5 to 3.5 percent. The soil has a seasonal high water table. The shrink-swell potential is moderate or high in the lower part of the soil. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to legumes for hay. Water erosion is a hazard. Measures that control erosion tend to increase the wetness because they retard the movement of surface water. Water tends to move laterally at the contact between the loamy overburden and the very firm clayey paleosol. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork and help to control seepage from higher lying, adjacent soils. Because of the very slow permeability in the clayey part of the subsoil, installing tile may be difficult. If possible, tile drains should be installed above the clayey part of the subsoil. If terraces are built, cuts should not expose the less productive clayey part of the subsoil. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately suited to trees. A few small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality is slight. Windthrow is a moderate hazard because the rooting depth is shallow. Thinning the stand so that the individual trees are widely spaced reduces the windthrow hazard by ensuring that the trees have adequate anchorage for their roots. The hazard of erosion is slight when trees are planted or harvested.

The land capability classification is IIe.

782C2—Donnan loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly black, friable loam about 7 inches thick. It is mixed with streaks and pockets of brown and dark grayish brown material from the subsoil. The subsoil extends to a depth of about 60 inches. In sequence downward, it is brown, dark yellowish brown, and yellowish brown, mottled, friable loam; yellowish brown and grayish brown, mottled, friable loam; dark gray and gray, mottled, firm and very firm silty clay and clay; and dark grayish brown, mottled, very firm clay loam. In places the surface layer has a higher content of clay and a lower content of organic matter because the soil has been severely eroded.

Permeability is moderate in the loamy material and very slow in the clayey material. Runoff is medium or rapid. Available water capacity is high. The content of organic matter in the surface layer is 2 to 3 percent. The soil has a seasonal high water table. The shrink-swell potential is moderate or high in the lower part of the soil. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to legumes for hay. It is well suited to grasses and legumes for pasture. Water erosion is a hazard. Measures that control erosion tend to increase the wetness because they retard the movement of surface water. Water tends to move laterally at the contact between the loamy overburden and the very firm clayey paleosol formed in glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork and can help to control seepage from higher lying, adjacent soils. Because of the very slow permeability in the clayey part of the subsoil, tile is difficult to install and all areas cannot be drained satisfactorily. If possible, tile drains should be installed above the clayey part of the subsoil. If terraces are built, cuts should not expose the less productive clayey part of the subsoil. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

A cover of pasture plants helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately suited to trees. A few small areas support native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality is slight. Windthrow is a moderate hazard because the rooting depth is shallow. Thinning the stand so that the individual trees are widely spaced reduces the windthrow hazard by ensuring that the trees have adequate anchorage for their roots. The hazard of erosion is slight when trees are planted or harvested.

The land capability classification is IIIe.

783B—Cresco loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges and side slopes in the uplands. Areas range from 3 to 50 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 5 inches thick. The subsoil is about 41 inches thick. The upper part is brown and dark yellowish brown, friable clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3.5 to 4.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. If the soil is cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Many are used for hay or pasture. This soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the underlying very firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

783C—Cresco loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, friable loam about 3 inches thick. The subsoil is about 36 inches thick. The upper part is brown and dark yellowish brown, friable clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3.5 to 4.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. If cultivated, the surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for pasture. Many are cultivated. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the underlying very firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork.

Grassed waterways help to prevent gully erosion. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

783C2—Cresco loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is dominantly black, friable loam about 7 inches thick. It is mixed with streaks and pockets of brown material from the subsoil. The subsoil is about 30 inches thick. The upper part is brown and dark yellowish brown, friable clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam. In places the surface layer has a higher content of clay and a lower content of organic matter because the soil has been severely eroded.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 2.7 to 3.7 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for cultivated crops. Some are used for hay or pasture. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Stones from the subsoil often interfere with tillage. Water tends to move laterally at the contact between the loamy overburden and the very firm glacial till. As a result, seepy areas form. A tile drainage system can improve the timeliness of fieldwork. Grassed waterways help to prevent gully erosion. Good tilth generally can be easily maintained. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIIe.

784B—Riceville loam, 1 to 4 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on foot slopes and side slopes in the uplands. It receives runoff from adjacent upland slopes. Areas range from 3 to 25 acres in size. They are irregularly shaped.

Typically, the surface layer is very dark brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown and grayish brown, mottled, friable loam about 6 inches thick. The subsoil is mottled, very firm clay loam about 36 inches thick. The upper part is yellowish brown and grayish brown, and the lower part is gray. The substratum to a depth of about 60 inches is grayish brown, yellowish brown, and strong brown, calcareous clay loam.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 3 to 4 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. This soil is moderately suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A drainage system lowers the water table and improves the timeliness of fieldwork. Glacial stones and boulders are common in most unimproved, undrained areas. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Many undrained areas are used for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. Some areas support native hardwoods. A drainage system helps to lower the water table and reduce the seedling mortality rate. No other hazards or limitations affect planting if the proper species are selected and the stand is managed properly.

The land capability classification is IIe.

797—Jameston silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on slightly concave foot slopes and in the center of the upper end of intermittent upland drainageways. It receives runoff from adjacent upland slopes. Areas range from 3 to 10 acres in size. They are elongated and irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer is black and dark olive gray, mottled, friable silty clay loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is dark gray, mottled, friable silty clay loam, and the lower part is gray and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is gray and strong brown clay loam. In places the soil is very gently sloping.

Permeability and runoff are slow. Available water capacity is high. The content of organic matter in the surface layer is 7 to 8 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are used for hay or pasture. Many areas are used for row crops. If drained and protected from runoff from adjacent upland slopes, this soil is well suited to intensive cropping of corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A tile drainage system lowers the water table and improves the timeliness of fieldwork. The spacing of the tile in the subsoil is critical because permeability in the subsoil is moderately slow. Glacial stones and boulders are common in unimproved, undrained areas. Tilth generally is fair. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Undrained areas generally are used as pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth, increases the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

798B—Protivin loam, 1 to 4 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on foot slopes and side slopes in the uplands. It receives runoff from adjacent upland slopes. Areas range from 3 to 25 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable loam about 8 inches thick. The subsurface layer is black, friable clay loam about 7 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is dark grayish brown, mottled, firm clay loam, and the lower part is mottled strong brown and gray, very firm clay loam.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. The content of organic matter in the surface layer is 5.5 to 6.5 percent. The soil has a seasonal high water table. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion is a hazard. A drainage system lowers the water table and improves the timeliness of fieldwork. Glacial stones and boulders are common in most unimproved, undrained areas. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Undrained areas generally are used as pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

809C—Bertram sandy loam, 2 to 9 percent slopes. This gently sloping and moderately sloping, somewhat excessively drained soil is on ridges and side slopes in the uplands. Areas range from 2 to 20 acres in size. They are irregularly shaped.

Typically, the surface layer is black, friable sandy loam about 8 inches thick. The subsurface layer is very dark brown, friable sandy loam about 5 inches thick. The subsoil is about 20 inches thick. The upper part is brown and dark yellowish brown, friable sandy loam, and the lower part is dark yellowish brown and yellowish brown, friable sandy clay loam and very firm clay loam. Fractured limestone bedrock is at a depth of about 33 inches. Some tongues of yellowish brown residuum are between the limestone fragments. In places the limestone bedrock is at a depth of less than 20 inches or more than 36 inches.

Included with this soil in mapping are small areas of Emeline soils. These soils have about 6 inches of loamy material above limestone bedrock. They make up about 10 percent of the unit.

Permeability of this Bertram soil is moderately rapid, and runoff is medium. Available water capacity is low. The content of organic matter in the surface layer is 1.5 to 2.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium. The surface layer is friable but tends to crust after hard rains and to puddle if tilled when wet.

Most areas are cultivated. Some are used for hay or pasture. This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses and legumes for hay and pasture. The root zone is limited because of the depth to bedrock and the low available water capacity. Plant growth also is limited during the growing season by the low available water capacity. Soil blowing is a hazard. The sandy windblown material sometimes damages newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A system of conservation tillage that leaves crop residue on the surface and cover crops help to conserve moisture. This soil is not well suited to terracing because of the limited depth to bedrock. If terraces are constructed, cuts should not expose the underlying bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay helps to control erosion. Overgrazing or grazing when the soil is too dry reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IVs.

1585—Coland-Spillville complex, channeled, 0 to 2 percent slopes. These nearly level, poorly drained and somewhat poorly drained soils are on flood plains along rivers and their major tributaries. They are frequently flooded. The mapped areas include oxbows, marshes, and old stream channels, which are a result of the meandering river channel. Areas range from 40 to more than several hundred acres in size. They generally are long and wide or are irregularly shaped. They are about 60 percent Coland soil and 30 percent Spillville soil. The two soils occur as areas so intricately mixed or so small in size that mapping them separately is not practical.

Typically, the surface layer of the Coland soil is black, friable clay loam about 8 inches thick. The subsurface layer is black, friable clay loam about 30 inches thick. It is mottled in the lower part. Next is a transitional layer of black and dark grayish brown, mottled, friable clay loam. The upper part of the substratum is grayish brown, mottled clay loam. The lower part to a depth of about 60 inches is grayish brown, mottled stratified loam, clay loam, and silt loam. In places the surface layer is loam.

Typically, the surface layer of the Spillville soil is black and very dark gray, friable loam about 8 inches thick. The subsurface layer is friable loam about 40 inches thick. The upper part is black and very dark gray, and the lower part is black. Next is a transitional layer of very dark grayish brown and black, mottled, friable sandy loam. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled sandy loam. In some places the surface layer and subsurface layer are sandy loam. In other places the combined thickness of the surface layer and subsurface layer is less than 36 inches.

Included with these soils in mapping are small areas of soils that have a subsurface layer of loamy sand. The included soils have a lower content of organic matter and lower available water capacity than the Coland and Spillville soils. They are in landscape positions similar to those of the Spillville soil. They make up about 10 percent of the map unit.

Permeability is moderate in the Coland and Spillville soils, and runoff is slow. Available water capacity is high. The content of organic matter is 5 to 7 percent in the surface layer of the Coland soil and 4 to 5 percent in the surface layer of the Spillville soil. Both of the soils have a seasonal high water table. The substratum of the Coland soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The substratum of the Spillville soil generally has a very low supply of available phosphorus and potassium.

These soils generally are unsuited to cultivated crops unless they are protected from the flooding by levees. Some wooded areas have been partially cleared of trees and are used as permanent pasture. Many areas support water-tolerant native timber. The potential for development of wetland wildlife habitat is very good because of the many small, naturally occurring ponded areas.

The land capability classification is Vw.

1936—Spillville-Udifluvents complex, channeled, 0 to 2 percent slopes. These nearly level, somewhat poorly drained to somewhat excessively drained soils are on flood plains along rivers and their major tributaries. They are frequently flooded. The mapped areas generally include oxbows and escarpments from old stream channels, which are a result of the meandering stream channel. Areas generally range from 40 to a few hundred acres in size and are elongated. They are about 50 percent Spillville soil and 35 percent Udifluvents. These two soils occur as areas so intricately mixed or so small in size that mapping them separately is impractical.

Typically, the surface layer of the Spillville soil is black and very dark gray, friable loam about 8 inches thick. The subsurface layer is friable loam about 40 inches thick. The upper part is black and very dark gray, and the lower part is black. Next is a transitional layer of very dark grayish brown and black, mottled, friable sandy loam. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled sandy loam. In places the combined thickness of the surface layer and subsurface layer is less than 36 inches.

Typically, the surface layer of the Udifluvents is dark grayish brown, friable sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is brown, dark grayish brown, and very dark grayish brown stratified loam and sandy loam. In places the strata are loamy sand or sand and are as much as 4 inches thick.

Included with these soils in mapping are Coland soils and areas of sandy riverwash. Coland soils are poorly drained and have more clay in the surface layer than the Spillville soil. They are in low areas adjacent to the Spillville soil. The riverwash is very droughty and has very rapid permeability. It generally is in areas adjacent to the river channels below the Spillville soil and the Udifluvents. Inclusions make up about 15 percent of the unit.

Permeability is moderate in the Spillville soil and generally is moderate to rapid in the Udifluvents. Runoff is slow on both soils. Available water capacity is high in the Spillville soil and generally is low in the Udifluvents. The content of organic matter is 4.0 to 5.0 percent in the surface layer of the Spillville soil and 2.0 to 4.5 in the surface layer of the Udifluvents. The Spillville soil has a seasonal high water table. The subsurface layer of the Spillville soil generally has a very low supply of available phosphorus and potassium. The substratum of the Udifluvents generally has a very low supply of available phosphorus and potassium.

These soils generally are unsuited to cultivated crops; however, if the soils are protected from flooding, some areas may be cultivated. Droughtiness is a limitation in areas of the Udifluvents and the sandy inclusions.

Most areas are used for pasture. Some areas support native trees. If these soils are used for pasture, overgrazing may result in damage to native trees. Proper stocking rates help to keep the trees, pasture plants, and streambanks in good condition. The potential for development of wetland wildlife habitat is very good because of the wide range in soil characteristics and the many small, naturally occurring ponded areas.

The capability classification is Vw.

5010—Pits, sand and gravel. This map unit dominantly is on stream terraces, but in some areas it is in the uplands. The pits generally are no longer being mined. They range from less than 1 acre to about 30 acres in size. They generally are square or rectangular.

Typically, available water capacity is low or very low in the soil material. As a result, the material tends to be droughty during much of the growing season. In some areas it has a seasonal high water table. Low areas are ponded during wet periods. Stones and cobbles are common on the surface. The content of organic matter in the surface layer generally is less than 1 percent. Reaction typically is moderately acid.

Most of the inactive pits support weeds and small trees. Some have been used as refuse dumps. The pits can be developed for wildlife or recreational uses. The trees and shrubs that can withstand the droughtiness should be selected for planting.

No land capability classification is assigned.

5030—Pits, limestone quarries. This map unit consists of pits from which limestone has been quarried, primarily for use in road construction and as agricultural lime. The pits are 40 or more feet deep and are surrounded by piles of spoil 15 or more feet high. They range from a few acres to 50 acres in size. They are irregularly shaped. Some of the pits have steep sides and contain water, which is shallow to many feet deep.

The spoil surrounding the pits varies in texture but generally is loamy or gravelly and contains varying amounts of limestone fragments. It is derived from glacial till, gravelly outwash, or a mixture of glacial till and gravelly outwash. In some areas it is very uneven. In other areas, it has been leveled and smoothed and grasses and trees grow reasonably well. The spoil ranges from moderately acid to moderately alkaline.

The quarries are well suited to wildlife habitat. Those containing water can provide habitat for fish. Because of the steepness of the sides of the pits and the variable depth of the water, the pits could be dangerous as sites for recreation and wildlife habitat. Onsite investigation is needed to determine if a hazard exits.

No land capability classification is assigned.

5040—Orthents, loamy. These nearly level to strongly sloping soils are used as borrow areas for construction. In some areas the original soil has been removed to a depth of 5 to 10 feet or more. In other areas 5 to 10 inches of topsoil has been redistributed on the surface, commonly in an uneven pattern. The soils range from excessively drained to somewhat poorly drained, depending on the kind of material from which the soils were derived and the extent to which the borrow area is restored. Areas typically range from about 2 to 40 acres in size.

Typically, the upper 60 inches of these soils is yellowish brown, friable and firm loam. In many places cobbles and pebbles are common on the surface. In some places the soil material is sandy loam. In other places the surface layer is very dark gray or dark brown.

Included with these soils in mapping are small areas of sand and a few areas that were once dumps or landfills and have now been covered. Also included is an active landfill in sec. 33, T. 95 N., R. 13 W.

Permeability varies in the Orthents, depending on the texture and density of the soil material. Runoff is slow to rapid. Available water capacity is high to low. The soil material that was once buried 5 to 10 feet or more beneath the surface has less pore space and a higher density than the original surface layer. It has not been appreciably affected by the processes of soil formation, such as freezing and thawing. The content of organic matter is generally low unless the topsoil has been redistributed throughout the area. As a result, preparing a good seedbed is difficult and drought is a hazard. Reaction typically is moderately alkaline. In most areas these soils have a very low supply of available phosphorus and potassium.

These soils are better suited to small grain and to grasses and legumes for hay and pasture than to row crops. They are suited to row crops only in areas where the topsoil has been redistributed. Corn and soybeans are grown in some of these areas. If cultivated crops are grown, erosion is a moderate or severe hazard in the more sloping areas. A system of conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface helps to control erosion and stabilize the soils.

No land capability classification is assigned.

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban 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 273,000 acres in the survey area, or 84 percent of the total acreage, meets the soil requirements for prime farmland. Most of this prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated three-fourths of the county's total agricultural income each year.

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

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

Some soils that have a seasonal high water table qualify as prime farmland only in areas where the limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; 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

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 1987, about 164,600 acres in Chickasaw County, or about 50 percent of the total acreage, was used for corn and soybean production. The remaining acreage was mainly used for small grain, hay, or pasture or as woodland or urban land.

Corn and soybeans are the main row crops, and legume-grass is the main hay crop. The main small grain crop is oats. The pasture typically is a mixture of legumes and grasses. Areas of pasture are renovated periodically.

The paragraphs that follow describe the management concerns in the areas of the county used for crops or pasture.

Water erosion is a major concern on more than 38 percent of the cropland in the county. The hazard of erosion is influenced by the slope of the land, the texture and structure of the soil, rainfall, the amount and type of plant cover, and tillage practices. Erosion-control measures are needed in areas of Bassett, Cresco, Dickinson, Flagler, Kenyon, Ostrander, Rockton, and other similar soils.

The loss of soil through erosion is damaging for several reasons. Erosion causes the loss of organic matter and nutrients and results in a decrease in the water-holding capacity of many soils that tend to be droughty. Productivity is generally reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Runoff rates also tend to increase as erosion increases.

Controlling erosion helps to maintain the productivity of soils. It also minimizes the pollution of streams by sediments and thus tends to improve water quality for municipal and recreational uses and for fish and other wildlife. More fuel is generally needed during seedbed preparation of eroded soils. Since erosion adversely affects the physical condition of the soil, the likelihood of surface crusting is increased and the emergence of seedlings is inhibited.

Measures that are effective in controlling erosion generally are those that provide a protective surface cover, reduce the rate of runoff, and increase the rate of water infiltration. A cropping system that keeps plants or plant residue on the surface for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is pasture and hayland, including legumes and grasses in the cropping system not only provides nitrogen and improves tilth for the following crop but also reduces the risk of erosion on the more sloping soils.

A system of conservation tillage that leaves crop residue on the surface is effective in controlling erosion. A drainage system, which improves the timeliness of fieldwork and lowers the seasonal high water table, greatly enhances the effectiveness of conservation tillage systems on many of the soils in the county. Following are examples of conservation tillage systems that can be used on most of the soils in the county. These four types of conservation tillage are only effective when enough residue is left on the soil surface to effectively reduce erosion.

Ridge-till is a system in which the seedbed is prepared and the seed is planted in one operation (fig. 7). The seed is planted on ridges that generally are 4 to 10 inches higher than the middle of the rows. The ridges, which act like a wick, remain moist as they draw moisture from the residue-covered areas between the ridges. Approximately one-third of the soil surface is tilled at planting time with sweeps or row cleaners. Ridge-till is beneficial on somewhat poorly drained and poorly drained soils, such as Clyde, Floyd, Readlyn, and Tripoli soils.

Mulch-till is a system in which the soil is loosened over the entire surface with chisels, field cultivators, or disks. The residue is only partially incorporated into the surface, as opposed to moldboard plowing, which inverts the soil and incorporates the majority of the residue into the soil. The seedbed is prepared and the seed is planted in one or two operations in a mulch-till system.

No-tillage, or slot tillage, is a system in which the seedbed is prepared and the seed is planted in one operation. The surface is disturbed only in the immediate area of the planted row of seeds. A protective cover of crop residue is left on at least 90 percent of the surface.

Strip tillage also is a system in which the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the total area. A protective cover of crop residue is left on two-thirds of the surface.

Contour farming and contour stripcropping also help to control erosion in the survey area. They are effective on soils that have long, smooth, uniform slopes, such as the Bassett, Cresco, Kenyon, Lourdes, Ostrander, and Racine soils.

Terraces and diversions help to control runoff and erosion by reducing the length of slopes. They are most effective on deep, well drained or moderately well drained soils that have regular and smooth slopes. Bassett, Cresco, Kenyon, Lourdes, and Ostrander soils are suited to terracing. Large stones and boulders should be removed when terraces are constructed; however, the less fertile subsoil of glacial soils should not be exposed.

Terracing is not practical in areas of the more sloping, coarse textured and moderately coarse textured Billett, Chelsea, Flagler, and Lilah soils. Terracing these soils is impractical because the soils generally have short, irregular slopes and are coarse textured. Applying a cropping system that includes a protective plant cover helps to control water erosion and soil blowing and conserve moisture on these droughty soils. Bertram, Rockton, and Winneshiek soils are poorly suited to terracing because they are shallow over bedrock. If terraces are constructed in areas of these soils, the cuts should not expose the underlying bedrock.

Soil blowing is a hazard on sandy or moderately coarse textured soils, such as the Bertram, Billett, Burkhardt, Chelsea, Dickinson, Flagler, Lilah, and Olin soils, and on organic soils, such as the Houghton and Palms soils. It can be controlled by a plant cover, surface mulch, or conservation tillage system that keeps the surface rough and protected.

Soils that are susceptible to water erosion and soil blowing should not be plowed in the fall. If a moldboard plow is used, little residue is left on the soil surface. As a result, the susceptibility to water erosion during periods of snowmelt and spring runoff is increased. The susceptibility to soil blowing also is increased throughout fall, winter, and spring, except when snow cover is adequate.

Information about measures that help to control water erosion and soil blowing on each kind of soil is contained in the "Technical Guide," which is available at the local office of the Natural Resources Conservation Service.

The wetness is a major management concern on about 43 percent of the acreage in the county. Some soils are naturally wet and poorly drained. Examples

Figure 7.—A ridge-till system in a field of corn.

are the Floyd, Havana, Houghton, Palms, Schley, and Tripoli soils on uplands. Other poorly drained soils are in waterways, on stream terraces, and on bottom land. Examples are the Clyde, Coland, Marshan, Shandep, Spillville, and Udolpho soils. All of these soils are more productive if tile is installed in the subsoil, although only marginal success may result in areas of the Houghton and Palms soils. A surface drainage system may also be needed in areas of several of these soils.

The design required for surface and subsurface drainage systems varies for the different kinds of soil. In most areas of poorly drained and somewhat poorly drained soils that are intensively row cropped, a surface drainage system and measures that control runoff from adjacent upland slopes are needed. Drainage tiles should be spaced more closely in soils that are moderately slowly permeable than in the more rapidly permeable soils.

Organic soils oxidize and subside when the pore space is filled with air. As a result, special drainage systems are needed to control the depth of the water table and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils, such as the Houghton and Palms soils.

Information about the design of drainage systems for each kind of soil is contained in the "Technical Guide," which is available at the local office of the Natural Resources Conservation Service.

Soil fertility is affected by the supply of available phosphorus and potassium in the subsoil, by reaction, and by the content of organic matter. The supply of available phosphorus and potassium is low or very low in most of the upland soils in the county. Alluvial soils also generally have a low or very low supply of available phosphorus and potassium; however, Coland soils typically have a medium supply of available potassium in the subsoil.

Most of the moderately well drained and well drained upland soils have an acid subsoil. Applications of ground limestone on these soils raise the pH level sufficiently for alfalfa and other crops to grow well. Most of the somewhat poorly drained and poorly drained upland soils have a neutral or slightly acid subsoil. Crops on these soils will not benefit from applications of lime. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime that should be applied.

Tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous and have a high content of organic matter. Soil tilth generally becomes poorer as the topsoil erodes. An eroded soil generally has an increase in clay incorporated into the surface layer from the subsoil and a loss of organic matter from the surface layer. As a result, the rate of water infiltration is reduced, the rate of runoff is increased, clods form, and the quality of the seedbed is reduced. Regularly adding crop residue, manure, or other organic material helps to improve structure and minimize crusting.

A cover of pasture plants helps to control erosion. The maximum production of grasses and legumes can be achieved if the pasture or hayland is properly managed. Proper management practices for established stands include applications of fertilizer, weed and brush control, rotational and deferred grazing where full-season grazing systems are used, proper stocking rates, and adequate livestock watering facilities. If the vegetative cover is destroyed when sloping areas of pasture and hayland are renovated, the hazard of erosion is severe. If cultivated crops are grown prior to seeding for pasture, soil losses can be minimized by conservation tillage, contour farming, and grassed waterways. Interseeding grasses and legumes into existing sod eliminates the need for destroying the plant cover during seedbed preparation.

Pasture and hay crops suited to the soils and climate of the county include several legumes and cool- and warm-season grasses. Most of the permanent pastures support bluegrass or brome. Other cool-season grasses well suited to the soils and climate of the county are orchardgrass, tall fescue, timothy, and reed canarygrass. Warm-season grasses suited to the soils and climate in the county are switchgrass, big bluestem, and indiangrass. These grasses grow well during the warm summer months, but special management practices and pasture rotation are needed when pastures are established or grazed.

Alfalfa is the most common legume grown for hay. It also is mixed with orchardgrass, brome, or timothy for hay and pasture. Birdsfoot trefoil is used in mixtures with bluegrass, orchardgrass, or timothy for pasture. Other legumes that can be grown for pasture are crownvetch and ladino, alsike, and red clover.

Good grazing management is needed to maintain the productivity of all of the pasture species. It is especially important in areas of steeply sloping soils, where it helps to prevent surface compaction and erosion.

Yields per Acre

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

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

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

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

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

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(16)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. 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. No class VIII soils are in Chickasaw County.

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

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

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

Corn Suitability Ratings

Corn suitability ratings provide a relative ranking of all of the soils mapped in the State of Iowa based on the potential of the soils to be used for intensive production of row crops. The corn suitability rating is an index that can be used to rate the potential production of one soil against another soil over a period of time. The average weather conditions and the frequency of use of the soil for row crop production are considered in the corn suitability rating. Ratings range from 100 for soils that have no physical limitations, occur on minimal slopes, and can be continuously row cropped to as low as 5 for soils that have severe limitations when used for row crops. The criteria used to determine the ratings listed in table 6 are that the soil is properly managed, is not irrigated, has been drained where needed, is not affected by frequent flooding, and has not been leveled or terraced. The reasons why the weighted corn suitability rating for a given field can be modified include if the field includes sandy spots, local deposits, outcrops of rock or gravel, and drainageways that cannot be crossed with machinery and the boundary of the field. Even though predicted average yields change with time, the corn suitability ratings are expected to remain relatively constant in relation to one another over time.

The corn suitability ratings in Chickasaw County range from 5 for map unit 412E, Emeline loam, 9 to 18 percent slopes, to 91 for map unit 485, Spillville loam, 0 to 2 percent slopes. Ratings are not assigned to miscellaneous areas or urban land in the county because the properties and use of these units vary. The corn suitability ratings are listed in the yields table.

Woodland Management and Productivity

In the 1850's, about 85,500 acres in Chickasaw County, or 26 percent of the total acreage, was woodland. Early settlers valued the trees as a source of building material and fuel. They harvested the best trees and left the less desirable ones. Gradually, the less desirable ones dominated the landscape. From the time of the earliest settlers to present, the woodland has been cleared and used for agricultural purposes.

The native tree species were bur oak, black oak, white oak, swamp white oak, walnut, cottonwood, silver maple, and green ash. As these native trees were cleared and thinned out, they have been gradually replaced by elm, boxelder, cherry, and ash. The practice of high-grade logging and poor woodland management have resulted in low-grade species dominating many of the wooded areas.

About 8,000 acres in the county, or 2 percent of the total acreage, is currently wooded. Most of this acreage is in areas where timber once flourished. The soils in these areas include the Coggon, Bassett, Oran, Chelsea, Billett, Udolpho, Wapsie, and Winneshiek soils. Some of the more sloping areas of these soils that are currently row cropped could be replanted to trees, which would help to control erosion and stabilize the landscape (fig. 8).

The major areas of forest are in the southwestern part of the county along the Cedar, Little Cedar, and Wapsipinicon Rivers. Some small stands of timber are in scattered areas throughout the rest of the county, especially along rivers and streams.

Grazing and overgrazing the woodland are detrimental to the trees and the soil. The hooves of livestock can damage bark on the base of trees, leaving open wounds and thus increasing susceptibility to damage from insects and diseases. Debarking is so severe in some areas that the trees are girdled. Livestock also destroy young seedlings. Overgrazing causes compaction, which reduces the growth rates and vigor of trees and other vegetation. Trees that are under stress from soil compaction are more susceptible to damage from insects and diseases. Rills form along livestock trails in steep wooded areas. Gullies can form in these areas unless the formation of rills is controlled. The forest vegetation in the wooded areas is very important because it helps to control erosion.

The woodland can be productive if it is protected from livestock, fire, insects, and diseases and if it is properly managed. Proper woodland management includes harvesting methods and measures that improve the timber stands. The objective of woodland management is to attain sustained production by cutting an amount equal to the yearly growth of trees in the stand. This cutting can be done each year or every 5 to 10 years. Seed blocking, shelterwood logging, selective cutting, and clearcutting methods are used for harvesting. Measures that improve timber stands include removal of undesired, poorly formed species; regeneration of the desired species; and thinning at the proper age intervals. Selection of species that are suited to the soil also is important.

The amount of moisture in the soil, aspect, the susceptibility of the soil to erosion, reaction, and fertility of the soil affect the productivity of woodland. The amount of moisture is affected by the depth of the soil, slope, texture, permeability, and drainage. Aspect is the direction that the slope faces. North- and east-facing slopes tend to be cooler and more moist than south- and west-facing slopes. Therefore, they tend to be more productive. Acid soils tend to be better sites for some coniferous trees than for hardwoods. Hardwoods grow better on neutral or slightly calcareous soils and on the more fertile soils.

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

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

Figure 8.—Christmas trees in an area of the moderately sloping Bassett and Coggon soils.

snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

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

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

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

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

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

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

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

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

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

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

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 9). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility

Figure 9.—A windbreak in the county.

of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

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

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

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for 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 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

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

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

Chickasaw County has an abundance of wildlife. Upland game birds, such as ring-necked pheasant, Hungarian partridge, and quail, are plentiful and are hunted in the fall and early winter. Other common upland game species are white-tailed deer, cottontail rabbit, gray and fox squirrels, and raccoon.

Fish are abundant in the rivers and streams throughout the county. Bluegill, largemouth bass, crappie, and catfish are stocked in a few ponds and water-filled quarries. Northern pike are plentiful in the Wapsipinicon River, and walleye and catfish are in the Cedar River. Smallmouth bass are in most of the streams and rivers in the county.

Wetland wildlife has been reduced in extent as wetlands have been drained and as wetland plants, shrubs, and trees have been destroyed. Runoff from feedlots and fields also has reduced the numbers and kinds of wetland plants and animals. Eroded soil from cropland accelerates siltation of wetlands and streams and often destroys the habitat for reproduction of wetland plants and animals. Wildlife that depend on quality wetland areas include great blue heron, American egret, teal, mallards, beaver, muskrat, mink, and otter. Wetland habitat can be improved by allowing native grasses and shrubs to grow and act as filter strips along streambanks and by fencing livestock out of the wetland areas. The filter strips and diversion of runoff away from wetland areas help to ensure that applied chemicals do not harm the wetland plants and animals.

A few wetland areas have been created by impounding water and dredging bottom land, especially along the Wapsipinicon River. These areas provide excellent habitat for wetland birds and game fish.

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

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

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and 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, orchardgrass, 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, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. 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, wildrice, 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, and deer.

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. 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 kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to 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 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills *(19)*. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for 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 or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

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

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

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

Excessive seepage 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, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, 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, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help 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 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal 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 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment (fig. 10). 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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that

Figure 10.—A pond reservoir, which can be used for recreational activities and by wildlife, in an area of Clyde clay loam, 0 to 3 percent slopes.

impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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, and sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

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

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Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

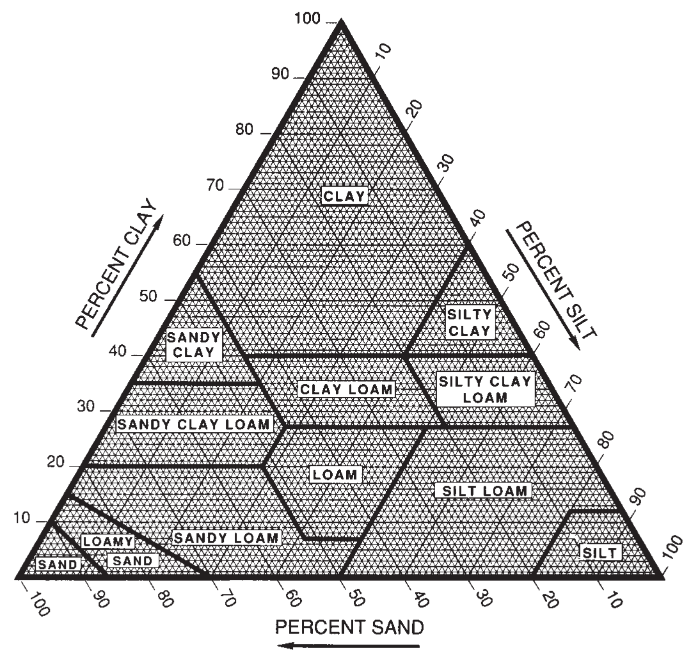

Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under 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. 11). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

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

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

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

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

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

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

Physical and Chemical Properties

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

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

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (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 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(17)*. 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, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum 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" *(18)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(17)*. 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."

Bassett Series

The Bassett series consists of moderately well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in 12 to 26 inches of loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Bassett loam, 2 to 5 percent slopes, in a cultivated field; 1,900 feet east and 900 feet south of the northwest corner of sec. 32, T. 95 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; common faint black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 13 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; common faint very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate medium platy structure; friable; slightly acid; clear wavy boundary.

Bt1—13 to 21 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2) silt coatings on faces of peds; few black (10YR 2/1) concretions of manganese oxide; about 5 percent gravel; moderately acid; clear smooth boundary.

2Bt2—21 to 33 inches; yellowish brown (10YR 5/4 and 5/6) loam; few fine faint brown (10YR 5/3) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; firm; few faint brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2) silt coatings on faces of peds; few black (10YR 2/1) concretions of manganese oxide; stone line in upper part; strongly acid; gradual smooth boundary.

2Bt3—33 to 41 inches; strong brown (7.5YR 5/6) loam; common medium prominent grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct brown (10YR 4/3) clay films and few distinct light gray (10YR 7/2) silt coatings on faces of peds; few black (10YR 2/1) concretions of manganese oxide; small pebbles; strongly acid; gradual smooth boundary.

2BC—41 to 49 inches; strong brown (7.5YR 5/6 and 5/8) loam; common medium prominent grayish brown (10YR 5/2) mottles; weak medium prismatic structure; firm; many black (10YR 2/1) concretions of manganese oxide; small pebbles; strongly acid; gradual smooth boundary.

2C—49 to 60 inches; strong brown (7.5YR 5/8) and grayish brown (10YR 5/2) loam; massive; firm; common black (10YR 2/1) concretions of manganese oxide; small pebbles; strongly acid.

The thickness of the solum ranges from 36 to 70 inches or more. Carbonates do not occur within a depth of 4 feet. Typically, a stone line at a depth of 12 to 26 inches separates the loamy erosional sediments and the loamy glacial till.

The A horizon ranges from 6 to 10 inches in thickness. It has value and chroma of 2 or 3. It typically is loam, but the range includes silt loam. The E horizon has value of 3 or 4 and chroma of 2 or 3. It typically is loam, but the range includes silt loam. Some pedons have a BE horizon. The BE horizon, the Bt1 horizon, and the upper part of the 2Bt horizon have hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The lower part of the 2Bt horizon has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 1 to 8. The grayer colors occur in part of the matrix or as mottles. The 2Bt horizon typically is loam, but the range includes clay loam and sandy clay loam. The 2BC and 2C horizons have colors similar to those in the lower part of the 2Bt horizon.

Bertram Series

The Bertram series consists of somewhat excessively drained soils on convex upland ridgetops and side slopes. These soils formed in loamy eolian material and the underlying residuum derived from limestone bedrock. Permeability is moderately rapid in the loamy eolian material and moderately slow in the underlying residuum. The native vegetation is prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Bertram sandy loam, 2 to 9 percent slopes, in a cultivated field; 1,200 feet south and 100 feet east of the center of sec. 32, T. 94 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 13 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) dry; common faint black (10YR 2/1) coatings on faces of peds; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

Bw1—13 to 21 inches; brown (10YR 4/3) sandy loam; weak medium subangular structure; friable; moderately acid; clear smooth boundary.

Bw2—21 to 27 inches; dark yellowish brown (10YR 4/4) sandy loam; common faint brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; friable; moderately acid; clear smooth boundary.

Bw3—27 to 30 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; thin faint brown (10YR 4/3) coatings on faces of peds; moderately acid; clear wavy boundary.

2Bt—30 to 33 inches; dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) clay loam; moderate fine subangular blocky structure; very firm; common distinct dark brown (7.5YR 3/2) clay films on faces of peds; few fine pale olive (5Y 6/4) fragments of limestone; slightly acid; abrupt wavy boundary.

2R—33 inches; hard limestone bedrock.

The thickness of the solum ranges from 20 to 36 inches and corresponds to the depth to limestone bedrock. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It typically is sandy loam, but the range includes loamy sand. The Bw horizon dominantly has value of 3 to 5 and chroma of 3 or 4. It is sandy loam. The 2Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is sandy clay loam or clay loam.

Billett Series

The Billett series consists of well drained, moderately rapid permeable soils on upland convex side slopes and ridgetops. These soils formed in loamy eolian sediments and the underlying sandy glacial outwash. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Billett sandy loam, 2 to 5 percent slopes, in a hayfield; 1,680 feet east and 160 feet south of the northwest corner of sec. 7, T. 94 N., R. 14 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; neutral; abrupt smooth boundary.

BE—8 to 14 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

Bt1—14 to 24 inches; dark yellowish brown (10YR 4/4) and brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay bridges between sand grains; slightly acid; gradual smooth boundary.

Bt2—24 to 34 inches; dark yellowish brown (10YR 4/4) loamy coarse sand; weak fine subangular blocky structure; very friable; common faint brown (10YR 4/3) clay bridges between sand grains; about 5 percent gravel; slightly acid; gradual smooth boundary.

E and Bt—34 to 54 inches; dark yellowish brown (10YR 4/6) loamy coarse sand; weak medium subangular blocky structure; very friable; dark brown (7.5YR 3/2) sandy loam lamellae at depths of 35, 41, 44, and 53 inches averaging about 0.5 inch in thickness; about 10 percent gravel; neutral; gradual smooth boundary.

C—54 to 60 inches; dark yellowish brown (10YR 4/4 and 4/6) gravelly loamy coarse sand; single grained; loose; about 20 percent gravel; slightly acid.

The thickness of the solum ranges from 30 to 60 inches or more. The thickness of the A horizon ranges from 6 to 10 inches.

The A horizon has value of 2 or 3 and chroma of 1 to 3. The BE horizon has value of 4 or 5 and chroma of 1 to 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The content of gravel ranges from 0 to 15 percent in the Bt horizon.

Burkhardt Series

The Burkhardt series consists of excessively drained, rapidly permeable soils on stream terraces and on upland convex ridgetops and side slopes. These soils formed in 12 to 24 inches of loamy alluvial deposits and the underlying sandy and gravelly glacial outwash. The native vegetation is drought-resistant grasses. Slopes range from 0 to 14 percent.

Typical pedon of Burkhardt sandy loam, 2 to 5 percent slopes, in a hayfield; 2,100 feet south and 180 feet east of the center of sec. 4, T. 94 N., R. 14 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

Bt—10 to 15 inches; dark brown (7.5YR 3/2) sandy loam; weak fine subangular blocky structure; friable; few faint dark brown (7.5YR 3/2) clay bridges between sand grains; about 8 percent gravel; slightly acid; clear smooth boundary.

2BC—15 to 18 inches; dark brown (7.5YR 3/4) gravelly loamy sand; weak fine subangular blocky structure parting to single grained; very friable and loose; slightly acid; clear smooth boundary.

2C1—18 to 40 inches; strong brown (7.5YR 4/6) gravelly coarse sand; single grained; loose; slightly acid; gradual smooth boundary.

2C2—40 to 60 inches; strong brown (7.5YR 4/6) extremely gravelly coarse sand; single grained; loose; 70 percent gravel; slightly acid.

The thickness of the solum ranges from 12 to 24 inches. It commonly corresponds to the depth to stratified sand and gravel.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. It typically is sandy loam, but the range includes loam. Some pedons have an AB horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is sandy loam, loamy sand, sand, or the gravelly analogs of those textures. The 2C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand, gravelly coarse sand, or extremely gravelly coarse sand.

Chelsea Series

The Chelsea series consists of excessively drained, rapidly permeable soils on upland convex ridgetops and side slopes and on alluvial terraces. These soils formed in sandy eolian material or in sandy glacial outwash that has been reworked by wind. The native vegetation is deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Chelsea loamy sand, 2 to 9 percent slopes, in a pasture; 500 feet east and 1,900 feet north of the southwest corner of sec. 32, T. 94 N., R. 14 W.

A—0 to 6 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; moderately acid; clear smooth boundary.

E1—6 to 12 inches; dark yellowish brown (10YR 4/4) loamy fine sand, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

E2—12 to 22 inches; dark yellowish brown (10YR 4/4 and 4/6) loamy fine sand, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; very friable; slightly acid; gradual smooth boundary.

E and Bt—22 to 60 inches; yellowish brown (10YR 5/6) and brown (7.5YR 4/4) sand; single grained; loose; 0.25- to 0.50-inch-thick lamellae of dark brown (7.5YR 3/4) loamy sand at depths of 24, 28, 36, and 44 inches; moderately acid.

The thickness of the solum ranges from 18 to 34 inches. The thickness of the A horizon ranges from 6 to 10 inches.

The A horizon has value of 3 or 4 and chroma of 1 to 3. The B horizon has value of 4 to 6 and chroma of 3 to 6. It is loamy sand or sand.

Clyde Series

The Clyde series consists of poorly drained, moderately permeable soils in intermittent upland drainageways. These soils formed in 30 to 50 inches of friable loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is water-tolerant grasses and sedges. Slopes range from 0 to 3 percent.

Typical pedon of Clyde clay loam, in a cultivated area of Clyde-Floyd complex, 1 to 4 percent slopes; 1,800 feet north and 480 feet east of the southwest corner of sec. 24, T. 94 N., R. 14 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.

AB—15 to 20 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; common distinct dark olive gray (5Y 3/2) mottles; weak medium subangular blocky structure; friable; neutral; gradual smooth boundary.

Bg1—20 to 36 inches; gray (5Y 5/1) and dark grayish brown (2.5Y 4/2) loam; many fine and medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few distinct very dark gray (10YR 3/1) organic flows in root channels; 2-inch-thick strata of sandy loam and sandy clay loam; neutral; gradual wavy boundary.

Bg2—36 to 40 inches; gray (5Y 5/1) sandy loam; many fine and medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few dark brown (7.5YR 4/4) concretions of iron oxide; slightly acid; clear wavy boundary.

2BCg—40 to 52 inches; gray (5Y 6/1) loam; many fine prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure; firm; few small dark brown (7.5YR 4/4) concretions of iron oxide; stone line in upper part; neutral; gradual smooth boundary.

2Cg—52 to 60 inches; gray (5Y 6/1 and 5/1) loam; many fine prominent yellowish brown (10YR 5/6) mottles; small pebbles; massive; firm; neutral.

The thickness of the solum ranges from 30 to 60 inches. The depth to carbonates ranges from 45 to 70 inches. The loamy material is 30 to 50 inches thick over glacial till.

The A horizon dominantly is clay loam, but in some pedons it may be loam. It is black (N 2/0 or 10YR 2/1). The AB or BA horizon, if it occurs, ranges from black (N 2/0) to very dark gray (10YR 3/1). It is clay loam or loam. The Bg, 2BCg, and 2Cg horizons commonly have hue of 5Y or 2.5Y, value of 5 or 6, and chroma of 1. Most pedons have thin strata of sandy loam or sandy clay loam in the Bg horizon.

Coggon Series

The Coggon series consists of moderately well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in friable loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Coggon loam, 2 to 5 percent slopes, in a wooded area; 2,460 feet west and 280 feet north of the center of sec. 5, T. 95 N., R. 14 W.

A—0 to 4 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

E—4 to 10 inches; grayish brown (10YR 5/2) loam, light gray (10YR 7/2) dry; few faint dark grayish brown (10YR 4/3) coatings on faces of peds; moderate medium platy structure; friable; common distinct very dark gray (10YR 3/1) castings in worm channels; few faint light gray (10YR 7/2) silt coatings on faces of peds; neutral; clear wavy boundary.

BE—10 to 18 inches; brown (10YR 4/3) loam; few faint dark grayish brown (10YR 4/2) coatings on faces of peds; weak medium platy structure parting to weak fine subangular blocky; friable; many prominent white (10YR 8/1) silt coatings on faces of peds; neutral; clear smooth boundary.

2Bt1—18 to 26 inches; yellowish brown (10YR 5/6) loam; common faint dark yellowish brown (10YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few distinct white (10YR 8/1) silt coatings on faces of peds; stone line in upper part; moderately acid; gradual smooth boundary.

2Bt2—26 to 37 inches; yellowish brown (10YR 5/6) loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; common fine distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few distinct dark grayish brown (10YR 4/2) clay films in root channels; few distinct white (10YR 8/1) silt coatings on faces of peds; few brown (7.5YR 4/4) concretions of iron oxide; few small stones and pebbles; strongly acid; gradual smooth boundary.

2Bt3—37 to 45 inches; yellowish brown (10YR 5/6) loam; few distinct grayish brown (10YR 5/2) coatings on vertical faces of prisms; few fine distinct grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; few distinct dark grayish brown (10YR 4/2) clay films in root channels and few distinct dark grayish brown (10YR 4/2) clay films on vertical faces of prisms; common black (10YR 2/1) concretions of manganese oxide; few 4- to 5-millimeter-thick dark reddish brown (5YR 3/2) and black (10YR 2/1) concretions of iron and manganese oxide; few small stones and pebbles; very strongly acid; gradual smooth boundary.

2Bt4—45 to 56 inches; yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; few faint grayish brown (10YR 5/2) coatings on faces of prisms; weak medium prismatic structure; firm; few distinct very dark grayish brown (10YR 3/2) clay flows in root channels; common black (10YR 2/1) concretions of manganese oxide; few 4- to 5-millimeter-thick dark reddish brown (5YR 3/2) and black (10YR 2/1) concretions of iron and manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2C—56 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; few small stones and pebbles; massive; firm; common black (10YR 2/1) concretions of manganese oxide; moderately acid.

The thickness of the solum ranges from 50 to 70 inches. The depth to carbonates ranges from 60 to 85 inches. Wedges of loamy sand or sand extend from the stone line to a depth of 3 to 5 feet in some pedons.

The A horizon has value of 3 and chroma of 1 or 2. The Ap horizon, if it occurs, has hue of 10YR, value of 4, and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. The 2Bt horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 5 or 6. It is clay loam, loam, or sandy clay loam. Mottles having chroma of 2 or less are few or common below a depth of 30 inches. The 2C horizon has colors of 10YR 5/6, 2.5Y 5/2, or 2.5Y 6/2.

Coland Series

The Coland series consists of poorly drained, moderately permeable soils. These soils formed in loamy alluvium on flood plains. The native vegetation is tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Coland clay loam, 0 to 2 percent slopes, in a cultivated field; 1,900 feet west and 250 feet north of the southeast corner of sec. 35, T. 96 N., R. 12 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A1—8 to 18 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure;

friable; slightly acid; gradual smooth boundary.

A2—18 to 29 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

A3—29 to 38 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; common fine and medium prominent dark brown (7.5YR 3/2) mottles; weak medium subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

AC—38 to 48 inches; black (N 2/0) and dark grayish brown (2.5Y 4/2) clay loam, black (10YR 2/1) and grayish brown (2.5YR 5/2) dry; few fine prominent brown (7.5YR 4/4) mottles; weak fine prismatic structure; friable; slightly acid; gradual smooth boundary.

Cg1—48 to 58 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct dark gray (10YR 4/1) and yellowish brown (10YR 5/6) and few fine prominent brown (7.5YR 4/4) mottles; massive; friable; slightly acid; gradual smooth boundary.

Cg2—58 to 60 inches; grayish brown (2.5Y 5/2) stratified loam, clay loam, and silt loam; few fine prominent brown (7.5YR 4/4) mottles; massive with weak horizontal bedding planes; friable; slightly acid.

The thickness of the solum ranges from 32 to 48 inches. The solum does not contain free carbonates. The mollic epipedon is 36 or more inches thick. The 10- to 40-inch control section ranges from 27 to 35 percent clay.

The A horizon is neutral in hue. It has value of 2 or 3. The AC horizon is neutral in hue or has hue of 10YR to 5Y. It has value of 2 to 4 and chroma of 0 to 2. The A and AC horizons typically are clay loam. The C horizon is neutral in hue or has hue of 2.5Y or 5Y. It has value of 2 to 5 and chroma of 0 to 2. It dominantly is clay loam or loam but includes thin strata ranging from silty clay to loamy sand. Contrasting sandy textures or gravelly material is below a depth of 48 inches in some pedons.

Cresco Series

The Cresco series consists of moderately well drained, moderately slowly permeable soils on convex upland ridgetops and side slopes. These soils formed in friable loamy erosional sediments and the underlying very firm loamy glacial till. The native vegetation is mixed prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Cresco loam, 2 to 5 percent slopes, in an area used for hay; 880 feet north and 400 feet east of the southwest corner of sec. 15, T. 96 N., R. 11 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.

A—8 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; streaks and pockets of very dark grayish brown (10YR 3/2) subsoil material; weak fine granular structure; friable; neutral; clear smooth boundary.

Bw—13 to 25 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) clay loam; few faint brown (10YR 4/3) coatings on faces of peds; weak fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

2Bt1—25 to 36 inches; gray (5Y 5/1) and strong brown (7.5YR 5/8) clay loam; few faint gray (5Y 5/1) coatings on faces of peds; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; few faint dark gray (5Y 4/1) clay films on faces of peds; common black (10YR 2/1) concretions of manganese oxide; stone line in upper part; strongly acid; gradual smooth boundary.

2Bt2—36 to 44 inches; gray (5Y 6/1) clay loam; common fine prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak coarse prismatic structure; very firm; common faint gray (5Y 6/1) clay films on faces of peds; common black (10YR 2/1) and few brown (7.5YR 4/4) concretions of iron and manganese oxide; few small stones and pebbles; strongly acid; gradual smooth boundary.

2BC—44 to 54 inches; gray (5YR 5/1) and strong brown (7.5YR 5/6 and 5/8) clay loam; weak coarse prismatic structure; very firm; few distinct very dark gray (10YR 3/1) clay flows in root channels; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; neutral; gradual smooth boundary.

2C—54 to 60 inches; gray (5Y 5/1) and strong brown (7.5YR 5/6 and 5/8) clay loam; massive; very firm; small black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; slight effervescence; slightly alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 and chroma of 3 or 4. The A and Bw horizons are loam or clay loam. The 2Bt horizon has colors of 7.5YR 5/8 and 5/6, 10YR 5/4 and 5/6, or 5Y 5/1 and 6/1. The gray colors tend to increase with increasing depth. The 2BC and 2C horizons have colors similar to those of the 2Bt horizon.

The Cresco soil in map unit 783C2 is a taxadjunct to the series because the dark surface layer is too thin to be classified as a mollic epipedon. It classifies as a fine-loamy, mixed, mesic Mollic Hapludalf.

Dickinson Series

The Dickinson series consists of somewhat excessively drained, moderately rapidly permeable soils on stream terraces and upland dunes. These soils formed in 24 to 36 inches of loamy eolian or erosional sediments over eolian sand or glacial outwash sand reworked by wind. The native vegetation is mixed prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Dickinson sandy loam, 2 to 5 percent slopes, in a cultivated field; 500 feet west and 730 feet north of the southeast corner of sec. 20, T. 94 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) and very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A1—8 to 12 inches; very dark brown (10YR 2/2) and black (10YR 2/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.

A2—12 to 22 inches; very dark brown (10YR 2/2) and dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw—22 to 38 inches; dark yellowish brown (10YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; few very dark brown (10YR 2/2) krotovinas; slightly acid; gradual smooth boundary.

E and Bt1—38 to 46 inches; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; few 0.5-inch-thick lamellae of dark brown (7.5YR 3/4) sandy loam at a depth of 45 inches; neutral; gradual smooth boundary.

E and Bt2—46 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; few 0.5-inch-thick lamellae of dark brown (7.5YR 3/4) sandy loam at a depth of 48 inches; neutral.

The thickness of the solum ranges from 24 to more than 60 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is fine sandy loam, sandy loam, or loam. The Bw horizon has value and chroma of 3 or 4. It is sandy loam or loamy sand. The C horizon, it if occurs, has value of 4 or 5 and chroma of 3 to 6. It is loamy sand or sand. The combined thickness of the lamellae is less than 3 inches.

Donnan Series

The Donnan series consists of somewhat poorly drained soils on upland convex side slopes and ridgetops. These soils formed in friable loamy erosional material over a very firm clayey paleosol. The paleosol formed in glacial till. Permeability is moderate in the erosional material and very slow in the paleosol. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Donnan loam, 2 to 5 percent slopes, in a cultivated field; 420 feet west and 440 feet north of the center of sec. 24, T. 96 N., R. 12 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—7 to 11 inches; brown (10YR 4/3) and dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; few distinct very dark brown (10YR 2/2) coatings on faces of peds; weak thin platy structure; friable; slightly acid; clear smooth boundary.

BE—11 to 16 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loam; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

Bt1—16 to 22 inches; yellowish brown (10YR 5/4) loam; few fine distinct strong brown (7.5YR 5/8) and few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; thin faint brown (10YR 4/3) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—22 to 28 inches; yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) loam; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium prismatic structure; friable; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in root channels; few distinct white (10YR 8/1) silt coatings on faces of peds; strongly acid; clear smooth boundary.

2Bt3—28 to 36 inches; dark gray (2.5Y 4/1) and gray (5Y 5/1) silty clay; common medium prominent brown (7.5YR 4/4) mottles; moderate fine angular blocky structure; firm; many prominent dark brown (7.5YR 3/2) clay films on faces of peds; many prominent white (10YR 8/1) silt coatings on faces of peds; moderately acid; gradual smooth boundary.

2Bt4—36 to 46 inches; dark gray (5Y 4/1) clay; few medium prominent brown (7.5YR 4/4) mottles;

moderate medium prismatic structure parting to moderate medium angular blocky; very firm; many prominent very dark gray (10YR 3/1) clay films on faces of peds; moderately acid; gradual smooth boundary.

2BC—46 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; few medium prominent brown (7.5YR 4/4) mottles; moderate medium prismatic structure; very firm; slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to the clayey paleosol ranges from 20 to 36 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam. The E and BE horizons have value of 4 or 5 and chroma of 2 to 4. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam, loam, or silty clay loam. The content of clay in the Bt horizon ranges from 20 to 30 percent. The 2Bt horizon has hue of 5Y or 2.5Y, value of 3 to 6, and chroma of 1 or 2. It is silty clay or clay. It has about 42 to 55 percent clay. The 2BC horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is clay loam or loam.

Du Page Series

The Du Page series consists of well drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. The native vegetation is mixed prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Du Page loam, 0 to 2 percent slopes, in a cultivated field; 620 feet east and 280 feet south of the northwest corner of sec. 20, T. 94 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) and very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few snail shells (10 to 15 millimeters) and few shell fragments; slight effervescence; slightly alkaline; gradual smooth boundary.

A2—14 to 18 inches; black (10YR 2/1) and very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few snail shells (10 to 15 millimeters) and few shell fragments; slight effervescence; slightly alkaline; clear smooth boundary.

A3—18 to 30 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few small snail shells (10 to 15 millimeters) and few shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

AC—30 to 54 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; few distinct black (10YR 2/1) wormcasts; few thin sand lenses in lower part; strong effervescence; moderately alkaline; gradual smooth boundary.

C—54 to 60 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) stratified loam and sandy loam; massive; very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 56 inches. The thickness of the mollic epipedon commonly is the same as that of the solum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has value of 3 or 4 and chroma of 1 to 4. It is loam or sandy loam.

Emeline Series

The Emeline series consists of somewhat excessively drained, moderately permeable soils on convex upland side slopes. These soils formed in 4 to 12 inches of loamy glacial outwash sediments over limestone bedrock. The native vegetation is drought-resistant grasses. Slopes range from 5 to 18 percent.

Typical pedon of Emeline loam, 9 to 18 percent slopes, in a pasture; 1,080 feet east and 700 feet south of the center of sec. 30, T. 94 N., R. 14 W.

A—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt wavy boundary.

R—6 inches; level-bedded, fractured limestone bedrock.

The thickness of the solum and depth to bedrock range from 4 to 12 inches. Coarse fragments make up less than 15 percent of the soil volume.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It dominantly is loam, but the range includes clay loam.

Flagler Series

The Flagler series consists of somewhat excessively drained soils on the convex summit and side slopes of high benches and on stream terraces. These soils formed in 24 to 36 inches of loamy alluvium deposits and the underlying sandy and gravelly glacial outwash.

Permeability is moderately rapid in the solum and very rapid in the substratum. The native vegetation is drought-tolerant grasses. Slopes range from 0 to 9 percent.

Typical pedon of Flagler sandy loam, 0 to 2 percent slopes, in a permanent pasture; 560 feet north and 440 feet east of the center of sec. 4, T. 94 N., R. 14 W.

A1—0 to 12 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; common fibrous roots; slightly acid; gradual smooth boundary.

A2—12 to 18 inches; black (10YR 2/1) and very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; few very fine fibrous roots; slightly acid; gradual smooth boundary.

A3—18 to 23 inches; very dark brown (10YR 2/2) and black (10YR 2/1) sandy loam, dark brown (10YR 3/3) dry; weak medium subangular blocky structure parting to weak medium granular; very friable; slightly acid; clear smooth boundary.

Bw—23 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; few faint brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; very friable; about 5 percent gravel; moderately acid; gradual smooth boundary.

2C—33 to 60 inches; yellowish brown (10YR 5/4 and 5/6) stratified gravelly coarse sand and coarse sand; distinct bedding planes; single grained; loose; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The depth to loamy sand, gravelly sand, gravelly loamy sand, fine sand, or sand typically is 24 to 33 inches but ranges from 20 to 36 inches. It varies greatly within a short distance.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It dominantly is sandy loam, but the range includes fine sandy loam. The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam. A BC horizon is in some pedons. It has value of 4 or 5 and chroma of 4 to 6. The 2C horizon has value and chroma of 4 to 6. It is gravelly coarse sand, coarse sand, or loamy sand.

The Flagler soil in map unit 284C2 is a taxadjunct to the series because the dark surface layer is too thin to be classified as a mollic epipedon. It classifies as a coarse-loamy, mixed, mesic Dystric Eutrochrept.

Floyd Series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on foot slopes and in intermittent upland drainageways. These soils formed in 32 to 46 inches of loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is mixed prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Floyd loam, 1 to 4 percent slopes, in a cultivated field; 1,050 feet east and 155 feet north of the southwest corner of sec. 36, T. 94 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; dark grayish brown (10YR 3/2) krotovinas; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

AB—15 to 19 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) loam, dark grayish brown (10YR 4/2) dry; few distinct black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—19 to 24 inches; olive brown (2.5Y 4/4) loam; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

Bw2—24 to 32 inches; light olive brown (2.5Y 5/4) loam; common fine faint grayish brown (2.5Y 5/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

Bw3—32 to 42 inches; dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) sandy loam; few fine faint light olive brown (2.5Y 5/4) and few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; stone line in lower part; neutral; clear smooth boundary.

2Bw4—42 to 60 inches; grayish brown (10YR 5/4) and yellowish brown (10YR 5/6) loam; few distinct grayish brown (10YR 5/2) coatings on vertical faces of prisms; common fine distinct strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure; firm; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; neutral.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the A horizon ranges from 16 to 24 inches. The content of coarse fragments larger than 3 inches in diameter in the B and 2B horizons commonly is 2 to 5 percent but ranges to 8 percent in the stone line above the firm glacial till.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or clay loam. The upper part of the Bw horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam or sandy clay loam. The lower part of the Bw horizon and the 2Bw horizon have hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 8. The 2BC and 2C horizons, if they occur, have the same range in color and texture as the lower part of the Bw horizon and the 2Bw horizon. Some pedons have 2- to 5-inch-wide vertical seams or pockets of sand in the 2Bw and 2C horizons.

Havana Series

The Havana series consists of poorly drained, moderately slowly permeable soils on upland flats. These soils formed in a 14- to 24-inch mantle of friable loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is a mixture of water-tolerant grasses, sedges, and deciduous trees. Slopes range from 0 to 2 percent.

Typical pedon of Havana loam, 0 to 2 percent slopes, in a cultivated field; 1,640 feet north and 120 feet west of the southeast corner of sec. 17, T. 95 N., R. 13 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure parting to weak fine subangular blocky; friable; slightly acid; abrupt smooth boundary.

E1—7 to 15 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5YR 7/2) dry; few medium distinct yellowish brown (10YR 5/6) mottles; weak thin platy structure; friable; strongly acid; gradual smooth boundary.

E2—15 to 23 inches; gray (10YR 5/1) and dark gray (10YR 4/1) loam, light gray (2.5YR 7/2) dry; few medium distinct yellowish brown (10YR 5/6) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; strongly acid; clear smooth boundary.

2Btg1—23 to 31 inches; gray (10YR 5/1) and yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; few distinct very dark grayish brown (10YR 3/2) clay flows in root channels; few distinct light gray (10YR 7/2) silt coatings on faces of peds; stone line in upper part; moderately acid; gradual smooth boundary.

2Btg2—31 to 41 inches; gray (10YR 5/1) and yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure parting to weak medium prismatic; friable; few distinct dark brown (10YR 3/3) clay coatings on faces of peds; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2Btg3—41 to 48 inches; yellowish brown (10YR 5/6) and gray (10YR 5/1) loam; moderate medium prismatic structure; firm; few prominent very dark grayish brown (10YR 3/2) clay flows in root channels; few distinct brown (10YR 3/3) clay coatings on faces of peds; common very dark brown (10YR 2/2) concretions of manganese oxide; few small stones and pebbles; slightly acid; gradual smooth boundary.

2C1—48 to 55 inches; yellowish brown (10YR 5/6) and gray (10YR 6/1) loam; massive; firm; few very dark brown (10YR 2/2) concretions of manganese oxide; few small stones and pebbles; neutral; gradual smooth boundary.

2C2—55 to 60 inches; yellowish brown (10YR 5/6) and gray (10YR 6/1) loam; massive; firm; common very dark brown (10YR 2/2) concretions of manganese oxide; few small stones and pebbles; slight effervescence; slightly alkaline.

The thickness of the solum and the depth to carbonates range from 36 to 66 inches. The A horizon dominantly is loam but ranges to silt loam. It has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It has few to many mottles. The 2Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It typically is loam, but the range includes clay loam. In some pedons one or more horizons may be sandy clay loam or sandy loam. A stone line in the upper part of the 2Bt horizon commonly separates the loamy erosional sediments and the glacial till.

Hayfield Series

The Hayfield series consists of somewhat poorly drained soils on stream terraces. These soils formed in 24 to 32 inches of loamy alluvial deposits over sandy and gravelly glacial outwash. Permeability is moderate in the upper part and very rapid in the lower part. The native vegetation is mixed prairie grasses and timber. Slopes range from 0 to 2 percent.

Typical pedon of Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 2,400 feet east and 300 feet south of the northwest corner of sec. 34, T. 95 N., R. 13 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

BE—7 to 11 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium platy structure; friable; few distinct light gray (10YR 7/2) silt coatings on faces of peds; moderately acid; clear smooth boundary.

Bt1—11 to 19 inches; olive brown (2.5YR 4/4) loam; common medium prominent dark brown (7.5YR 5/8) and common medium faint grayish brown (2.5Y 5/2) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; few faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; few distinct light gray (10YR 7/1) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt2—19 to 24 inches; dark yellowish brown (10YR 4/4) loam; common medium distinct strong brown (7.5YR 5/8) and grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very friable; few faint dark grayish brown (2.5Y 4/2) clay films in root channels; strongly acid; gradual smooth boundary.

2C1—24 to 31 inches; yellowish brown (10YR 5/4 and 5/6) loamy coarse sand; common medium distinct strong brown (7.5YR 5/8) and grayish brown (10YR 5/2) mottles; single grained; loose; about 5 percent gravel; strongly acid; gradual smooth boundary.

2C2—31 to 60 inches; yellowish brown (10YR 5/6) gravelly coarse sand; common medium distinct strong brown (7.5YR 5/8) and few medium distinct grayish brown (10YR 5/2) mottles; single grained; loose; about 20 percent gravel; moderately acid.

The thickness of the solum ranges from 20 to 40 inches. The content of coarse fragments, which are of mixed lithology, ranges from 0 to 5 percent, by volume, throughout the solum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The BE horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam. Some pedons have a 2BC horizon. The 2C horizon has value of 4 or 5 and chroma of 2 to 6.

Hoopeston Series

The Hoopeston series consists of somewhat poorly drained, moderately rapidly permeable soils on broad upland flats and convex side slopes. These soils formed in eolian loamy sediments and the underlying sandy glacial outwash sediments. The native vegetation is prairie grasses. Slopes range from 0 to 3 percent.

Typical pedon of Hoopeston sandy loam, 0 to 3 percent slopes, in a cultivated field; 2,440 feet north and 150 feet east of the southwest corner of sec. 33, T. 94 N., R. 13 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 12 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; moderately acid; clear smooth boundary.

Bw1—12 to 21 inches; dark grayish brown (10YR and 2.5Y 4/2) sandy loam; common faint very dark grayish brown (10YR 3/2) coatings on faces of peds; common fine faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; moderately acid; gradual wavy boundary.

Bw2—21 to 34 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) loamy sand; common medium distinct strong brown (7.5YR 4/6) and few fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

C—34 to 60 inches; pale brown (10YR 6/3) and olive brown (2.5Y 6/4) loamy sand; common fine distinct strong brown (10YR 5/6) mottles; single grained; loose; moderately acid.

The thickness of the solum ranges from 20 to 54 inches. The thickness of the mollic epipedon ranges from 8 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It commonly is sandy loam, but the range includes fine sandy loam and loam. The B horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 2 or 3. It is sandy loam in the upper part and loamy sand or sandy loam in the lower part.

Houghton Series

The Houghton series consists of very poorly drained, moderately slowly permeable to moderately rapidly permeable soils formed in bogs in seepy areas on upland hillsides and foot slopes. These soils formed in deep organic deposits. The native vegetation is sedges and water-tolerant grasses. Slopes range from 2 to 5 percent.

Typical pedon of Houghton muck, 2 to 5 percent slopes, in an area of idle land formerly used as pasture; 400 feet east and 300 feet north of the southwest corner of sec. 13, T. 95 N., R. 12 W.

Oa1—0 to 6 inches; sapric material, black (5YR 2.5/1) broken face and rubbed, very dark gray (5YR 3/1) dry; about 50 percent fiber unrubbed, 15 percent rubbed; weak fine subangular blocky structure; nonsticky; neutral; abrupt smooth boundary.

Oa2—6 to 12 inches; sapric material, black (N 2/0) broken face and rubbed, black (10YR 2/1) dry; about 35 percent fiber unrubbed, 15 percent rubbed; weak thick platy structure; nonsticky; neutral; clear smooth boundary.

Oa3—12 to 21 inches; sapric material, black (5YR 2.5/1) broken face and rubbed, very dark gray (5YR 3/1) dry; about 25 percent fiber unrubbed, 10 percent rubbed; massive with horizontal bedding planes; nonsticky; neutral; clear smooth boundary.

Oa4—21 to 29 inches; sapric material, black (N 2/0) broken face and rubbed, black (10YR 2/1) dry; about 10 percent fiber; weak medium subangular blocky structure; slightly sticky; common small snail shells; slight effervescence; slightly alkaline; gradual smooth boundary.

Oa5—29 to 46 inches; sapric material, black (N 2/0) broken face and rubbed, black (10YR 2/1) dry; about 5 percent fiber; massive with horizontal bedding planes; sticky; many small snail shells; slight effervescence; slightly alkaline; gradual smooth boundary.

Oa6—46 to 60 inches; sapric material, black (N 2/0) broken face and rubbed, black (10YR 2/1) dry; less than 5 percent fiber; massive with horizontal bedding planes; sticky; many small snail shells; slight effervescence; slightly alkaline.

The organic layers are 60 or more inches thick. The organic fibers are derived primarily from herbaceous plants, but some layers may contain as much as 30 percent woody material. The organic layers have hue of 10YR to 5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. The surface organic layer and subsurface organic layer typically are sapric, but in some pedons they include up to 10 inches of hemic material.

Jameston Series

The Jameston series consists of poorly drained, slowly permeable soils in intermittent upland drainageways. These soils formed in 14 to 24 inches of friable loamy erosional sediments and the underlying very firm loamy glacial till. The native vegetation is water-tolerant grasses and sedges. Slopes range from 0 to 2 percent.

Typical pedon of Jameston silty clay loam, 0 to 2 percent slopes, in a hayfield; 1,000 feet west and 440 feet north of the southeast corner of sec. 36, T. 97 N., R. 11 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—10 to 14 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

AB—14 to 16 inches; black (5Y 2.5/1 and N 2/0) and dark olive gray (5Y 3/2) silty clay loam, very dark gray (5Y 3/1) dry; common fine prominent olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure parting to moderate medium granular; friable; neutral; clear smooth boundary.

Bg—16 to 22 inches; dark gray (5Y 4/1) silty clay loam; common fine prominent yellowish brown (10YR 5/4) and common fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate fine subangular blocky structure; friable; few small black (10YR 2/1) concretions of manganese oxide; neutral; abrupt smooth boundary.

2Btg1—22 to 35 inches; gray (5Y 5/1) and strong brown (7.5YR 5/6) clay loam; gray (5Y 5/1) coatings on faces of prisms; moderate medium prismatic structure; very firm; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few 2-millimeter-thick black (5Y 2/1) concretions of manganese oxide; stone line in upper part; neutral; gradual smooth boundary.

2Btg2—35 to 42 inches; gray (5Y 5/1) and strong brown (7.5YR 5/6) clay loam; gray (5Y 5/1) coatings on faces of prisms; weak coarse prismatic structure; very firm; few prominent dark brown (7.5Y 3/2) organic coatings in root channels; few prominent very dark gray (10YR 3/1) spherical accumulations of clay; few small stones and pebbles; neutral; gradual smooth boundary.

2BC—42 to 49 inches; gray (5Y 5/1) and strong brown (7.5YR 5/6) clay loam; weak coarse prismatic structure; very firm; few small stones and pebbles; neutral; gradual smooth boundary.

2C—49 to 60 inches; gray (5Y 5/1) and strong brown (7.5YR 5/6) clay loam; massive; very firm; few small stones and pebbles; slightly alkaline; slight effervescence.

The thickness of the solum ranges from 40 to 60 inches. The depth to carbonates ranges from 30 to 50 inches. The thickness of the mollic epipedon ranges from 14 to 22 inches.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is silty clay loam or loam. The Bg horizon has hue of 5Y, 2.5Y, or 10YR, value of 4 or 5, and chroma of 1 to 4. The 2Btg horizon has hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 1 to 8. It ranges from 30 to 35 percent clay. Tongues of sandy loam or loamy sand extend downward from the stone line to a depth of 3 to 5 feet in some pedons.

Kenyon Series

The Kenyon series consists of moderately well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in friable loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Kenyon loam, 2 to 5 percent slopes, in a cultivated field; 350 feet north and 320 feet east of the southwest corner of sec. 14, T. 94 N., R. 11 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.

A—8 to 14 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam, dark grayish brown (10YR 4/2) dry; few faint black (10YR 2/1) coatings on faces of peds; weak fine and very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

BA—14 to 20 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on faces of peds; few faint black (10YR 2/1) organic coatings in root channels; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

2Bw1—20 to 24 inches; dark yellowish brown (10YR 4/4) loam; few faint brown (10YR 4/3) coatings on faces of peds; few fine faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; stone line and few pebbles in upper part; strongly acid; clear smooth boundary.

2Bw2—24 to 32 inches; yellowish brown (10YR 5/4 and 5/6) loam; common medium faint strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2Bw3—32 to 40 inches; yellowish brown (10YR 5/6) loam; few distinct grayish brown (10YR 5/2) coatings on faces of peds; common medium faint strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2Bw4—40 to 53 inches; yellowish brown (10YR 5/6) loam; few distinct grayish brown (10YR 5/2) coatings on faces of peds; few prominent black (10YR 2/1) organic coatings in root channels; common medium distinct strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure parting to weak fine angular and subangular blocky; firm; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2BC—53 to 60 inches; mixed yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and strong brown (7.5YR 5/6) loam; weak fine subangular blocky and weak coarse prismatic structure; firm; few small stones and pebbles; neutral.

The thickness of the solum ranges from 45 to more than 60 inches. The A horizon has value of 2 or 3 and chroma of 1 to 3. It is loam. The soil has an AB or BA horizon. The BA horizon has value of 3 or 4 and chroma of 2 or 3. The 2B horizon has value of 4 or 5 and chroma of 2 to 6. It dominantly is loam, but the range includes sandy clay loam and clay loam. The 2B horizon has less than 30 percent clay. The 2C horizon, if it occurs, is loam. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 6.

The Kenyon soil in map unit 83C2 is a taxadjunct to the series because the dark surface layer is too thin to be classified as a mollic epipedon. It classifies as a fine-loamy, mixed, mesic Dystric Eutrochrept.

Lawler Series

The Lawler series consists of somewhat poorly drained soils on stream terraces. These soils formed in 24 to 40 inches of loamy alluvial deposits and the underlying sandy and gravelly glacial outwash. Permeability is moderate in the upper part of the profile and very rapid in the lower part. The native vegetation is mixed prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 620 feet east and 250 feet south of the northwest corner of sec. 20, T. 97 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; few mixed areas of very dark brown (10YR 2/2) material; weak fine granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—8 to 18 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium granular structure; friable; about 2 percent gravel; neutral; gradual smooth boundary.

A2—18 to 23 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; few faint black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; about 5 percent gravel; slightly acid; gradual smooth boundary.

Bw1—23 to 33 inches; dark grayish brown (10YR 4/2) loam; common fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few distinct very dark gray (10YR 3/1) wormcasts; about 5 percent gravel; moderately acid; clear wavy boundary.

2BC—33 to 36 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) gravelly sandy loam; few faint grayish brown (10YR 5/2) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very friable; about 20 percent gravel; slightly acid; clear wavy boundary.

2C—36 to 60 inches; brown (10YR 5/3) and grayish brown (2.5Y 5/2) gravelly loamy sand; single grained; loose; about 25 percent gravel; slightly acid.

The thickness of the solum ranges from 24 to 40 inches and commonly corresponds to the depth to sand and gravel. The thickness of the mollic epipedon ranges from 10 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 to 6. If the matrix has chroma of more than 2, the mottles and the faces of peds have chroma of 2. The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 to 8, and chroma of 1 to 6.

Lilah Series

The Lilah series consists of excessively drained soils on the convex summit and side slopes of high benches and on stream terraces. These soils formed in loamy erosional sediments and the underlying gravelly and sandy glacial outwash. Permeability is moderately rapid in the upper part and very rapid in the lower part. The native vegetation is drought-tolerant prairie grasses and trees. Slopes range from 2 to 14 percent.

Typical pedon of Lilah sandy loam, 2 to 5 percent slopes, in a cultivated field; 2,020 feet north and 60 feet east of the southwest corner of sec. 12, T. 95 N., R. 11 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; 10 to 15 percent gravel; moderately acid; clear wavy boundary.

BE—8 to 10 inches; brown (10YR 4/3) sandy loam; few faint very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky and weak thin platy structure; very friable; few distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; many fine fibrous roots; 10 to 15 percent gravel; moderately acid; clear wavy boundary.

Bt1—10 to 17 inches; strong brown (7.5YR 4/6) and brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; very friable; many faint brown (7.5YR 4/4) clay bridges between sand grains; many fine fibrous roots; about 50 percent gravel; moderately acid; gradual wavy boundary.

2Bt2—17 to 30 inches; strong brown (7.5YR 4/6) and brown (7.5YR 4/4) very gravelly coarse sand; weak coarse subangular blocky structure; very friable; many faint brown (7.5YR 4/4) clay bridges between sand grains; few fine fibrous roots; 50 to 60 percent gravel; moderately acid; clear wavy boundary.

2Bt3—30 to 35 inches; strong brown (7.5YR 5/6 and 5/8) coarse sand; weak coarse subangular blocky structure; very friable; 0.25- to 0.75-inch-thick lamellae of dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/3) loamy sand; 1-inch-thick band of discontinuous olive gray (5Y 5/2) shale; 10 to 15 percent gravel; moderately acid; gradual wavy boundary.

2Bt4—35 to 60 inches, strong brown (7.5YR 5/6 and 5/8) coarse sand; single grained; loose; 0.25- to 0.75-inch-thick lamellae of reddish brown (5YR 4/3 and 4/4) loamy sand; 2 to 5 percent gravel; strongly acid.

The thickness of the solum ranges from 30 to more than 60 inches. The A horizon is 6 to 9 inches thick. The greatest concentration of gravel is above a depth of 50 inches.

The A horizon has hue of 10YR and value and chroma of 2 or 3. The BE horizon has chroma of 2 or 3. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8. It is gravelly sandy loam or sandy loam that has some gravel. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 8. It is coarse sand, gravelly loamy sand, gravelly sand, or very gravelly coarse sand.

Lourdes Series

The Lourdes series consists of moderately well drained, moderately slowly permeable soils on upland convex ridgetops and side slopes. These soils formed in 12 to 22 inches of friable loamy erosional sediments and the underlying very firm loamy glacial till. The native vegetation is mixed grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Lourdes loam, 2 to 5 percent slopes, in a cultivated field; 1,250 feet west and 220 feet south of the center of sec. 20, T. 95 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark brown (10YR 3/3) dry; few faint black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 13 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; few faint dark grayish brown (10YR 4/2) coatings on faces of peds; moderate thin platy structure; friable; few distinct very dark gray (10YR 3/1) organic flows in root channels; few distinct light gray (10YR 7/2) silt coatings on faces of peds; slightly acid; clear smooth boundary.

2Bt1—13 to 20 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few faint very dark gray (10YR 4/3) clay flows in root channels; few faint brown (10YR 4/3) clay coatings on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; stone line in upper part; strongly acid; clear smooth boundary.

2Bt2—20 to 27 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure parting to moderate fine angular blocky; very firm; common prominent very dark grayish brown (10YR 3/2) clay flows in root channels; few distinct grayish brown (2.5Y 5/2) clay coatings on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; few small stones and pebbles; very strongly acid; gradual wavy boundary.

2Bt3—27 to 36 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) clay loam; many faint grayish brown (2.5Y 5/2) coatings on faces of peds; moderate fine prismatic structure parting to moderate medium angular blocky; very firm; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; very strongly acid; gradual wavy boundary.

2Bt4—36 to 43 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) clay loam; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; few distinct very dark grayish brown (10YR 3/2) clay flows in root channels; common faint light gray (2.5Y 5/2) clay films on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; very strongly acid; gradual wavy boundary.

2Bt5—43 to 51 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) clay loam; weak medium prismatic structure; very firm; few prominent very dark brown (10YR 3/1) clay flows in root channels; few faint grayish brown (2.5Y 5/2) clay coatings on faces of peds; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual wavy boundary.

2BC—51 to 60 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) clay loam; weak medium prismatic structure; very firm; common black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; neutral.

The thickness of the solum and the depth to free carbonates range from 44 to more than 60 inches. The A horizon has value of 2 or 3 and chroma of 1 to 3. The E horizon and the upper part of the 2Bt horizon in most pedons have chroma of 3 or 4. The A and E horizons are loam or silt loam that has a high content of sand. The 2Bt horizon has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 1 to 8. The upper part of the 2Bt horizon is loam or clay loam.

Marshan Series

The Marshan series consists of poorly drained soils on stream terraces. These soils formed in 24 to 40 inches of loamy alluvial sediments over sandy and gravelly glacial outwash. Permeability is moderate in the upper part and rapid in the lower part. The native vegetation is water-tolerant grasses and sedges. Slopes range from 0 to 2 percent.

Typical pedon of Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 1,540 feet east and 1,480 feet south of the northwest corner of sec. 30, T. 96 N., R. 11 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate medium granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A—8 to 14 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear wavy boundary.

BA—14 to 17 inches; olive gray (5Y 5/2) and dark gray (5Y 4/1) silty clay loam, dark grayish brown (10YR 4/2) dry; many distinct very dark gray (5Y 3/1) coatings on faces of peds; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear wavy boundary.

Bg1—17 to 23 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; about 2 percent gravel; slightly acid; clear wavy boundary.

Bg2—23 to 26 inches; mottled grayish brown (2.5Y 5/2), light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/8) sandy loam; weak medium subangular blocky structure; very friable; about 5 percent gravel; slightly acid; abrupt wavy boundary.

2C1—26 to 36 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) gravelly coarse sand; single grained; loose; about 18 percent gravel; slightly acid; abrupt wavy boundary.

2C2—36 to 60 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) gravelly coarse sand; single grained; loose; about 20 percent gravel; neutral.

The thickness of the solum and the thickness of the loamy material range from 24 to 40 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches.

The A horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 2 or 3. It has chroma of 0 or 1 in the upper part and 0 to 2 in the lower part. It is clay loam, silty clay loam, or loam. The upper part of the Bg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, silty clay loam, or loam. The lower part of the Bg horizon has hue of 5Y, 2.5Y, 10YR, or 7.5YR, value of 5 or 6, and chroma of 1 to 8. It is sandy loam, loam, or clay loam. The 2C horizon is gravelly coarse sand, gravelly sand, or sand. Some pedons have a 3C horizon of loam or clay loam at a depth of 60 inches.

Olin Series

The Olin series consists of well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in eolian loamy sediments and the underlying firm loamy glacial till. The native vegetation is prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Olin sandy loam, 2 to 5 percent slopes, in a cultivated field; 260 feet west and 200 feet north of the center of sec. 21, T. 94 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A1—8 to 17 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; slightly acid; gradual smooth boundary.

A2—17 to 23 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; common faint very dark brown (10YR 2/2) coatings on faces of peds; weak medium subangular blocky structure parting to weak fine subangular; very friable; few pebbles in upper part; slightly acid; gradual smooth boundary.

Bw1—23 to 32 inches; brown (10YR 4/3) sandy loam; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds in upper part; weak medium subangular blocky structure parting to weak fine subangular; very friable; slightly acid; clear smooth boundary.

2Bw2—32 to 42 inches; dark yellowish brown (10YR 4/4) loam; few distinct grayish brown (2.5Y 5/2) coatings on faces of peds; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few black (N 2/0) concretions of manganese oxide; stone line in upper part; moderately acid; gradual smooth boundary.

2C—42 to 60 inches; dark yellowish brown (10YR 5/6) and yellowish brown (10YR 4/4) loam; massive; firm; few fine distinct black (N 2/0) nodules; few small stones and pebbles; slightly alkaline.

The thickness of the solum ranges from 40 to 60 inches. Depth to the lithologic discontinuity ranges from 24 to 36 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches.

The A horizon has value of 2 or 3. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It dominantly is sandy loam, but in some pedons it contains a 6- to 8-inch-thick layer of loamy sand. The 2Bw horizon has value of 4 or 5 and chroma of 3 to 6. It dominantly is loam, but the lower part of the horizon is clay loam or sandy clay loam in some pedons. Some pedons have a 2BC horizon. The 2C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is loam or clay loam.

Oran Series

The Oran series consists of somewhat poorly drained, moderately permeable soils on upland flats, on convex ridges and side slopes, and in coves at the head of drainageways. These soils formed in friable loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Oran loam, 0 to 2 percent slopes, in a cultivated field; 1,415 feet east and 55 feet south of the center of sec. 30, T. 95 N., R. 13 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; moderately acid; abrupt smooth boundary.

BE—8 to 14 inches; dark grayish brown (2.5Y 4/2) loam; few faint very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium platy structure parting to weak very fine granular; friable; strongly acid; clear smooth boundary.

Bt1—14 to 19 inches; olive brown (2.5Y 4/4) clay loam; weak very fine subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) clay films; few distinct light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

2Bt2—19 to 24 inches; light olive brown (2.5Y 5/4) clay loam; few fine distinct strong brown (7.5YR 5/8) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; stone line in upper part; strongly acid; clear smooth boundary.

2Bt3—24 to 30 inches; light olive brown (2.5Y 5/4) clay loam; few faint grayish brown (10YR 5/2) coatings on faces of peds; common fine distinct strong brown (7.5YR 5/8) and few fine distinct gray (5Y 5/1) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; very dark grayish brown (10YR 3/2) krotovinas; few small stones and pebbles; moderately acid; gradual smooth boundary.

2Bt4—30 to 44 inches; yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) clay loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; few distinct very dark gray (10YR 3/1) clay flows in root channels; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; moderately acid; gradual smooth boundary.

2BC—44 to 49 inches; light olive brown (2.5Y 5/6) loam; common fine prominent strong brown (7.5YR 5/8), common fine faint grayish brown (2.5Y 5/2), and few fine distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; firm; few distinct very dark gray (10YR 3/1) clay flows in root channels; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; slightly acid; gradual smooth boundary.

2C—49 to 60 inches; yellowish brown (10YR 5/6) loam; common fine distinct grayish brown (2.5Y 5/2) and few fine faint strong brown (7.5Y 5/8) mottles; massive; firm; few black (10YR 2/1) concretions of manganese oxide; few small stones and pebbles; slightly alkaline.

The thickness of the solum ranges from 30 to 55 inches. The depth to carbonates ranges from 40 to 70 inches. The A horizon is 6 to 9 inches thick.

The Ap horizon has value of 2 or 3. The Ap or A horizon typically is loam but ranges to silt loam that has a high content of sand. The E horizon, if it occurs, has value of 4 or 5 and chroma of 2 or 3. The BE horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or 3. The E and BE horizons are loam or silt loam that has a high content of sand. The matrix and mottles in the Bt, 2Bt, and 2BC horizons have hue of 10YR, 2.5Y, or 7.5YR, value of 4 to 6, and chroma of 2 to 8. The texture is clay loam, loam, or sandy clay loam. Some pedons have 2- to 4-inch-wide tongues or wedges of loamy sand or sand that extend downward from the stone line to a depth of 3 to 5 feet. The 2C horizon has hue of 10YR or 7.5YR and chroma of 6 to 8.

Ostrander Series

The Ostrander series consists of well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in 12 to 28 inches of loamy erosional sediments and the underlying friable loamy glacial till or glacial sediments derived from glacial till. The native vegetation is prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Ostrander loam, 2 to 5 percent slopes, in a cultivated field; 1,720 feet west and 70 feet south of the northeast corner of sec. 34, T. 95 N., R. 11 W.

Ap—0 to 9 inches; black (10YR 2/1) and very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—9 to 16 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.

Bw1—16 to 20 inches; dark yellowish brown (10YR 4/4) loam; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; stone line in lower part; moderately acid; clear smooth boundary.

Bw2—20 to 29 inches; dark yellowish brown (10YR 4/4) loam; few faint brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; friable; few small pebbles; moderately acid; clear smooth boundary.

2Bw3—29 to 36 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; few fine reddish brown (5YR 4/4) concretions of iron oxide; few small stones and pebbles; moderately acid; clear smooth boundary.

2Bw4—36 to 49 inches; yellowish brown (10YR 5/4 and 5/6) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine reddish brown (5YR 4/4) concretions of iron oxide; few small stones and pebbles; moderately acid; clear smooth boundary.

2C—49 to 60 inches; yellowish brown (10YR 5/4 and 5/6) loam; massive; friable; few fine distinct brown (7.5YR 4/4) concretions of iron oxide; few black (N 2/0) concretions of manganese oxide; few small stones and pebbles; slightly acid.

The thickness of the solum and the depth to free carbonates range from 44 to 76 inches. The thickness of the mollic epipedon ranges from 7 to 23 inches.

The A horizon has value of 2 or 3 and chroma of 1 to 3. It is loam or silt loam that has a high content of sand. The upper part of the B horizon has value and chroma of 3 or 4. The 2B horizon has value of 4 or 5 and chroma of 4 to 8. It is loam, sandy clay loam, fine sandy loam, or sandy loam. It has thin subhorizons of loamy sand in some pedons.

The Ostrander soil in map unit 394C2 is a taxadjunct to the series because the dark surface layer is too thin to be classified as a mollic epipedon. It classifies as a fine-loamy, mixed, mesic Dystric Eutrochrept.

Palms Series

The Palms series consists of very poorly drained, moderately permeable soils in seep areas in intermittent upland drainageways on upland hillsides and foot slopes. These soils formed in 16 to 50 inches of organic material and the underlying loamy mineral material. The native vegetation is sedges and water-tolerant grasses. Slopes range from 1 to 4 percent.

Typical pedon of Palms muck, 1 to 4 percent slopes, in a pasture; 2,310 feet east and 45 feet north of the southwest corner of sec. 36, T. 95 N., R. 14 W.

Oa1—0 to 8 inches; sapric material, black (10YR 2/1) broken face and rubbed, very dark gray (10YR 3/1) dry; about 60 percent fiber unrubbed, 15 percent rubbed; few medium distinct reddish brown (5YR 4/4) mottles; weak fine granular structure; nonsticky; herbaceous fibers; about 10 percent mineral material; neutral; abrupt smooth boundary.

Oa2—8 to 24 inches; sapric material, black (N 2/0) broken face and rubbed, black (N 2/0) dry; about 10 percent fiber, less than 5 percent rubbed; weak coarse subangular blocky structure; slightly sticky; herbaceous fibers; about 10 to 15 percent mineral material; neutral; clear smooth boundary.

Oa3—24 to 34 inches; sapric material, black (N 2/0) and very dark gray (10YR 3/1) broken face and rubbed, very dark gray (N 3/0) dry; about 5 percent fiber unrubbed, a trace rubbed; weak medium platy structure; slightly sticky; herbaceous fibers; about 15 to 20 percent mineral material; slightly alkaline; clear smooth boundary.

2Cg1—34 to 47 inches; greenish gray (5G 5/1) sandy loam; massive; friable; some stratification of texture; slightly alkaline; clear smooth boundary.

2Cg2—47 to 54 inches; olive gray (5Y 4/2) sandy loam; massive; friable; about 10 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

2Cg3—54 to 60 inches; olive brown (2.5Y 4/4) sandy loam; massive; friable; about 14 percent gravel; slight effervescence; slightly alkaline.

Depth to the 2C horizon ranges from 16 to 50 inches. The organic material is derived primarily from herbaceous plants, but some pedons contain as much as 15 percent woody material.

The surface tier has hue of 10YR, 7.5YR, or 5Y or is neutral in hue. It has value of 2 and chroma of 0 to 2. The subsurface tiers have hue of 10YR to 5YR or are neutral in hue. They have value of 2 to 4 and chroma of 0 to 3. Some pedons have as much as 10 inches of hemic material and as much as 5 inches of friable material. The 2C horizon has hue of 10YR to 5G, value of 3 to 7, and chroma of 1 or 2. It is sandy clay loam, sandy loam, loam, or clay loam.

Protivin Series

The Protivin series consists of somewhat poorly drained, moderately slowly permeable soils on slightly concave foot slopes in the uplands. These soils formed in friable loamy erosional sediments and the underlying very firm loamy glacial till. The native vegetation is prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Protivin loam, 1 to 4 percent slopes, in an area of hayland; 1,610 feet north and 115 feet east of the southwest corner of sec. 25, T. 96 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw—15 to 20 inches; dark grayish brown (2.5Y 4/2) clay loam; few distinct black (10YR 2/1) coatings on faces of peds in upper part; common fine faint olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; firm; few black (N 2/0) concretions of iron oxide; moderately acid; clear smooth boundary.

2Bt1—20 to 37 inches; mottled strong brown (7.5YR 5/6) and gray (10YR 5/1) clay loam; moderate fine prismatic structure; very firm; few distinct dark gray (10YR 4/1) clay films on vertical faces of peds; few distinct very dark gray (10YR 3/1) clay flows in root channels; few yellowish red (5YR 5/6) concretions of iron oxide; 0.5- to 1.0-inch-thick stone line in upper part; slightly acid; gradual smooth boundary.

2Bt2—37 to 44 inches; mottled strong brown (7.5YR 5/6) and gray (5Y 5/1) clay loam; moderate fine prismatic structure; very firm; few distinct dark gray (10YR 4/1) clay films on faces of prisms; common strong brown (7.5YR 5/8) concretions of iron oxide; few small stones and pebbles; slightly acid; gradual smooth boundary.

2Bt3—44 to 60 inches; mottled strong brown (7.5YR 5/6) and gray (5Y 6/1) clay loam; weak moderate prismatic structure; very firm; few distinct dark gray (10YR 4/1) clay flows in root channels; few small very dark brown (10YR 2/2) concretions of iron and manganese oxide; few small stones and pebbles; neutral.

The thickness of the solum ranges from 36 to more than 60 inches and commonly is the same as the depth to carbonates. The A horizon dominantly is loam, but the range includes clay loam. The horizon has chroma of 1 or 2. The Bw horizon has hue of 10YR to 2.5Y and chroma of 2 to 4. A stone line is commonly at the contact of the Bw and 2Bt horizons. The 2Bt horizon has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 1 to 8.

Racine Series

The Racine series consists of well drained, moderately permeable soils on convex upland ridgetops and side slopes. These soils formed in 12 to 24 inches of loamy erosional sediments and the underlying friable loamy glacial till or glacial sediments derived from glacial till. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 2 to 9 percent.

Typical pedon of Racine loam, 2 to 5 percent slopes, in a cultivated field; 1,840 feet west and 420 feet north of the center of sec. 23, T. 96 N., R. 13 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 13 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; few distinct black (10YR 2/1) coatings on faces of peds in the upper part; weak thin platy structure parting to weak fine granular; friable; neutral; clear smooth boundary.

Bt1—13 to 18 inches; brown (10YR 4/3) loam; few faint dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay coatings on faces of peds; moderately acid; clear smooth boundary.

2Bt2—18 to 24 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films on faces of peds; about 5 to 10 percent coarse fragments; moderately acid; gradual smooth boundary.

2Bt3—24 to 33 inches; dark yellowish brown (10YR 4/6) loam; moderate fine subangular structure; friable; few faint brown (10YR 4/3) clay coatings on faces of peds; about 5 to 10 percent coarse fragments; moderately acid; gradual smooth boundary.

2Bt4—33 to 40 inches; yellowish brown (10YR 5/6) sandy clay loam; weak fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay bridges between sand grains; about 5 to 10 percent coarse fragments; moderately acid; gradual smooth boundary.

2BC—40 to 48 inches; yellowish brown (10YR 5/6) loam; weak medium subangular blocky structure; friable; few black (10YR 2/1) concretions of manganese oxide; about 5 to 10 percent coarse fragments; slightly acid; gradual smooth boundary.

2C—48 to 60 inches; yellowish brown (10YR 5/6) loam; common medium distinct strong brown (7.5YR 5/8) and common fine faint brown (10YR 5/3) mottles; massive; firm; few very dark brown (10YR 2/2) concretions of iron and manganese oxide; about 5 to 10 percent coarse fragments; slightly acid.

The thickness of the solum ranges from 36 to 60 inches. The depth to free carbonates ranges from 40 to 70 inches.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has chroma of 2 or 3. The A and E horizons dominantly are loam, but the range includes silt loam that has a high content of sand. The Bt horizon has value of 4 and chroma of 3 or 4. It is loam, clay loam, or silt loam that has a high content of sand. The 2Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is loam, clay loam, or sandy clay loam. Some pedons have sand wedges that are as much as 12 inches wide. The 2C horizon has chroma of 3 to 8. It is loam.

Readlyn Series

The Readlyn series consists of somewhat poorly drained, moderately permeable soils on broad upland divides, slightly convex ridges and side slopes, and in coves at the head of drainageways. These soils formed in loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is mixed prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Readlyn loam, 0 to 2 percent slopes, in a cultivated field; 375 feet west and 330 feet north of the southeast corner of sec. 33, T. 94 N., R. 13 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; gradual smooth boundary.

BA—15 to 17 inches; dark grayish brown (2.5Y 4/2) loam; few faint very dark grayish brown (2.5Y 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; few faint very dark grayish brown (2.5Y 3/2) coatings in root channels; slightly acid; abrupt smooth boundary.

2Bw1—17 to 25 inches; olive brown (2.5Y 4/4) and dark grayish brown (2.5Y 4/2) loam; few faint very dark grayish brown (2.5Y 3/2) coatings on faces of peds; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; stone line in upper part; slightly acid; clear smooth boundary.

2Bw2—25 to 42 inches; olive brown (2.5Y 4/4) loam; common fine prominent yellowish brown (10YR 5/6) and distinct grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; small pebbles; slightly acid; gradual smooth boundary.

2C—42 to 60 inches; mottled dark yellowish brown (10YR 4/4), strong brown (7.5YR 5/6), and grayish brown (2.5Y 5/2) loam; few black (10YR 2/1) concretions of iron and manganese oxide; massive; firm; small pebbles; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. The A horizon has chroma of 1 or 2. The 2Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 8. It is loam, clay loam, or sandy clay loam. A stone line is common in the upper part of the 2Bw horizon. The 2C horizon has hue of 2.5Y, 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 8. It is loam or sandy clay loam.

Riceville Series

The Riceville series consists of somewhat poorly drained, moderately slowly permeable soils on slightly convex foot slopes and side slopes in the uplands. These soils formed in friable loamy erosional sediments and the underlying very firm loamy glacial till. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 1 to 4 percent.

Typical pedon of Riceville loam, 1 to 4 percent slopes, in a cultivated field; 2,280 feet west and 300 feet north of the center of sec. 6, T. 94 N., R. 14 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; few faint very dark gray (10YR 3/1) coatings on faces of peds; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 14 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium platy structure parting to weak fine subangular blocky; friable; strongly acid; clear wavy boundary.

2Bt1—14 to 23 inches; yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam; moderate medium angular blocky structure parting to moderate fine angular blocky; very firm; common distinct very dark gray (10YR 3/1) clay films on faces of peds; stone line in upper part; very strongly acid; gradual smooth boundary.

2Bt2—23 to 30 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) clay loam; common medium distinct dark gray (10YR 4/1) mottles; moderate medium angular blocky structure parting to moderate fine angular blocky; very firm; common distinct very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds; few distinct very dark gray (10YR 3/1) clay films in root channels; few small stones and pebbles; very strongly acid; gradual smooth boundary.

2Bt3—30 to 42 inches; gray (5Y 5/1) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; common distinct dark gray (10YR 4/1) and very dark gray (10YR 3/1) clay films on faces of peds; few distinct black (10YR 2/1) clay flows in root channels; few small stones and pebbles; slightly acid; gradual smooth boundary.

2Bt4—42 to 50 inches; gray (5Y 5/1) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; very firm; few distinct grayish brown (10YR 5/2) clay films on faces of peds; few distinct very dark grayish brown (10YR 3/2) clay flows in root channels; common white (10YR 8/1) accumulations of calcium carbonate; few small stones and pebbles; slight effervescence; slightly alkaline.

2C—50 to 60 inches; mottled grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/8) clay loam; massive; very firm; many white (10YR 8/1) accumulations of calcium carbonate; few small stones and pebbles; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Carbonates are at a depth of 30 to 50 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. The Ap and E horizons are loam or silt loam. The 2Bt horizon has hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 1 to 8. It is clay loam that dominantly is 30 to 35 percent clay but ranges to 38 percent clay in some subhorizons.

Rockton Series

The Rockton series consists of well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in loamy erosional material and the underlying loamy or clayey residuum derived from limestone bedrock. The native vegetation is mixed prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes, in a pasture; 1,160 feet east and 560 feet south of the center of sec. 30, T. 94 N., R. 14 W.

A1—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A2—10 to 14 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bt1—14 to 19 inches; brown (10YR 4/3) clay loam; weak fine subangular blocky and weak fine angular blocky structure; friable; few distinct very dark grayish brown (10YR 3/2) clay coatings on faces of peds; mixed with dark yellowish brown (10YR 5/4) krotovinas from below; slightly acid; gradual wavy boundary.

2Bt2—19 to 24 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; friable; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 5 percent rock fragments; slightly acid; abrupt wavy boundary.

R—24 inches; level-bedded, fractured limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments of mixed lithology ranges from 0 to 8 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It dominantly is loam, but the range includes fine sandy loam and silt loam. The Bt horizon has hue of 10YR in the upper part and 10YR to 5YR in the lower part. It has value of 4 or 5 and chroma of 3 or 4. It is clay loam or loam. A 2Bt horizon is in most pedons. It has colors similar to those of the Bt horizon. It is clay loam, silty clay loam, clay, or silty clay.

Saude Series

The Saude series consists of well drained soils on stream terraces. These soils formed in 24 to 32 inches of loamy alluvial deposits and the underlying sandy and gravelly glacial outwash. Permeability is moderate in the upper part and very rapid in the lower part. The native vegetation is mixed prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Saude loam, 0 to 2 percent slopes, in a pasture; 420 feet east and 920 feet south of the northwest corner of sec. 3, T. 96 N., R. 13 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent gravel; moderately acid; abrupt smooth boundary.

A—8 to 13 inches; very dark brown (10YR 2/2) and black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 2 percent gravel; moderately acid; clear smooth boundary.

BA—13 to 18 inches; dark brown (10YR 3/3) loam; few faint very dark brown (10YR 2/2) coatings on faces of peds; weak fine subangular blocky structure; friable; about 2 percent gravel; moderately acid; clear smooth boundary.

Bw1—18 to 24 inches; brown (10YR 4/3) loam; few faint dark brown (10YR 3/3) coatings on faces of peds; few distinct very dark grayish brown (10YR 3/2) coatings in worm channels; weak fine subangular blocky structure; friable; about 5 percent gravel; moderately acid; clear smooth boundary.

Bw2—24 to 27 inches; dark yellowish brown (10YR 4/4) sandy loam; few faint brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; very friable; stone line in lower part; about

10 percent gravel; moderately acid; abrupt wavy boundary.

2C—27 to 60 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grained; loose; about 30 percent gravel; strongly acid.

The thickness of the solum ranges from 18 to 38 inches. The thickness of the mollic epipedon ranges from 11 to 16 inches.

The A horizon has value of 2 and chroma of 1 or 2. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. Some pedons have a 2BC horizon. The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It generally is gravelly coarse sand, loamy sand, or sand that has some gravel.

Schley Series

The Schley series consists of somewhat poorly drained, moderately permeable soils on plane or slightly concave foot slopes in the uplands. These soils formed in 32 to 48 inches of stratified loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 1 to 4 percent.

Typical pedon of Schley loam, 1 to 4 percent slopes, in a cultivated field; 900 feet west and 180 feet south of the northeast corner of sec. 35, T. 96 N., R. 11 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 22 inches; brown (10YR 4/3) and grayish brown (10YR 5/2) loam, pale brown (10YR 6/3) dry; common medium distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure parting to moderate thin platy; friable; slightly acid; clear smooth boundary.

BE—22 to 28 inches; mottled grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) sandy loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak thin platy structure; friable; strongly acid; clear smooth boundary.

Bt1—28 to 36 inches; mottled grayish brown (10YR 5/2) and brown (7.5YR 4/4) sandy loam; weak medium platy structure parting to weak fine subangular blocky; friable; few distinct (7.5YR 5/6) clay bridges between sand grains; strongly acid; clear smooth boundary.

2Bt2—36 to 44 inches; strong brown (7.5YR 5/6) loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few distinct very dark grayish brown (10YR 3/2) clay flows in root channels; stone line in upper part; strongly acid; clear smooth boundary.

2Bt3—44 to 60 inches; strong brown (7.5YR 5/6) sandy clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct very dark grayish brown (10YR 3/2) clay flows; few small stones and pebbles; moderately acid.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to carbonates is more than 60 inches. In most pedons a stone line separates the upper loamy erosional sediments from the underlying glacial till.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The A and E horizons are loam or silt loam. The BE horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 2 to 8. It is sandy loam or loam. Some pedons have a Bt horizon, which has colors and textures similar to those of the BE horizon. The 2Bt horizon typically is mottled with colors of 7.5YR or 2.5Y, but the range includes 10YR. The 2Bt horizon is loam, clay loam, or sandy clay loam.

Shandep Series

The Shandep series consists of very poorly drained soils in depressions on stream terraces. These soils formed in 40 to 60 inches of loamy alluvial deposits and in the underlying sandy and gravelly glacial outwash. Permeability is moderate in the upper part and rapid in the lower part. The native vegetation is cattails, rushes, sedges, and other water-tolerant plants. Slopes are 0 to 1 percent.

Typical pedon of Shandep clay loam, 0 to 1 percent slopes, in a cultivated field; 2,460 feet north and 80 feet east of the southwest corner of sec. 20, T. 97 N., R. 14 W.

Ap—0 to 7 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—7 to 22 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; about 5 percent gravel; neutral; gradual smooth boundary.

A2—22 to 33 inches; black (5Y 2/1) clay loam, very dark gray (5Y 3/1) dry; few fine prominent dark brown (7.5YR 3/4) mottles; weak fine subangular blocky structure parting to moderate fine granular;

friable; about 5 percent gravel; slightly acid; gradual smooth boundary.

Bg—33 to 49 inches; gray (5Y 5/1) silty clay loam; common fine prominent strong brown (7.5YR 5/8) and few medium prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; friable; common small black (10YR 2/1) concretions of manganese oxide; about 2 percent gravel; neutral; abrupt wavy boundary.

2Cg—49 to 60 inches; grayish brown (2.5Y 5/2) and gray (5Y 5/1) gravelly coarse sand; single grained; loose; about 30 percent gravel; neutral.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 36 inches.

The A horizon is neutral in hue or has hue of 5Y. It has value of 2 or 3 and chroma of 0 or 1. It is clay loam, loam, or silty clay loam. The Bg horizon is neutral in hue or has hue of 5Y. It has value of 4 or 5 and chroma of 0 or 1. It is silty clay loam, clay loam, or loam. The 2Cg horizon is gravelly coarse sand, gravelly loamy coarse sand, loamy sand, or coarse sand.

Spillville Series

The Spillville series consists of somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. The native vegetation is mixed prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Spillville loam, in a cultivated area of Coland-Spillville complex, 0 to 2 percent slopes; 1,300 feet east and 340 feet south of the northwest corner of sec. 30, T. 96 N., R. 11 W.

Ap—0 to 8 inches; black (10YR 2/1) and very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; common fibrous roots; neutral; abrupt smooth boundary.

A1—8 to 15 inches; black (10YR 2/1) and very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few fine fibrous roots; neutral; abrupt smooth boundary.

A2—15 to 24 inches; black (10YR 2/1) and very dark gray (10YR 3/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; few fine fibrous roots; neutral; gradual smooth boundary.

A3—24 to 36 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few fine fibrous roots; neutral; gradual smooth boundary.

A4—36 to 48 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

AC—48 to 54 inches; very dark grayish brown (10YR 3/2) and black (10YR 2/1) sandy loam, dark grayish brown (10YR 4/2) dry; few fine faint dark grayish brown (10YR 4/2) mottles; massive; friable; slightly acid; gradual smooth boundary.

C—54 to 60 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) sandy loam; thin strata of loamy sand; few fine faint dark grayish brown (10YR 4/2) mottles; massive with weak bedding planes; friable; slightly acid.

The thickness of the solum ranges from 36 to 56 inches. Carbonates are at a depth of 48 inches or more. The thickness of the mollic epipedon ranges from 36 to more than 60 inches. High- or low-chroma mottles are not within a depth of at least 36 inches. The weighted average clay content of the 10- to 40-inch control section is 18 to 26 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam that has a high content of sand. The AC horizon has colors similar to those of the A horizon; however, the colors in the AC horizon typically have higher value.

Terril Series

The Terril series consists of moderately well drained soils on foot slopes, in intermittent drainageways, and on alluvial fans. These soils formed in 30 to 50 inches of loamy alluvial sediments and in the underlying sandy glacial outwash. Permeability is moderate in the upper part and rapid in the lower part. The native vegetation is mixed prairie grasses. Slopes range from 2 to 5 percent.

Typical pedon of Terril loam, sandy substratum, 2 to 5 percent slopes, in a cultivated field; 1,300 feet west and 520 feet south of the northeast corner of sec. 23, T. 94 N., R. 14 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; common faint black (N 2/0) coatings on faces of peds; weak very fine granular structure; friable; slightly acid; abrupt smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) and very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

A2—13 to 30 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; common faint black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure parting to moderate medium granular; friable; slightly acid; clear smooth boundary.

A3—30 to 35 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; few faint black (10YR 2/1) coatings on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw1—35 to 40 inches; brown (10YR 4/3) loam; common distinct very dark brown (10YR 2/2) and black (10YR 2/1) coatings on faces of peds; few fine faint dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

2BC1—40 to 45 inches; brown (10YR 4/3) loamy sand and coarse sand; common distinct very dark grayish brown (10YR 3/2) coatings on sand grains; few fine faint dark grayish brown (10YR 4/2) mottles; weak coarse subangular blocky structure; very friable; few small pebbles at a depth of 40 inches; neutral; clear smooth boundary.

2C2—45 to 60 inches; dark yellowish brown (10YR 4/4) and brown (10YR 4/3) sand and coarse sand; single grained; loose; neutral.

The thickness of the solum ranges from 36 to 56 inches. The depth to sandy material ranges from 30 to 50 inches.

The A horizon ranges from 24 to 36 inches in thickness. It has chroma of 1 or 2 in the upper part and value of 2 or 3 in the lower part. It typically is loam, but the range includes silt loam that has a high content of sand. Some pedons have an AB or BA horizon. The Bw horizon has value and chroma of 3 or 4. It is loam or sandy loam. The 2C horizon has value of 4 or 5 and chroma of 3 to 5. It is loamy sand, coarse sand, sand, or gravelly coarse sand.

Tripoli Series

The Tripoli series consists of poorly drained, moderately permeable soils on broad upland flats. These soils formed in 18 to 28 inches of loamy erosional sediments and the underlying firm loamy glacial till. The native vegetation is water-tolerant grasses and sedges. Slopes range from 0 to 2 percent.

Typical pedon of Tripoli clay loam, 0 to 2 percent slopes, in a cultivated field; 1,450 feet south and 100 feet west of the northeast corner of sec. 19, T. 94 N., R. 12 W.

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

A1—8 to 12 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A2—12 to 17 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine faint very dark grayish brown (2.5Y 3/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bg—17 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; few faint dark olive gray (5Y 3/2) coatings on faces of peds; few fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; neutral; gradual smooth boundary.

2Bw1—26 to 32 inches; mottled yellowish brown (10YR 5/6) and dark grayish brown (2.5Y 4/2) loam; few prominent very dark grayish brown (10YR 3/2) organic coatings in root channels; weak fine subangular blocky structure; firm; stone line in upper part; slightly alkaline; gradual wavy boundary.

2Bw2—32 to 42 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; weak medium subangular blocky structure; firm; few fine very dark gray (10YR 3/1) concretions of iron and manganese oxide; few small stones and pebbles; slightly alkaline; gradual wavy boundary.

2C1—42 to 50 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/1) loam; massive; firm; few very dark gray (10YR 3/1) concretions of iron and manganese oxide; few small white (10YR 8/1) soft accumulations of calcium carbonate; slight effervescence; slightly alkaline; gradual smooth boundary.

2C2—50 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) loam; massive; firm; few very dark gray (10YR 3/1) concretions of iron and manganese oxide; few small white (10YR 8/1) soft accumulations of calcium carbonate; few small stones and pebbles; slight effervescence; slightly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The A horizon is neutral in hue or has hue of 10YR. It has value of 2 or 3 and chroma of 0 or 1. It is clay loam or silty clay loam that has a high content of sand. Some pedons have an AB or BA horizon. The Bg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. The 2Bw horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 6. It is loam, clay loam, or sandy clay loam.

Udolpho Series

The Udolpho series consists of poorly drained soils on stream terraces. These soils formed in 24 to 32 inches of loamy alluvial deposits and in the underlying sandy and gravelly glacial outwash. Permeability is moderate in the upper part and rapid in the lower part. The native vegetation is water-tolerant grasses, sedges, and trees. Slopes range from 0 to 2 percent.

Typical pedon of Udolpho loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field; 1,440 feet east and 280 feet south of the northwest corner of sec. 22, T. 95 N., R. 13 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

E—8 to 13 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5YR 6/2) dry; few mixed areas of black (10YR 2/1) material; common faint dark gray (10YR 4/1) coatings on faces of peds; few fine prominent strong brown (7.5YR 4/6) mottles; weak medium platy structure; friable; slightly acid; clear smooth boundary.

BE—13 to 19 inches; dark grayish brown (2.5Y 4/2) loam; common distinct dark gray (10YR 4/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure parting to weak thin platy; friable; few distinct light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Btg1—19 to 25 inches; grayish brown (2.5Y 5/2) loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; few small black (10YR 2/1) concretions of manganese oxide; about 2 percent gravel; strongly acid; clear smooth boundary.

Btg2—25 to 28 inches; grayish brown (2.5Y 5/2) loam; many medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few distinct brown (10YR 4/3) clay films on faces of peds; few distinct light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; abrupt wavy boundary.

2C1—28 to 42 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) gravelly coarse sand; single grained; loose; about 20 to 30 percent gravel; moderately acid; gradual wavy boundary.

2C2—42 to 58 inches; mottled light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) very gravelly coarse sand; single grained; loose; about 40 to 50 percent gravel; moderately acid; gradual wavy boundary.

2C3—58 to 60 inches; light olive brown (2.5Y 5/6) very gravelly coarse sand; single grained; loose; about 35 to 40 percent gravel; neutral.

The thickness of the solum ranges from 24 to 32 inches. The thickness of the A horizon ranges from 6 to 10 inches. The depth to free carbonates ranges from 36 to 66 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E and BE horizons, if they occur, have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The A, E, and BE horizons are loam or silt loam that has a high content of sand. The Btg horizon has hue of 2.5Y, 10YR, or 5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, silty clay loam, or clay loam in the upper part and loam, sandy clay loam, silty clay loam, or clay loam in the lower part. Some pedons have a 2BC horizon. The 2C horizon has hue of 2.5Y or 5Y. It is coarse sand, gravelly coarse sand, or very gravelly coarse sand.

Wapsie Series

The Wapsie series consists of well drained soils on stream terraces. These soils formed in 20 to 32 inches of loamy alluvial deposits and in the underlying sandy and gravelly glacial outwash. Permeability is moderate in the upper part and very rapid in the lower part. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 0 to 5 percent.

Typical pedon of Wapsie loam, 0 to 2 percent slopes, in a cultivated field; 2,600 feet north and 130 feet east of the southwest corner of sec. 34, T. 95 N., R. 13 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 13 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak thin platy structure parting to weak fine subangular blocky; few black (10YR 2/1) wormcasts; friable; few distinct pale brown (10YR 6/3) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—13 to 19 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; few faint brown (10YR 4/3) clay films in root channels; few distinct pale brown (10YR 6/3) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt2—19 to 29 inches; dark yellowish brown (10YR 4/6) loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; few faint brown (10YR 4/3) clay films in root channels and on faces of peds; few 0.5- to 1.0-inch-diameter pebbles in lower part; strongly acid; clear smooth boundary.

BC—29 to 32 inches; yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) sandy loam; very weak coarse subangular blocky structure; very friable; about 5 percent gravel; strongly acid; abrupt smooth boundary.

2C—32 to 60 inches; yellowish brown (10YR 5/6) gravelly sand and gravelly coarse sand; single grained; loose, strongly acid.

The thickness of the solum ranges from 18 to 44 inches. The depth to gravelly sand, gravelly coarse sand, or sand ranges from 20 to 32 inches. The A horizon is 6 to 9 inches thick.

The A or Ap horizon has value of 2 or 3 and chroma of 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The A and E horizons are loam or silt loam that has a high content of sand. The Bt and BC horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. The Bt horizon is loam or sandy clay loam, and the BC horizon is loam or sandy loam. The 2C horizon has hue of 10YR or 7.5YR and chroma of 4 to 6. It is gravelly sand, gravelly coarse sand, or sand that contains some gravel.

Winneshiek Series

The Winneshiek series consists of well drained, moderately permeable soils on upland convex ridgetops and side slopes. These soils formed in loamy erosional material and the underlying clayey residuum derived from limestone bedrock. The native vegetation is mixed prairie grasses and deciduous trees. Slopes range from 2 to 5 percent.

Typical pedon of Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes, in a wooded pasture; 300 feet east and 200 feet south of the center of sec. 7, T. 94 N., R. 14 W.

A—0 to 6 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

E—6 to 10 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; friable; few distinct light gray (10YR 7/2) silt coatings on faces of peds; slightly acid; clear wavy boundary.

BE—10 to 17 inches; brown (10YR 4/3) loam; few faint dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure parting to weak thin platy; friable; common prominent light gray (10YR 7/2) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—17 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; friable; few distinct dark brown (7.5YR 3/4) clay films on faces of peds; neutral; abrupt wavy boundary.

2Bt2—24 to 28 inches; brown (7.5YR 4/4) and strong brown (7.5YR 4/6) clay; moderate medium and fine angular blocky structure; firm; common distinct dark brown (7.5YR 3/2) clay films on faces of peds; neutral; abrupt wavy boundary.

2R—28 inches; level-bedded, fractured limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam. The E horizon has chroma of 2 or 3. The BE and Bt horizons have value and chroma of 3 or 4. The Bt horizon is sandy clay loam, clay loam, or loam. The 2Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3 to 8. It is clay or silty clay.

Formation of the Soils

This section describes the factors of soil formation and relates these factors to the soils in Chickasaw County. It also describes the processes that result in the formation of soil horizons.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by five soil-forming factors: the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on soil material *(6)*. Human activities also affect soil formation.

Climate and plant and animal life are active factors in soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of parent material into a soil. Some time is always needed for horizon differentiation. Generally, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

Parent Material

The accumulation of parent material is the first step in the development of a soil. Most of the soils in the county formed in material that was transported from other locations and redeposited through the action of glacial ice, water, wind, or gravity. A few of the soils in the county formed in limestone bedrock that weathered in place. The main kinds of parent material in the county are glacial drift, alluvium, and eolian deposits. The less extensive kinds are residuum and organic deposits. Some moderately deep soils in the county formed in glacial material over limestone bedrock.

Glacial drift is the most extensive parent material in the county. It is all rock material that has been transported or deposited by glacial ice, including glacial till and the material sorted by meltwater. Glacial till is unsorted sediment in which particles range in size from boulders to clay (fig. 12). At least twice during the glacial period, continental glaciers moved over the land. The record of these two ice invasions is contained in the unconsolidated rock material that was deposited by the melting ice and meltwater streams. The older ice sheet, known as the Nebraskan Glaciation, covered the area about 750,000 years ago *(13)*. It was followed by the Aftonian interglacial period. The Kansan Glaciation is thought to have started 500,000 years ago. A more recent glaciation, the Iowa substage of the Wisconsin Glaciation, was recognized in a study published in 1933 *(7)*.

Intensive, detailed geomorphic and stratigraphic work shows that the landscape is a multilevel sequence of erosion surfaces and that many of the levels are cut into Kansan and Nebraskan till *(14)*. Landscapes similar to those in Chickasaw County have been studied in detail *(13)*. Subsurface investigations and studies demonstrate that the Iowan till does not exist but that an erosional surface cut does exist in the Iowa region. The Iowan erosional surface is arranged in a series of steps from the major drainageways toward the bounding divides. It is marked by a stone line or pebble band where it cuts through Kansan and Nebraskan till. The stone line occurs on all levels of the stepped surfaces and under the alluvium along the drainageways.

Bassett, Clyde, Cresco, Donnan, Floyd, Havana, Kenyon, Oran, Ostrander, Protivin, Readlyn, Schley, and Tripoli soils formed in loamy erosional sediments and in the underlying glacial till on the Iowan erosional surface. The loamy sediments generally are about 1 to 2 feet deep over the glacial material. They are deeper, however, in areas of Clyde, Floyd, and Schley soils on the lower concave slopes and in the drainageways. The stone line or pebble band commonly separates the

Figure 12.—A large boulder, or a glacier erratic. It is a landmark in Chickasaw County known as "St. Peter's Rock."

friable loamy surficial sediments from the firm or very firm loam or clay loam glacial till *(12)*.

Alluvium is material deposited by water from rivers or streams. Alluvial deposits of recent age are on flood plains, and alluvial deposits of late Wisconsin age are on stream terraces. Soils that formed in alluvium make up nearly 20 percent of the total acreage in the county, or about 64,000 acres.

When streams overflow their channels and the water spreads over the flood plains, the coarse textured material is deposited first. As the floodwater spreads, it moves more slowly and fine textured sediments, such as silt, are deposited. After the floodwater has receded, the finest material, or clay, settles from the water that is left standing on the lowest part of the flood plain, generally some distance from the main channel. Near the channel, or within the present meander belt, are recent alluvial soils. Coland-Spillville complex, channeled, 0 to 2 percent slopes, is in areas along the Wapsipinicon River and its tributaries. The soils in this unit contain varying amounts of sand, silt, and clay. Spillville-Udifluvents complex, channeled, 0 to 2 percent slopes, is in areas along the current meander channel of most of the rest of the rivers and streams in the county. The soils in this unit typically contain higher percentages of sand and lower percentages of clay than the soils along the Wapsipinicon River system.

Other differences relate to the river system the soils are adjacent to. Most of the alluvial soils in the county are free of carbonates and are slightly acid or neutral in reaction; however, Du Page loam, 0 to 2 percent slopes, typically is slightly alkaline or moderately alkaline throughout the solum and substratum. The Du Page soil is in areas along the Cedar River in the southwestern part of the county.

Sandy eolian material, which is deposited by wind, is in areas on uplands and stream terraces. Although these areas make up only 1 or 2 percent of the county, they have significant local impact because the soils are droughty and are subject to soil blowing. In the glacial till uplands, these soils are on low mounds or dunes and are underlain by glacial till at varying depths. The sandy material is mainly quartz, which is fine or medium in size and highly resistant to weathering. It has not been altered appreciably since it was deposited. Chelsea soils formed in sandy eolian material. The upper part of the Billett, Dickinson, Hoopeston, and Olin soils also formed mainly in this material.

Residuum is material weathered in place from sedimentary rock, mainly limestone in Chickasaw County. Soils that formed in residuum typically are silty clay, clay, or clay loam in the upper part and are only a few inches thick. The residuum typically is in a discontinuous layer. Several of the soils in the county have a layer of glacial drift or sandy eolian material over the residuum and bedrock. Bertram, Rockton, and Winneshiek soils partially or completely formed in residuum.

Organic deposits of plant material accumulated in fens or bogs, in old lakebeds, and in swamps that supported dense stands of water-tolerant plants. The organic soils in the county are in small, wet areas where poor drainage has slowed the decay of plant remains. In most areas the organic material ranges from 16 inches to 8 feet or more in thickness. Houghton and Palms soils formed in organic material.

Climate

The soils in Chickasaw County formed under the influence of a midcontinental, subhumid climate for at least 5,000 years. Between 5,000 and 16,000 years ago, the climate was conducive to the growth of forest vegetation *(10, 11)*. The morphology of most of the soils in the county indicates that the climate under which the soils formed was similar to the present one. The climate is generally uniform throughout the county but is marked by wide seasonal extremes in temperature. Precipitation is well distributed throughout the year.

Climate is a major factor in determining what soils form in the various kinds of parent material. It affects the rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions in the soil. Temperature, rainfall, relative humidity, and length of the frost-free period affect the kind of vegetation on the soil.

The influence of the general climate of the region is somewhat modified by local conditions. For example, soils on south-facing slopes formed under a microclimate that is warmer and drier than the average climate in nearby areas. Poorly drained soils in low areas formed under a microclimate that is wetter and colder than that in most of the surrounding areas. These local conditions account for some of the differences between soils that are within the same general climatic regions.

Plant and Animal Life

Plant and animal life is an important factor in soil formation. The type of vegetation under which a soil forms significantly affects the organic matter content, the color of the surface layer, and the content of nutrients. As plants grow and die, they add organic matter to the upper layers of soil material. Native grasses have myriads of fibrous roots that penetrate the soil to a depth of 10 to 20 inches and add large amounts of organic matter to the surface layer. Conversely, trees commonly feed on plant nutrients deep in the subsoil and add little organic matter to the surface layer other than that gained from falling leaves and dead trees. Although most of the soils in Chickasaw County formed under prairie vegetation, a significant acreage formed under trees, especially in areas that are adjacent to the river or stream systems.

Soils that formed under prairie vegetation have a high content of organic matter and a thick, dark surface layer. Cresco, Floyd, Kenyon, Readlyn, and Tripoli soils formed under prairie grasses. Soils that formed under forest vegetation have a lighter colored surface layer that generally is less than 5 inches thick. They generally have a light colored E horizon directly below the surface layer. Coggon soils formed under forest vegetation. Bassett, Havana, Oran, Schley, and Wapsie soils have properties intermediate between those of soils that formed entirely under prairie grasses and those that formed entirely under forest vegetation.

Bassett, Coggon, and Kenyon soils are members of a biosequence, which is a group of soils that formed in the same kind of parent material and in a similar environment but that supported different kinds of native vegetation. Variations in the native vegetation caused the main morphological differences among the soils in this group.

Animals, bacteria, and fungi also are important to soil formation. Earthworms and burrowing animals help to keep the soil open and porous. Bacteria and fungi, which decompose the vegetation, release nutrients for plant food.

Relief

Relief, or topography, causes important differences among soils, mainly through its effect on drainage, runoff, and erosion. The soils in the county generally range from level to strongly sloping, but in some small areas they are moderately steep. Most of the level and nearly level soils have a seasonal high water table. Water soaks into these soils, and a limited amount of water runs off the soils. More water runs off the surface of steeper soils. Kenyon, Readlyn, and Tripoli soils, which formed in the same kind of parent material and under similar vegetation, differ from one another because of relief and position on the landscape. The nearly level Tripoli soils are on broad, flat upland divides. The nearly level and gently sloping Readlyn soils are on broad divides and slightly convex ridges and side slopes. The gently sloping and moderately sloping Kenyon soils are on ridges and side slopes. Generally, as slope increases, development in the soil profile decreases because most of the precipitation runs off the soil instead of soaking into and through the soil profile.

Aspect, as well as gradient, significantly influences soil formation. Because they are warmer and drier, south-facing slopes generally support a different kind and amount of vegetation than north-facing slopes.

Soils that formed in alluvium, such as Coland, Hayfield, Spillville, Udolpho, and Wapsie soils, are on bottom land or stream terraces. Even though they are all nearly level, their microrelief affects the rate of runoff, the depth to the water table, and the addition of new sediment. Coland soils, which are at the lowest elevations on bottom land, are poorly drained, have a high water table, and impound water for short periods. Spillville soils, which are at the slightly higher elevations, are somewhat poorly drained, have a lower water table, and are less likely to impound water. Hayfield, Udolpho, and Wapsie soils, which are all nearly level soils on stream terraces, generally are not flooded. The poorly drained Udolpho soils are at slightly lower elevations than the somewhat poorly drained Hayfield soils, which are at slightly lower elevations than the well drained Wapsie soils. The differences in drainage are a result of the microrelief, which can differ by only a few inches.

The influence of porous, rapidly permeable parent material can override the influence of relief. For example, Burkhardt soils are nearly level, but they are excessively drained because they are very rapidly permeable.

Time

Time is necessary for the various processes of soil formation to take place. The amount of time necessary can be as much as a thousand years or more for the formation of the subsoil in many of the older upland soils. The older, or more strongly developed soils, have well defined genetic horizons. Cresco and Kenyon soils are older soils. The less developed soils have weakly expressed horizons. Coland and Spillville soils, which formed in freshly deposited alluvium, are younger soils. They show little or no evidence of profile development because the alluvial material is recently deposited and has not been in place long enough for the formation of well defined genetic horizons.

Generally, if other factors are favorable, the texture of the subsoil becomes finer and a greater amount of soluble material is leached out as the soils continue to weather. Exceptions are soils that formed in quartz sand, such as Billet, Chelsea, and Dickinson soils, or in other material that is resistant to weathering. These soils do not change much over long periods. Other exceptions are moderately steep soils, such as Emeline soils, where much of the rainfall runs off the surface of the soils. As a result, these soils weather more slowly than stable, less sloping soils. These exceptions indicate that the age of the parent material does not necessarily reflect the maturity of the soils that form in the material.

Where organic material, such as trees, has been buried by later deposition through the action of ice, water, or wind, the age of a landscape can be determined by radiocarbon dating the organic material. Recent studies using radiocarbon dating show that the Iowan erosional surface formed 14,000 to 20,000 years ago. In areas where it is covered by loamy surficial sediment, the Iowan erosional surface is less than 14,000 years old *(13)*. Soils on slopes are probably much younger. Bassett, Kenyon, and Readlyn soils are in the higher areas of the Iowa erosional surface. Clyde, Floyd, and Schley soils are younger because they are cut in and below these higher lying soils.

Human Activities

Important changes in the soils took place when the county was settled. Some changes had little effect on soil productivity; others had drastic effects. Breaking the prairie sod and clearing the timber destroyed or changed the protective plant cover.

The changes caused by water erosion are the most apparent. Cultivation increases the susceptibility of the more sloping areas to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is prevalent in the county, removes a few inches of topsoil at a time, but cultivation generally destroys all evidence of this loss. In some areas, shallow or deep gullies have formed and the material removed through erosion has been deposited on the lower slopes. As the land was brought under cultivation, the rate of runoff increased and the rate at which water moved through the soil decreased. As a result, accelerated erosion has removed part or all of the original surface layer from many of the more sloping soils. Examples are the moderately eroded Bassett, Kenyon, and Ostrander soils.

Accelerated erosion has not only changed the thickness of the surface layer but the structure and consistence of the surface layer as well. In a few areas in Chickasaw County, the soil has been severely eroded. In these areas, the plow layer commonly consists partly of the upper part of the subsoil and is less friable and finer textured than the original surface layer. Severe erosion results in a lower content of organic matter, a cloddy surface layer, and the formation of gullies, which make the land more difficult to farm. Because the parent material in the county is glacial till, the number of stones and pebbles on the soil surface is higher in areas where severe erosion has occurred.

Cultivation and erosion affect the soil by reducing the content of organic matter and lowering fertility. Even in areas not subject to erosion, compaction by heavy machinery reduces the thickness of the surface layer and changes the structure of the soil. Granular structure, which is apparent in soils under natural virgin grassland, breaks down under intensive cropping. The surface soil tends to bake and become hard when dry. Fine textured soils that have been plowed continuously when wet tend to puddle and are less permeable than similar soils in undisturbed areas.

Soil blowing also occurs after the soils are cultivated. Soils that have a low content of clay are highly susceptible to soil blowing, especially if the surface is bare and the topsoil is dry. If nearly level fields are plowed in the fall, the topsoil and snow are mixed by wind and water and are redeposited along fence rows and road ditches during the winter.

Applications of commercial fertilizer and lime have helped to make many soils more productive because they help to compensate for deficiencies in plant nutrients. Other management practices increase the productivity and availability of some soils. Installing drainage tile reduces wetness on most of the upland soils in the county. Terraces help to control erosion on many of the fields. Drainage ditches and diversions at the foot of slopes help to prevent flooding on bottom land.

Processes of Horizon Differentiation

Horizon differentiation is caused by four basic kinds of change. The changes are additions, removals, transfers, and transformations *(15)*. Each of these kinds of change affects many of the substances that make up soils, such as organic matter, soluble salts, the reduction and transfer of iron, carbonates, sesquioxides, and the translocation of silicate clay minerals. In general, these processes tend to promote horizon differentiation, but some tend to offset or retard it. The processes and the resulting changes proceed simultaneously in soils, and the ultimate nature of the profile is governed by the balance of these changes.

An accumulation of organic matter is an early step in the process of horizon differentiation in most soils. The content of organic matter ranges from very low to very high in the A horizon of the soils in Chickasaw County. For example, Coggon soils have a thin A horizon and a low content of organic matter and Coland and Spillville soils have a thick, dark A horizon and a high content of organic matter. Some soils that formerly had a high content of organic matter now have a low one because of the accelerated erosion caused by cultivation.

The removal of substances from parts of the soil profile is important in the differentiation of soil horizons. The downward movement of calcium carbonates and other soluble salts is an example. The upper part of the solum of most of the soils in the county, except for the Du Page soils, has been leached. Typically, the more strongly the soil profile is leached, the more acid the subsoil becomes.

The transfer of substances from one horizon to another is evident in the soils in the county. For example, phosphorus is removed from the subsoil by plant roots and transferred to parts of the plant growing above the ground. It is then added to the surface layer in the plant residue. This process affects the form and distribution of phosphorus in the soil.

Another type of transfer that is minimal in most soils, but occurs to some extent in clayey soils, is caused by shrinking and swelling. Shrinking and swelling causes cracks to form and helps to incorporate material from the surface layer into the lower part of the profile. Donnan soils are subject to shrinking and swelling.

The translocation of silicate clay minerals is an important process of horizon differentiation. The clay minerals are carried downward in suspension in percolating water from the A horizon. They accumulate in the B horizon in pores and root channels and as clay films on the faces of peds. This process has affected many of the soils in the county. In other soils, however, the content of clay in the A and B horizons is not markedly different and other evidence of clay movement is minimal.

Transformations are physical and chemical. The weathering of soil particles to smaller sizes is an example of physical transformation. Gleying, or the reduction of iron, is an example of a chemical transformation. It occurs when soils that contain organic matter are saturated with water for a long period of time. The soils have enough organic matter for biological activity to take place during the periods of saturation. Gleying is evidenced by the presence of ferrous iron and gray colors. It is characteristic of poorly drained soils, such as Clyde, Coland, Marshan, Shandep, and Tripoli soils. Reductive extractable iron, or free iron, generally is not so evident in somewhat poorly drained soils, such as Floyd, Hayfield, and Oran soils.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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

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.

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.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

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.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

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.

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.

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.

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.

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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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 substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

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.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-86 at New Hampton, Iowa)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days*	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	23.2	4.7	14.0	46	-26	0	0.82	0.33	1.19	3	8.7
February----	29.7	11.4	20.6	52	-19	0	.90	.26	1.44	3	7.2
March-------	40.1	22.0	31.1	73	-8	17	1.89	.91	2.71	5	8.8
April-------	57.3	35.7	46.5	85	16	74	3.32	1.84	4.70	7	2.2
May---------	69.9	47.5	58.7	89	29	285	4.19	2.56	5.57	8	.0
June--------	78.7	56.6	67.7	94	41	531	4.42	2.53	6.17	8	.0
July--------	82.3	61.2	71.8	95	47	676	4.32	2.18	6.09	7	.0
August------	80.4	58.9	69.7	93	43	611	4.07	1.66	6.06	7	.0
September---	72.3	50.1	61.2	91	31	336	3.66	1.47	5.66	6	.0
October-----	61.3	39.6	50.5	84	20	110	2.52	1.14	3.83	5	.2
November----	43.3	25.4	34.4	68	-2	0	1.74	.57	2.73	4	4.7
December----	28.7	12.0	20.4	54	-18	0	1.17	.60	1.70	4	9.5
Yearly:											
Average---	55.6	35.4	45.6	---	---	---	---	---	---	---	---
Extreme---	---	---	---	96	-26	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,640	33.02	26.48	38.67	67	41.3

* 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 1951-86 at New Hampton, Iowa)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 21	May 6	May 17
2 years in 10 later than--	Apr. 17	May 1	May 12
5 years in 10 later than--	Apr. 9	Apr. 20	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 14	Sept. 30	Sept. 24
2 years in 10 earlier than--	Oct. 19	Oct. 5	Sept. 28
5 years in 10 earlier than--	Oct. 28	Oct. 15	Oct. 5

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-86 at New Hampton, Iowa)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	184	155	139
8 years in 10	190	163	145
5 years in 10	202	178	155
2 years in 10	214	192	166
1 year in 10	221	200	172

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
63C	Chelsea loamy sand, 2 to 9 percent slopes	210	0.1
83B	Kenyon loam, 2 to 5 percent slopes	24,475	7.6
83C	Kenyon loam, 5 to 9 percent slopes	3,110	1.0
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded	4,170	1.3
84	Clyde clay loam, 0 to 3 percent slopes	51,755	15.9
135	Coland clay loam, 0 to 2 percent slopes	1,600	0.5
151	Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	4,635	1.4
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	490	0.2
153	Shandep clay loam, 0 to 1 percent slopes	545	0.2
171B	Bassett loam, 2 to 5 percent slopes	11,380	3.5
171C	Bassett loam, 5 to 9 percent slopes	1,660	0.5
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded	2,670	0.8
173	Hoopeston sandy loam, 0 to 3 percent slopes	355	0.1
175B	Dickinson sandy loam, 2 to 5 percent slopes	1,755	0.5
175C	Dickinson sandy loam, 5 to 9 percent slopes	240	0.1
177	Saude loam, 0 to 2 percent slopes	5,710	1.8
177B	Saude loam, 2 to 5 percent slopes	3,240	1.0
198B	Floyd loam, 1 to 4 percent slopes	19,205	5.8
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	565	0.2
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	620	0.2
214C	Rockton loam, 20 to 30 inches to limestone, 5 to 9 percent slopes	240	0.1
221B	Palms muck, 1 to 4 percent slopes	660	0.2
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	4,750	1.5
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	885	0.3
284	Flagler sandy loam, 0 to 2 percent slopes	215	0.1
284B	Flagler sandy loam, 2 to 5 percent slopes	1,470	0.5
284C	Flagler sandy loam, 5 to 9 percent slopes	320	0.1
284C2	Flagler sandy loam, 5 to 9 percent slopes, moderately eroded	335	0.1
285	Burkhardt sandy loam, 0 to 2 percent slopes	510	0.2
285B	Burkhardt sandy loam, 2 to 5 percent slopes	1,490	0.5
285D	Burkhardt sandy loam, 5 to 14 percent slopes	965	0.3
302B	Coggon loam, 2 to 5 percent slopes	350	0.1
302C	Coggon loam, 5 to 9 percent slopes	290	0.1
323B	Terril loam, sandy substratum, 2 to 5 percent slopes	795	0.2
391B	Clyde-Floyd complex, 1 to 4 percent slopes	25,885	7.9
394B	Ostrander loam, 2 to 5 percent slopes	10,440	3.2
394C	Ostrander loam, 5 to 9 percent slopes	1,240	0.4
394C2	Ostrander loam, 5 to 9 percent slopes, moderately eroded	1,665	0.5
398	Tripoli clay loam, 0 to 2 percent slopes	11,160	3.4
399	Readlyn loam, 0 to 2 percent slopes	11,780	3.5
399B	Readlyn loam, 2 to 5 percent slopes	12,325	3.8
407B	Schley loam, 1 to 4 percent slopes	7,705	2.4
408B	Olin sandy loam, 2 to 5 percent slopes	530	0.2
408C	Olin sandy loam, 5 to 9 percent slopes	370	0.1
412C	Emeline loam, 5 to 9 percent slopes	385	0.1
412E	Emeline loam, 9 to 18 percent slopes	260	0.1
457	Du Page loam, 0 to 2 percent slopes	215	0.1
471	Oran loam, 0 to 2 percent slopes	6,800	2.1
471B	Oran loam, 2 to 5 percent slopes	11,065	3.4
472	Havana loam, 0 to 2 percent slopes	2,420	0.7
482B	Racine loam, 2 to 5 percent slopes	4,360	1.3
482C2	Racine loam, 5 to 9 percent slopes, moderately eroded	2,175	0.7
485	Spillville loam, 0 to 2 percent slopes	1,925	0.6
585	Coland-Spillville complex, 0 to 2 percent slopes	5,190	1.6
621B	Houghton muck, 2 to 5 percent slopes	290	0.1
713B	Winneshiek loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	265	0.1
714B	Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	230	0.1
725	Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	5,020	1.6
728	Udolpho loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	1,065	0.3
775B	Billett sandy loam, 2 to 5 percent slopes	360	0.1
775C	Billett sandy loam, 5 to 9 percent slopes	235	0.1
776B	Lilah sandy loam, 2 to 5 percent slopes	960	0.3
776D2	Lilah sandy loam, 5 to 14 percent slopes, moderately eroded	830	0.3

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
777	Wapsie loam, 0 to 2 percent slopes	6,095	1.9
777B	Wapsie loam, 2 to 5 percent slopes	2,195	0.7
781B	Lourdes loam, 2 to 5 percent slopes	1,250	0.4
781C2	Lourdes loam, 5 to 9 percent slopes, moderately eroded	605	0.2
782B	Donnan loam, 2 to 5 percent slopes	1,535	0.5
782C2	Donnan loam, 5 to 9 percent slopes, moderately eroded	320	0.1
783B	Cresco loam, 2 to 5 percent slopes	2,430	0.8
783C	Cresco loam, 5 to 9 percent slopes	1,005	0.3
783C2	Cresco loam, 5 to 9 percent slopes, moderately eroded	1,745	0.5
784B	Riceville loam, 1 to 4 percent slopes	2,015	0.6
797	Jameston silty clay loam, 0 to 2 percent slopes	2,510	0.8
798B	Protivin loam, 1 to 4 percent slopes	3,890	1.2
809C	Bertram sandy loam, 2 to 9 percent slopes	235	0.1
1585	Coland-Spillville complex, channeled, 0 to 2 percent slopes	7,960	2.5
1936	Spillville-Udifluvents complex, channeled, 0 to 2 percent slopes	9,230	2.9
5010	Pits, sand and gravel	160	*
5030	Pits, limestone quarries	145	*
5040	Orthents, loamy	180	0.1
	Water	980	0.3
	Total	323,300	100.0

* Less than 0.1 percent.

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
83B	Kenyon loam, 2 to 5 percent slopes
84	Clyde clay loam, 0 to 3 percent slopes (where drained)
135	Coland clay loam, 0 to 2 percent slopes (where drained)
151	Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes (where drained)
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes (where drained)
153	Shandep clay loam, 0 to 1 percent slopes (where drained)
171B	Bassett loam, 2 to 5 percent slopes
173	Hoopeston sandy loam, 0 to 3 percent slopes
175B	Dickinson sandy loam, 2 to 5 percent slopes
177	Saude loam, 0 to 2 percent slopes
177B	Saude loam, 2 to 5 percent slopes
198B	Floyd loam, 1 to 4 percent slopes
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes
302B	Coggon loam, 2 to 5 percent slopes
323B	Terril loam, sandy substratum, 2 to 5 percent slopes
391B	Clyde-Floyd complex, 1 to 4 percent slopes (where drained)
394B	Ostrander loam, 2 to 5 percent slopes
398	Tripoli clay loam, 0 to 2 percent slopes (where drained)
399	Readlyn loam, 0 to 2 percent slopes
399B	Readlyn loam, 2 to 5 percent slopes
407B	Schley loam, 1 to 4 percent slopes (where drained)
408B	Olin sandy loam, 2 to 5 percent slopes
457	Du Page loam, 0 to 2 percent slopes
471	Oran loam, 0 to 2 percent slopes
471B	Oran loam, 2 to 5 percent slopes
472	Havana loam, 0 to 2 percent slopes (where drained)
482B	Racine loam, 2 to 5 percent slopes
485	Spillville loam, 0 to 2 percent slopes
585	Coland-Spillville complex, 0 to 2 percent slopes (where drained)
713B	Winneshiek loam, 30 to 40 inches to limestone, 2 to 5 percent slopes
714B	Winneshiek loam, 20 to 30 inches to limestone, 2 to 5 percent slopes
725	Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
728	Udolpho loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes (where drained)
777	Wapsie loam, 0 to 2 percent slopes
777B	Wapsie loam, 2 to 5 percent slopes
781B	Lourdes loam, 2 to 5 percent slopes
782B	Donnan loam, 2 to 5 percent slopes
783B	Cresco loam, 2 to 5 percent slopes
784B	Riceville loam, 1 to 4 percent slopes
797	Jameston silty clay loam, 0 to 2 percent slopes (where drained)
798B	Protivin loam, 1 to 4 percent slopes

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
63C----------------- Chelsea	IVs	21	63	21	38	2.6	1.5	2.6	4.3
83B----------------- Kenyon	IIe	84	152	46	91	6.4	3.7	6.2	18.7
83C----------------- Kenyon	IIIe	69	147	45	88	6.2	3.6	6.0	10.4
83C2---------------- Kenyon	IIIe	67	143	44	86	6.0	3.5	5.9	10.0
84------------------ Clyde	IIw	74	138	42	83	4.1	3.4	5.7	6.8
135----------------- Coland	IIw	79	134	41	80	4.0	3.3	5.5	6.7
151----------------- Marshan	IIw	63	110	34	66	3.3	2.7	4.5	5.5
152----------------- Marshan	IIw	71	124	38	74	3.7	3.1	5.1	6.2
153----------------- Shandep	Vw	25	---	---	---	---	2.4	---	---
171B---------------- Bassett	IIe	79	143	44	86	6.0	3.5	5.9	10.0
171C---------------- Bassett	IIIe	64	138	42	83	5.8	3.4	5.7	9.7
171C2--------------- Bassett	IIIe	62	134	41	80	5.6	3.3	5.5	9.4
173----------------- Hoopeston	IIs	59	113	38	68	4.7	2.8	4.6	7.8
175B---------------- Dickinson	IIIe	54	107	36	64	4.5	2.6	4.4	7.5
175C---------------- Dickinson	IIIe	40	102	34	61	4.3	2.5	4.2	7.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
177----------------- Saude	IIs	62	105	32	63	4.4	2.6	4.3	7.3
177B---------------- Saude	IIe	57	102	31	61	4.3	2.5	4.2	7.2
198B---------------- Floyd	IIw	74	142	43	85	5.7	3.5	5.8	9.5
213B---------------- Rockton	IIe	73	127	39	76	5.3	3.1	5.2	8.9
214B---------------- Rockton	IIe	57	102	31	61	4.3	2.5	4.2	7.2
214C---------------- Rockton	IIIe	38	97	30	58	4.1	2.4	4.0	6.8
221B---------------- Palms	Vw	25	---	---	---	---	2.8	---	---
225----------------- Lawler	IIs	65	117	36	70	4.7	2.9	4.8	7.8
226----------------- Lawler	IIs	77	136	41	82	5.4	3.3	5.6	9.0
284----------------- Flagler	IIIs	49	85	28	51	3.6	2.1	3.5	6.0
284B---------------- Flagler	IIIe	45	82	27	49	3.4	2.0	3.4	5.7
284C---------------- Flagler	IIIe	30	77	26	46	3.2	1.9	3.2	5.3
284C2--------------- Flagler	IIIe	25	74	25	44	3.1	1.8	3.0	5.2
285----------------- Burkhardt	IVs	30	52	17	31	2.2	1.3	2.1	3.7
285B---------------- Burkhardt	IVs	25	49	16	29	2.1	1.2	2.0	3.5
285D---------------- Burkhardt	VIe	5	---	---	---	1.5	0.9	1.4	2.5
302B---------------- Coggon	IIe	74	134	41	80	5.6	3.3	5.5	9.4

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
302C---------------- Coggon	IIIe	59	129	39	77	5.4	3.2	5.3	9.0
323B---------------- Terril	IIe	71	132	40	79	5.5	3.2	5.4	9.2
391B---------------- Clyde-Floyd	IIw	72	133	41	80	4.0	3.3	5.5	6.7
394B---------------- Ostrander	IIe	84	152	46	91	6.4	3.7	6.2	10.7
394C---------------- Ostrander	IIIe	69	147	45	88	6.2	3.6	6.0	10.4
394C2--------------- Ostrander	IIIe	67	143	44	86	6.0	3.5	5.9	10.0
398----------------- Tripoli	IIw	79	151	46	91	4.5	3.7	6.2	7.5
399----------------- Readlyn	I	89	155	47	93	6.2	3.8	6.4	10.4
399B---------------- Readlyn	IIe	84	152	46	91	6.1	3.7	6.2	10.2
407B---------------- Schley	IIw	69	128	39	77	5.1	3.1	5.2	8.5
408B---------------- Olin	IIe	66	131	44	79	5.5	3.2	5.4	9.2
408C---------------- Olin	IIIe	51	126	42	76	5.3	3.1	5.2	8.9
412C---------------- Emeline	IVs	13	61	20	37	2.6	1.5	2.5	4.3
412E---------------- Emeline	VIIs	5	---	---	---	---	0.9	---	---
457----------------- Du Page	IIw	71	134	45	80	5.6	3.3	5.5	9.4
471----------------- Oran	I	84	146	45	88	5.8	3.6	6.0	9.7
471B---------------- Oran	IIe	79	143	44	86	5.7	3.5	5.9	9.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
472----------------- Havana	IIw	74	141	43	85	4.2	3.5	5.8	7.0
482B---------------- Racine	IIe	79	143	44	86	6.0	3.5	5.9	10.0
482C2--------------- Racine	IIIe	62	134	41	80	5.6	3.3	5.5	9.4
485----------------- Spillville	IIw	91	154	47	92	6.2	3.8	6.3	10.4
585----------------- Coland-Spillville	IIw	85	138	42	83	4.1	3.4	5.7	6.8
621B---------------- Houghton	Vw	20	---	---	---	---	2.4	---	---
713B---------------- Winneshiek	IIe	68	118	36	71	5.0	2.9	4.8	8.4
714B---------------- Winneshiek	IIe	52	93	28	56	3.9	2.3	3.8	6.5
725----------------- Hayfield	IIs	60	108	33	65	4.3	2.7	4.4	7.2
728----------------- Udolpho	IIw	61	126	38	76	3.8	3.1	5.2	6.3
775B---------------- Billett	IIIs	50	97	32	58	4.1	2.4	4.0	6.8
775C---------------- Billett	IIIe	36	92	31	55	3.9	2.3	3.8	6.5
776B---------------- Lilah	IVs	28	48	16	29	2.0	1.2	2.0	3.3
776D2--------------- Lilah	VIs	5	---	---	---	1.3	0.8	1.3	2.2
777----------------- Wapsie	IIs	57	93	28	56	3.9	2.3	3.8	6.5
777B---------------- Wapsie	IIe	52	90	27	54	3.8	2.2	3.7	6.4
781B---------------- Lourdes	IIe	61	120	37	72	5.0	3.0	4.9	8.4

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
781C2---------------- Lourdes	IIIe	36	111	34	67	4.7	2.7	4.6	7.8
782B---------------- Donnan	IIe	49	90	27	54	3.6	2.2	3.7	6.0
782C2---------------- Donnan	IIIe	30	75	23	45	3.0	1.8	3.1	5.0
783B---------------- Cresco	IIe	66	129	39	77	5.4	3.2	5.3	9.0
783C---------------- Cresco	IIIe	46	124	38	74	5.2	3.1	5.1	8.7
783C2---------------- Cresco	IIIe	41	120	37	72	5.0	3.0	4.9	8.3
784B---------------- Riceville	IIe	51	117	36	70	4.7	2.9	4.8	7.9
797---------------- Jameston	IIw	56	124	38	74	3.7	3.1	5.1	6.2
798B---------------- Protivin	IIe	56	125	38	75	5.0	3.1	5.1	8.4
809C---------------- Bertram	IVs	9	52	16	31	2.2	1.3	2.1	3.7
1585---------------- Coland-Spillville	Vw	25	---	---	---	---	3.8	---	---
1936---------------- Spillville-Udifluvents	Vw	25	---	---	---	---	1.9	---	---
5010***. Pits, sand and gravel									
5030***. Pits, limestone quarries									
5040***. Orthents									

* Relative value: The value for the corn suitability rating.

** Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

*** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
63C: Chelsea	5S	Slight	Slight	Moderate	Slight	Moderate	White oak	70	5	Eastern white pine, red pine, jack pine.
							Red pine	72	9	
							Eastern white pine	83	13	
							Jack pine	70	7	
							Quaking aspen	72	6	
171B, 171C, 171C2: Bassett	3A	Slight	Slight	Slight	Slight	Slight	White oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
							Northern red oak	55	3	
221B: Palms	2W	Slight	Severe	Severe	Severe	Severe	Red maple	55	2	Northern whitecedar, tamarack.
							Silver maple	80	2	
							White ash	---	---	
							Quaking aspen	---	---	
							Northern whitecedar	---	---	
							Tamarack	61	4	
							Black ash	---	---	
285, 285B, 285D: Burkhardt	2S	Slight	Moderate	Severe	Slight	Moderate	Northern pin oak	52	2	Eastern white pine, jack pine, Norway spruce.
							Jack pine	---	---	
302B, 302C: Coggon	4A	Slight	Slight	Slight	Slight	Moderate	Northern red oak	65	4	Eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, European larch, black walnut, sugar maple.
							White oak	65	4	
407B: Schley	3W	Slight	Slight	Slight	Slight	Moderate	White oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
							Northern red oak	55	3	
412C, 412E: Emeline	2D	Slight	Severe	Severe	Severe	Slight	Black oak	50	2	Eastern redcedar, eastern white pine, red pine, jack pine, bur oak.
							Bur oak	50	2	
							Eastern redcedar	50	4	
							Shagbark hickory	50	---	
							Northern red oak	50	2	
							American elm	50	---	
471, 471B: Oran	3A	Slight	Slight	Slight	Slight	Slight	White oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
							Northern red oak	55	3	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
472: Havana	2W	Slight	Severe	Moderate	Moderate	Severe	Green ash	50	2	White ash, green ash, white spruce, eastern white pine, northern red oak, silver maple.
							Eastern cottonwood	85	6	
							American elm	55	---	
							Black ash	50	2	
482B, 482C2: Racine	4A	Slight	Slight	Slight	Slight	Severe	American basswood	68	4	White spruce, eastern white pine, black walnut, green ash.
							Northern red oak	65	4	
							Black walnut	60	---	
							Sugar maple	60	3	
713B, 714B: Winneshiek	4D	Slight	Slight	Slight	Moderate	Moderate	Northern red oak	65	4	Eastern white pine, red pine, black walnut.
							White oak	65	4	
725: Hayfield	4A	Slight	Slight	Slight	Slight	Severe	Northern red oak	65	4	Northern red oak, white oak, silver maple, eastern white pine, black walnut, red pine, white spruce, white ash.
							White oak	65	4	
							Eastern white pine	60	8	
728: Udolpho	2W	Slight	Severe	Slight	Moderate	Severe	Green ash	50	2	Eastern white pine, green ash, silver maple, northern red oak, white spruce.
							Eastern cottonwood	90	7	
775B, 775C: Billett	4A	Slight	Slight	Slight	Slight	Slight	Northern red oak	60	4	Red pine, eastern white pine, white spruce, Norway spruce.
							Bur oak	---	---	
							Black oak	---	---	
							White oak	---	---	
							Black cherry	---	---	
							Shagbark hickory	---	---	
776B, 776D2: Lilah	3S	Slight	Slight	Severe	Slight	Moderate	Northern red oak	55	3	Eastern white pine, white oak, eastern redcedar.
777, 777B: Wapsie	3A	Slight	Slight	Slight	Slight	Moderate	Northern red oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
							White oak	55	3	
781B, 781C2: Lourdes	3A	Slight	Slight	Slight	Slight	Moderate	White oak	55	3	Eastern white pine, red pine, black walnut, sugar maple.
							Northern red oak	55	3	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
782B, 782C2-------- Donnan	3A	Slight	Slight	Slight	Slight	Moderate	White oak----------- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, silver maple.
784B--------------- Riceville	3A	Slight	Slight	Slight	Slight	Moderate	White oak----------- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--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
63C. Chelsea	Siberian peashrub, lilac.	Eastern redcedar	Red pine, jack pine, Austrian pine.	Eastern white pine	---
83B, 83C, 83C2. Kenyon	---	Siberian peashrub, gray dogwood, redosier dogwood, lilac.	Northern whitecedar, hackberry, blue spruce, eastern redcedar, Russian-olive, Amur maple.	Eastern white pine, green ash.	---
84. Clyde	---	Redosier dogwood, American plum.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
135. Coland	---	Redosier dogwood, cotoneaster, American plum.	White spruce, hackberry, northern whitecedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
151, 152. Marshan	---	Common ninebark, redosier dogwood, silky dogwood, nannyberry viburnum, American cranberrybush, northern whitecedar.	Balsam fir, white spruce.	Green ash, white ash, red maple, silver maple.	---
153. Shandep					
171B, 171C, 171C2. Bassett	---	Redosier dogwood, gray dogwood, Siberian peashrub, lilac.	Russian-olive, eastern redcedar, northern whitecedar, blue spruce, Amur maple, hackberry.	Green ash, eastern white pine.	---
173. Hoopeston	---	Northern whitecedar, nannyberry viburnum, redosier dogwood, lilac.	Amur maple, white spruce.	Eastern white pine, hackberry, red maple, white ash, green ash.	Silver maple.
175B, 175C. Dickinson	Lilac	Eastern redcedar, Russian-olive, Siberian peashrub.	Eastern white pine, green ash, Norway spruce, honeylocust, red pine, Amur maple, hackberry.	---	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
177, 177B---------- Saude	Lilac, Siberian peashrub.	Manchurian crabapple, hackberry, eastern redcedar.	Eastern white pine, bur oak, jack pine, green ash, honeylocust, Russian-olive.	---	---
198B--------------- Floyd	---	Redosier dogwood, lilac.	Blue spruce, Amur maple, northern whitecedar, white spruce.	Austrian pine, hackberry, green ash, eastern white pine.	Silver maple.
213B, 214B, 214C-- Rockton	Cotoneaster, lilac	Eastern redcedar, Siberian peashrub.	Eastern white pine, green ash, hackberry, Manchurian crabapple, Russian-olive, jack pine.	Honeylocust, Siberian elm.	---
221B--------------- Palms	---	Silky dogwood, common ninebark, nannyberry viburnum, American cranberrybush.	Northern whitecedar, Black Hills spruce, Manchurian crabapple, white spruce.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
225, 226----------- Lawler	---	Lilac, redosier dogwood.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Eastern white pine, hackberry, Austrian pine, green ash.	Silver maple.
284, 284B, 284C, 284C2------------- Flagler	Lilac, Siberian peashrub.	Manchurian crabapple, hackberry, eastern redcedar.	Honeylocust, eastern white pine, jack pine, green ash, Russian-olive, bur oak.	---	---
285, 285B---------- Burkhardt	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
285D. Burkhardt					
302B, 302C--------- Coggon	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Northern whitecedar, hackberry, blue spruce, Russian-olive, Amur maple, eastern redcedar.	Eastern white pine, green ash.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
323B: Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Northern whitecedar, hackberry, blue spruce, Russian-olive, eastern redcedar, Amur maple.	Eastern white pine, green ash.	---
391B*:					
Clyde	---	Redosier dogwood, American plum.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Floyd	---	Redosier dogwood, lilac.	Blue spruce, Amur maple, northern whitecedar, white spruce.	Austrian pine, hackberry, green ash, eastern white pine.	Silver maple.
394B, 394C, 394C2: Ostrander	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Hackberry, Russian-olive, Amur maple, blue spruce, eastern redcedar, northern whitecedar.	Eastern white pine, green ash.	---
398: Tripoli	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, bur oak, eastern redcedar, white spruce.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
399, 399B: Readlyn	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
407B: Schley	---	Redosier dogwood, lilac.	Northern whitecedar, blue spruce, white spruce, Amur maple.	Green ash, Austrian pine, eastern white pine, hackberry.	Silver maple.
408B, 408C: Olin	Lilac	Russian-olive, eastern redcedar, cotoneaster, Siberian peashrub.	Red pine, green ash, Norway spruce, eastern white pine, Amur maple, hackberry, honeylocust.	---	---
412C, 412E. Emeline					
457: Du Page	---	Northern whitecedar, Siberian peashrub, lilac.	Hackberry, bur oak, eastern redcedar, white spruce.	Green ash, golden willow, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
471, 471B. Oran	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
472. Havana	---	American plum, redosier dogwood.	White spruce, Amur maple, northern whitecedar, tall purple willow, hackberry.	Green ash, golden willow.	Eastern cottonwood, silver maple.
482B, 482C2. Racine	---	Gray dogwood, Amur maple, American cranberrybush, lilac, northern whitecedar.	Black Hills spruce, Norway spruce, white spruce.	Red maple, white ash, red pine, eastern white pine.	---
485. Spillville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
585*:					
Coland	---	Redosier dogwood, cotoneaster, American plum.	White spruce, hackberry, northern whitecedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Spillville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
621B. Houghton	---	Redosier dogwood	Tall purple willow	Black willow, golden willow, white willow.	---
713B, 714B. Winneshiek	Lilac	Eastern redcedar, Siberian peashrub.	Russian-olive, eastern white pine, green ash, Manchurian crabapple, jack pine, hackberry.	Honeylocust, Siberian elm.	---
725. Hayfield	---	Redosier dogwood, silky dogwood, nannyberry viburnum, American cranberrybush, lilac, northern whitecedar.	White spruce	Silver maple, red maple, white ash, red pine, eastern white pine.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
728. Udolpho	---	Common ninebark, redosier dogwood, silky dogwood, nannyberry viburnum, American cranberrybush, northern whitecedar.	Balsam fir, white spruce.	Green ash, white ash, red maple, silver maple.	---
775B, 775C. Billett	Lilac, manyflower cotoneaster.	Russian-olive, Siberian peashrub, eastern redcedar.	Eastern white pine, red pine, Norway spruce, honeylocust, hackberry, green ash, Amur maple.	---	---
776B, 776D2. Lilah	Lilac, Siberian peashrub.	Eastern redcedar	Red pine, Austrian pine, jack pine.	Eastern white pine	---
777, 777B. Wapsie	Lilac, Siberian peashrub.	Eastern redcedar, Manchurian crabapple, hackberry.	Russian-olive, jack pine, green ash, honeylocust, bur oak, eastern white pine.	---	---
781B, 781C2. Lourdes	---	Redosier dogwood, lilac, gray dogwood, Siberian peashrub.	Eastern redcedar, northern whitecedar, blue spruce, Amur maple, hackberry, Russian-olive.	Green ash, eastern white pine.	---
782B, 782C2. Donnan	---	Redosier dogwood, lilac.	Blue spruce, white spruce, northern whitecedar, Amur maple.	Green ash, Austrian pine, eastern white pine, hackberry.	Silver maple.
783B, 783C, 783C2. Cresco	---	Redosier dogwood, gray dogwood, Siberian peashrub, lilac.	Northern whitecedar, eastern redcedar, Russian-olive, blue spruce, Amur maple, hackberry.	Green ash, eastern white pine.	---
784B. Riceville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, hackberry, green ash.	Silver maple.
797. Jameston	---	Redosier dogwood, American plum.	Tall purple willow, Amur maple, hackberry, northern whitecedar, white spruce.	Green ash, golden willow.	Silver maple, eastern cottonwood.
798B. Protivin	Gray dogwood, silky dogwood.	Redosier dogwood, American plum.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, hackberry.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
809C: Bertram	Lilac	Eastern redcedar, Siberian peashrub.	Green ash, eastern white pine, Russian-olive, hackberry, Manchurian crabapple.	Honeylocust, Siberian elm.	---
1585*:					
Coland	---	Redosier dogwood, cotoneaster, American plum.	White spruce, hackberry, northern whitecedar, tall purple willow, Amur maple.	Golden willow, green ash.	Eastern cottonwood, silver maple.
Spillville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
1936*:					
Spillville	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Hackberry, eastern white pine, Austrian pine, green ash.	Silver maple.
Udifluvents.					
5010*. Pits, sand and gravel					
5030*. Pits, limestone quarries					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
63C Chelsea	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
83B Kenyon	Slight	Slight	Moderate: slope.	Slight	Slight.
83C, 83C2 Kenyon	Slight	Slight	Severe: slope.	Slight	Slight.
84 Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
135 Coland	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
151, 152 Marshan	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
153 Shandep	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
171B Bassett	Slight	Slight	Moderate: slope.	Slight	Slight.
171C, 171C2 Bassett	Slight	Slight	Severe: slope.	Slight	Slight.
173 Hoopeston	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
175B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
175C Dickinson	Slight	Slight	Severe: slope.	Slight	Slight.
177 Saude	Slight	Slight	Slight	Slight	Slight.
177B Saude	Slight	Slight	Moderate: slope.	Slight	Slight.
198B Floyd	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
213B, 214B Rockton	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
214C Rockton	Slight	Slight	Severe: slope.	Slight	Moderate: depth to rock.
221B Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
225, 226 Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
284 Flagler	Slight	Slight	Slight	Slight	Slight.
284B Flagler	Slight	Slight	Moderate: slope.	Slight	Slight.
284C Flagler	Slight	Slight	Severe: slope.	Slight	Slight.
284C2 Flagler	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
285 Burkhardt	Slight	Slight	Slight	Slight	Moderate: droughty.
285B Burkhardt	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
285D Burkhardt	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
302B, 302C Coggon	Slight	Slight	Severe: slope.	Slight	Slight.
323B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
391B*:					
Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Floyd	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
394B Ostrander	Slight	Slight	Moderate: slope.	Slight	Slight.
394C, 394C2 Ostrander	Slight	Slight	Severe: slope.	Slight	Slight.
398 Tripoli	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
399 Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
399B Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
407B Schley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
408B Olin	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
408C------------------ Olin	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
412C, 412E------------ Emeline	Severe: percs slowly, depth to rock.	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock, percs slowly.	Slight----------	Severe: depth to rock.
457------------------- Du Page	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
471------------------- Oran	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
471B------------------ Oran	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
472------------------- Havana	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
482B------------------ Racine	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
482C2----------------- Racine	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
485------------------- Spillville	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
585*:					
Coland---------------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Spillville-----------	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
621B------------------ Houghton	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
713B, 714B------------ Winneshiek	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight----------	Moderate: depth to rock.
725------------------- Hayfield	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
728------------------- Udolpho	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
775B------------------ Billett	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
775C------------------ Billett	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: droughty.
776B------------------ Lilah	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
776D2 Lilah	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
777 Wapsie	Slight	Slight	Slight	Slight	Slight.
777B Wapsie	Slight	Slight	Moderate: slope.	Slight	Slight.
781B Lourdes	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
781C2 Lourdes	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
782B Donnan	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
782C2 Donnan	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Slight	Slight.
783B Cresco	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
783C, 783C2 Cresco	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
784B Riceville	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
797 Jameston	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
798B Protivin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
809C Bertram	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: depth to rock.
1585*:					
Coland	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
Spillville	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
1936*:					
Spillville	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1936*:					
Udifluvents----------	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
5010*. Pits, sand and gravel					
5030*. Pits, limestone quarries					
5040*----------------- Orthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope.	Slight----------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
63C: Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
83B: Kenyon	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
83C, 83C2: Kenyon	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
84: Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
135: Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
151, 152: Marshan	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
153: Shandep	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
171B: Bassett	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
171C, 171C2: Bassett	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
173: Hoopeston	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
175B: Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
175C: Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
177, 177B: Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
198B: Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
213B, 214B, 214C: Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
221B: Palms	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
225, 226: Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
284, 284B: Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
284C, 284C2: Flagler	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
285, 285B, 285D----Burkhardt	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
302B, 302C---------Coggon	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
323B---------------Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
391B*:										
Clyde--------------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Floyd--------------	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
394B---------------Ostrander	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
394C, 394C2--------Ostrander	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
398----------------Tripoli	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
399, 399B----------Readlyn	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
407B---------------Schley	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
408B---------------Olin	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
408C---------------Olin	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
412C, 412E---------Emeline	Very poor.	Very poor.	Poor	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.
457----------------Du Page	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
471, 471B----------Oran	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
472----------------Havana	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
482B---------------Racine	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
482C2--------------Racine	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
485----------------Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
585*:										
Coland-------------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Spillville---------	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
621B----------------Houghton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
713B, 714B---------Winneshiek	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
725-----------------Hayfield	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
728-----------------Udolpho	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
775B----------------Billett	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
775C----------------Billett	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
776B----------------Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
776D2---------------Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
777, 777B----------Wapsie	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
781B----------------Lourdes	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
781C2---------------Lourdes	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
782B----------------Donnan	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
782C2---------------Donnan	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
783B----------------Cresco	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
783C, 783C2--------Cresco	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Fair.
784B----------------Riceville	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
797-----------------Jameston	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good.
798B----------------Protivin	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
809C----------------Bertram	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
1585*:										
Coland--------------	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
1585*:										
Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1936*:										
Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Udifluvents.										
5010*. Pits, sand and gravel										
5030*. Pits, limestone quarries										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
63C--------------- Chelsea	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
83B--------------- Kenyon	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.
83C, 83C2--------- Kenyon	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
84---------------- Clyde	Severe: excess humus, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
135--------------- Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
151, 152---------- Marshan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
153--------------- Shandep	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
171B-------------- Bassett	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.
171C, 171C2------- Bassett	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
173--------------- Hoopeston	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
175B-------------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
175C-------------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
177, 177B--------- Saude	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
198B-------------- Floyd	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: frost action.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
213B, 214B-------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: depth to rock.
214C-------------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Moderate: depth to rock.
221B-------------- Palms	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
225, 226---------- Lawler	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
284, 284B--------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
284C-------------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
284C2------------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
285, 285B--------- Burkhardt	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
285D-------------- Burkhardt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
302B, 302C-------- Coggon	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
323B-------------- Terril	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.
391B*:						
Clyde------------	Severe: excess humus, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Floyd------------	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: frost action.	Slight.
394B-------------- Ostrander	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
394C, 394C2------- Ostrander	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
398--------------- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
399, 399B--------- Readlyn	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
407B-------------- Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
408B-------------- Olin	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
408C-------------- Olin	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
412C-------------- Emeline	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
412E-------------- Emeline	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
457--------------- Du Page	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
471, 471B--------- Oran	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
472--------------- Havana	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
482B-------------- Racine	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
482C2------------- Racine	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
485--------------- Spillville	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
585*:						
Coland-----------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Spillville--------	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
621B-------------- Houghton	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
713B, 714B-------- Winneshiek	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, low strength.	Moderate: depth to rock.
725--------------- Hayfield	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Severe: frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
728---------------- Udolpho	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
775B--------------- Billett	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Moderate: droughty.
775C--------------- Billett	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
776B--------------- Lilah	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
776D2-------------- Lilah	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
777, 777B---------- Wapsie	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
781B--------------- Lourdes	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
781C2-------------- Lourdes	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
782B, 782C2-------- Donnan	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
783B--------------- Cresco	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: frost action.	Slight.
783C, 783C2-------- Cresco	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: frost action.	Slight.
784B--------------- Riceville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
797---------------- Jameston	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
798B--------------- Protivin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
809C--------------- Bertram	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: depth to rock.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1585*:						
Coland	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
Spillville	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
1936*:						
Spillville	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
Udifluvents	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
5010*. Pits, sand and gravel						
5030*. Pits, limestone quarries						
5040* Orthents	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
63C----------------- Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
83B----------------- Kenyon	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
83C, 83C2----------- Kenyon	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
84------------------ Clyde	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
135----------------- Coland	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
151, 152------------ Marshan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
153----------------- Shandep	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: hard to pack, ponding.
171B---------------- Bassett	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
171C, 171C2--------- Bassett	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
173----------------- Hoopeston	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
175B---------------- Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
175C---------------- Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
177, 177B----------- Saude	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
198B---------------- Floyd	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
213B, 214B----------- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
214C----------------- Rockton	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
221B----------------- Palms	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
225, 226------------- Lawler	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
284, 284B------------ Flagler	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
284C, 284C2---------- Flagler	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
285, 285B------------ Burkhardt	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
285D----------------- Burkhardt	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
302B, 302C----------- Coggon	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
323B----------------- Terril	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: thin layer.
391B*:					
Clyde---------------	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Floyd---------------	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
394B----------------- Ostrander	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Fair: small stones.
394C, 394C2---------- Ostrander	Moderate: percs slowly.	Severe: slope.	Slight-----------	Slight-----------	Fair: small stones.
398------------------ Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
399, 399B Readlyn	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
407B Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
408B Olin	Slight	Severe: seepage.	Slight	Severe: seepage.	Good.
408C Olin	Slight	Severe: seepage, slope.	Slight	Severe: seepage.	Good.
412C, 412E Emeline	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
457 Du Page	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding.	Good.
471, 471B Oran	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
472 Havana	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
482B Racine	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
482C2 Racine	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
485 Spillville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness.
585*:					
Coland	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Spillville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness.
621B Houghton	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
713B, 714B---------- Winneshiek	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
725----------------- Hayfield	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
728----------------- Udolpho	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
775B---------------- Billett	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, small stones.
775C---------------- Billett	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, small stones.
776B---------------- Lilah	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
776D2--------------- Lilah	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
777, 777B----------- Wapsie	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
781B---------------- Lourdes	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too clayey.	Slight-----------	Fair: too clayey, wetness.
781C2--------------- Lourdes	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Slight-----------	Fair: too clayey, wetness.
782B---------------- Donnan	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
782C2--------------- Donnan	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
783B---------------- Cresco	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too clayey.	Slight-----------	Fair: too clayey, wetness.
783C, 783C2--------- Cresco	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Slight-----------	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
784B----------------- Riceville	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
797----------------- Jameston	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
798B---------------- Protivin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
809C---------------- Bertram	Severe: depth to rock, percs slowly.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: depth to rock.
1585*:					
Coland--------------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Spillville----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness.
1936*:					
Spillville----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Fair: wetness.
Udifluvents---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
5010*. Pits, sand and gravel					
5030*. Pits, limestone quarries					
5040*--------------- Orthents	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
63C------------------- Chelsea	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
83B, 83C-------------- Kenyon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
83C2------------------ Kenyon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
84-------------------- Clyde	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
135------------------- Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
151, 152-------------- Marshan	Poor: wetness.	Probable-------------	Probable-------------	Poor: area reclaim, wetness.
153------------------- Shandep	Poor: wetness.	Probable-------------	Probable-------------	Poor: wetness.
171B, 171C, 171C2----- Bassett	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
173------------------- Hoopeston	Fair: wetness.	Probable-------------	Improbable: too sandy.	Fair: small stones, thin layer.
175B, 175C------------ Dickinson	Good-----------------	Probable-------------	Improbable: too sandy.	Fair: thin layer.
177, 177B------------- Saude	Good-----------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
198B------------------ Floyd	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
213B, 214B, 214C------ Rockton	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
221B------------------ Palms	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
225, 226-------------- Lawler	Fair: wetness.	Probable-------------	Probable-------------	Poor: area reclaim.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
284, 284B, 284C, 284C2-- Flagler	Good--	Probable--	Probable--	Fair: small stones, area reclaim, thin layer.
285, 285B, 285D-- Burkhardt	Good--	Probable--	Probable--	Poor: too sandy, small stones, area reclaim.
302B, 302C-- Coggon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
323B-- Terril	Good--	Probable--	Improbable: too sandy.	Fair: small stones, area reclaim.
391B*:				
Clyde--	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Floyd--	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
394B, 394C, 394C2-- Ostrander	Good--	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
398-- Tripoli	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
399, 399B-- Readlyn	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
407B-- Schley	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
408B, 408C-- Olin	Good--	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
412C, 412E-- Emeline	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
457-- Du Page	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
471, 471B-- Oran	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
472-- Havana	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
482B, 482C2: Racine	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
485: Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
585*:				
Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
621B: Houghton	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
713B, 714B: Winneshiek	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
725: Hayfield	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
728: Udolpho	Fair: wetness.	Probable	Probable	Poor: area reclaim.
775B, 775C: Billett	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
776B, 776D2: Lilah	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
777, 777B: Wapsie	Good	Probable	Probable	Fair: too clayey, small stones, area reclaim.
781B: Lourdes	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
781C2: Lourdes	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
782B: Donnan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
782C2: Donnan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, thin layer.
783B, 783C: Cresco	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
783C2: Cresco	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
784B: Riceville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
797: Jameston	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
798B: Protivin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
809C: Bertram	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
1585*:				
Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
1936*:				
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Udifluvents	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
5010*. Pits, sand and gravel				
5030*. Pits, limestone quarries				
5040*: Orthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
63C Chelsea	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
83B, 83C, 83C2 Kenyon	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
84 Clyde	Severe: seepage.	Severe: thin layer, wetness.	Moderate: slow refill.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
135 Coland	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
151, 152 Marshan	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy.	Wetness.
153 Shandep	Severe: seepage.	Severe: ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Wetness.
171B, 171C, 171C2 Bassett	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
173 Hoopeston	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Wetness.
175B, 175C Dickinson	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Favorable.
177, 177B Saude	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy	Rooting depth.
198B Floyd	Severe: seepage.	Moderate: piping, wetness.	Severe: cutbanks cave.	Frost action	Wetness	Favorable.
213B, 214B, 214C Rockton	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
221B Palms	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.
225, 226 Lawler	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy.	Rooting depth.
284, 284B, 284C Flagler	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
284C2-------------- Flagler	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty, rooting depth.
285, 285B--------- Burkhardt	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty, rooting depth.
285D-------------- Burkhardt	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
302B, 302C-------- Coggon	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
323B-------------- Terril	Severe: seepage.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
391B*:						
Clyde------------	Severe: seepage.	Severe: thin layer, wetness.	Moderate: slow refill.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.
Floyd------------	Severe: seepage.	Moderate: piping, wetness.	Severe: cutbanks cave.	Frost action, slope.	Wetness--------	Favorable.
394B, 394C, 394C2- Ostrander	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
398--------------- Tripoli	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness, rooting depth.
399--------------- Readlyn	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Favorable.
399B-------------- Readlyn	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Wetness--------	Favorable.
407B-------------- Schley	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness, rooting depth.
408B, 408C-------- Olin	Severe: seepage.	Slight---------	Severe: no water.	Deep to water	Erodes easily, soil blowing.	Erodes easily.
412C-------------- Emeline	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock, percs slowly.
412E-------------- Emeline	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock.	Slope, depth to rock, percs slowly.
457--------------- Du Page	Severe: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
471 Oran	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action	Wetness	Favorable.
471B Oran	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Wetness	Favorable.
472 Havana	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action	Wetness	Wetness.
482B, 482C2 Racine	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
485 Spillville	Severe: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
585*:						
Coland	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
Spillville	Severe: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
621B Houghton	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill.	Subsides, frost action, slope.	Wetness, soil blowing.	Wetness.
713B, 714B Winneshiek	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock, percs slowly.
725 Hayfield	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy.	Favorable.
728 Udolpho	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Erodes easily, wetness, too sandy.	Wetness, erodes easily.
775B, 775C Billett	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
776B Lilah	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty, rooting depth.
776D2 Lilah	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
777, 777B Wapsie	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy	Rooting depth.
781B, 781C2 Lourdes	Moderate: slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
782B, 782C2: Donnan	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Percs slowly.
783B, 783C, 783C2: Cresco	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
784B: Riceville	Slight	Moderate: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily, rooting depth.
797: Jameston	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
798B: Protivin	Slight	Moderate: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
809C: Bertram	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, soil blowing.	Depth to rock, rooting depth.
1585*:						
Coland	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
Spillville	Severe: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
1936*:						
Spillville	Severe: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
Udifluvents	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Soil blowing	Droughty.
5010*. Pits, sand and gravel						
5030*. Pits, limestone quarries						
5040*: Orthents	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Favorable	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
63C-------------- Chelsea	0-6	Loamy sand-------	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	6-60	Fine sand, sand, loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
83B, 83C, 83C2--- Kenyon	0-14	Loam-------------	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
	14-53	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
	53-60	Loam-------------	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
84--------------- Clyde	0-20	Clay loam--------	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	20-36	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	36-40	Sandy loam, loam, sandy clay loam.	SM, SC-SM	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	40-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
135-------------- Coland	0-8	Clay loam--------	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	8-58	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	58-60	Loam, clay loam, silt loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
151-------------- Marshan	0-14	Clay loam--------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
	14-23	Silty clay loam, clay loam, silt loam.	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	30-50	15-30
	23-26	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-6, A-4	0	95-100	75-100	70-90	45-75	25-40	5-15
	26-60	Coarse sand, gravelly coarse sand, sand.	SP, SW, SP-SM	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
152-------------- Marshan	0-18	Clay loam--------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
	18-34	Silty clay loam, clay loam, silt loam.	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	30-50	15-30
	34-38	Loam, sandy loam	CL, CL-ML, SC, SC-SM	A-6, A-4	0	95-100	75-100	70-90	45-75	25-40	5-15
	38-60	Coarse sand, gravelly coarse sand, sand.	SP, SW, SP-SM	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
153-------------- Shandep	0-33	Clay loam--------	CL, CH	A-7	0	95-100	95-100	90-100	85-95	40-55	20-30
	33-49	Silty clay loam, clay loam, loam.	CL	A-7	0	95-100	95-100	90-100	85-95	40-50	20-30
	49-60	Loamy sand, gravelly loamy coarse sand, gravelly coarse sand.	SW, SP, SP-SM	A-1	0-5	65-90	60-90	20-45	2-5	---	NP
171B, 171C, 171C2----------- Bassett	0-13	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	65-85	20-30	5-15
	13-49	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	11-20
	49-60	Loam-------------	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	11-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
173-------------- Hoopeston	0-12	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0	90-100	90-100	70-90	25-45	<25	NP-10
	12-21	Sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4	0	90-100	90-100	60-85	25-50	<30	NP-10
	21-60	Loamy sand, sand, fine sand.	SP-SM, SM, SC, SC-SM	A-2, A-3	0	90-100	90-100	50-80	5-20	<25	NP-10
175B, 175C------- Dickinson	0-8	Sandy loam-------	SM, SC, SC-SM	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	8-38	Fine sandy loam, sandy loam.	SM, SC, SC-SM	A-4	0	100	100	85-95	35-50	15-30	NP-10
	38-46	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SC-SM	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	46-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
177, 177B-------- Saude	0-13	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	13-27	Loam, sandy loam, gravelly sandy loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0-5	85-95	65-95	60-85	45-60	20-30	5-15
	27-60	Loamy sand, gravelly coarse sand, sand.	SW, SM, GP, GM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
198B------------- Floyd	0-19	Loam-------------	OL, ML, CL	A-4, A-6	0	100	100	80-90	55-75	30-40	5-15
	19-32	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	32-42	Sandy loam, loamy sand.	SM, SC-SM	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	42-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
213B------------- Rockton	0-17	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	17-31	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	31-35	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	35	Weathered bedrock	---	---	---	---	---	---	---	---	---
214B, 214C------- Rockton	0-14	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	14-19	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	19-24	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	24	Weathered bedrock	---	---	---	---	---	---	---	---	---
221B------------- Palms	0-8	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	8-34	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	34-60	Clay loam, silty clay loam, gravelly sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6, A-7, A-2	0	85-100	60-100	35-95	15-90	20-45	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
225-------------- Lawler	0-18	Loam-------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	18-26	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	26-60	Gravelly coarse sand, gravelly loamy sand, gravelly sandy loam.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
226-------------- Lawler	0-23	Loam-------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	23-33	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	33-60	Gravelly coarse sand, gravelly loamy sand, gravelly sandy loam.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
284, 284B, 284C-- Flagler	0-23	Sandy loam-------	SC, SC-SM	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	23-33	Sandy loam-------	SC, SC-SM	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	33-60	Loamy sand, gravelly coarse sand, coarse sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
284C2------------ Flagler	0-7	Sandy loam-------	SC, SC-SM	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	7-25	Sandy loam-------	SC, SC-SM	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	25-60	Loamy sand, gravelly sand, coarse sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
285, 285B, 285D-- Burkhardt	0-10	Sandy loam-------	SM, SC-SM	A-2, A-4	0	95-100	90-100	55-70	25-40	<26	2-7
	10-15	Sandy loam, loam	SM, ML, SC, CL	A-2, A-4	0	95-100	85-100	50-95	25-75	15-30	2-10
	15-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1	0	50-85	45-85	20-35	1-5	---	NP
302B, 302C------- Coggon	0-18	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	90-95	65-85	20-30	5-15
	18-45	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
	45-60	Loam-------------	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
323B------------- Terril	0-35	Loam-------------	CL	A-4, A-6	0-5	100	95-100	70-90	60-80	25-40	8-15
	35-40	Loam, clay loam	CL	A-4, A-6	0-5	100	90-100	70-90	60-80	25-40	8-15
	40-60	Sand, coarse sand, loamy sand.	SP-SM, SM, SP	A-2-4, A-3	0-25	90-100	75-90	60-80	2-35	---	NP
391B*:											
Clyde-----------	0-20	Clay loam--------	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	20-36	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	36-40	Sandy loam, loam, sandy clay loam.	SM, SC-SM	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	40-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
391B*:											
Floyd	0-19	Loam	OL, ML, CL	A-4, A-6	0	100	100	80-90	55-75	30-40	5-15
	19-32	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	32-42	Sandy loam, loamy sand.	SM, SC-SM	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	42-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
394B, 394C, 394C2 Ostrander	0-16	Loam	CL-ML, CL	A-4, A-6	0	100	95-100	90-95	70-90	25-40	5-15
	16-49	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	90-95	70-90	25-40	5-15
	49-60	Loam	CL	A-6	1-5	95-100	90-100	80-95	50-75	25-40	10-20
398 Tripoli	0-17	Clay loam	CL	A-6, A-7	0	100	100	85-95	55-75	35-45	15-25
	17-50	Clay loam, loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	11-20
	50-60	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	11-20
399, 399B Readlyn	0-15	Loam	CL	A-6	0	100	100	85-95	55-75	30-40	15-25
	15-42	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	10-20
	42-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	25-35	10-20
407B Schley	0-22	Loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-90	55-75	25-40	5-15
	22-36	Loam, sandy loam, silty clay loam.	CL, SC, SC-SM, CL-ML	A-2, A-4	2-8	90-95	70-80	50-70	20-60	20-30	5-10
	36-60	Loam, sandy clay loam, clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-40	10-20
408B, 408C Olin	0-32	Sandy loam	SC-SM, SC	A-2, A-4	0	100	95-100	85-95	30-50	20-30	5-10
	32-42	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-95	80-90	45-65	25-35	10-20
	42-60	Loam, clay loam	CL	A-6	2-5	90-95	85-95	80-90	50-65	25-35	10-20
412C, 412E Emeline	0-6	Loam	CL	A-6	0-10	85-100	85-100	85-100	70-100	25-40	11-23
	6	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
457 Du Page	0-54	Loam	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-45	11-21
	54-60	Sandy loam, loam, gravelly sandy clay loam.	CL	A-4, A-6, A-7	0	85-100	75-100	65-100	55-95	25-45	7-20
471, 471B Oran	0-14	Loam	CL, CL-ML	A-4, A-6	0	100	100	85-95	55-75	25-35	5-15
	14-49	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
	49-60	Loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
472 Havana	0-7	Loam	CL, ML	A-6, A-4	0	100	95-100	90-100	70-90	30-40	5-15
	7-23	Silty clay loam, loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	70-85	30-45	10-20
	23-48	Loam, clay loam	CL	A-6	0-5	90-100	90-100	85-95	60-80	25-40	10-20
	48-60	Loam	CL-ML, CL	A-6, A-4	0-5	90-100	90-100	85-95	60-75	25-40	5-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
482B, 482C2------	0-13	Loam-------------	ML	A-4, A-6	0	95-100	95-100	90-100	55-85	30-40	5-14
Racine	13-40	Clay loam, sandy clay loam, loam.	CL, SC	A-6	2-5	95-100	75-100	65-90	45-65	25-35	10-15
	40-60	Loam-------------	ML, CL	A-6	1-5	95-100	90-100	80-95	50-75	25-40	10-20
485--------------	0-48	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
Spillville	48-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SC-SM, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
585*:											
Coland----------	0-8	Clay loam--------	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	8-58	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	58-60	Loam, clay loam, silt loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
Spillville------	0-48	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	48-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SC-SM, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
621B-------------	0-6	Muck-------------	PT	A-8	0	---	---	---	---	---	---
Houghton	6-60	Muck-------------	PT	A-8	0	---	---	---	---	---	---
713B-------------	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	55-70	20-30	5-15
Winneshiek	10-32	Loam, clay loam	CL	A-6	2-5	90-95	80-95	80-90	50-65	25-40	11-20
	32-36	Clay, silty clay	CH	A-7	0-10	85-95	80-95	80-90	70-90	55-70	30-45
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
714B-------------	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	55-70	20-30	5-15
Winneshiek	10-24	Loam, clay loam	CL	A-6	2-5	90-95	80-95	80-90	50-65	25-40	11-20
	24-28	Clay, silty clay	CH	A-7	0-10	85-95	80-95	80-90	70-90	55-70	30-45
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
725--------------	0-11	Loam-------------	CL-ML, CL	A-6, A-4	0	100	100	90-98	70-90	25-40	6-15
Hayfield	11-24	Loam, silt loam, clay loam.	CL-ML, CL	A-4, A-6	0	95-100	90-100	70-90	65-80	25-40	6-15
	24-60	Coarse sand, gravelly coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-1	0-3	85-100	50-98	25-50	0-15	---	NP
728--------------	0-8	Loam-------------	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
Udolpho	8-19	Silt loam, loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	90-100	70-95	30-50	10-20
	19-28	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0-2	95-100	85-100	80-95	60-85	30-50	10-20
	28-60	Coarse sand, sand, gravelly coarse sand, very gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-3	45-90	35-85	20-45	0-10	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
775B, 775C--------- Billett	0-8	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0	100	100	85-100	25-50	<25	2-10
	8-24	Sandy loam, fine sandy loam.	SC-SM, SC	A-2, A-4, A-6	0-10	90-100	90-100	85-100	25-50	20-30	5-15
	24-54	Gravelly loamy coarse sand, sandy loam, loamy coarse sand.	SM, SC-SM, SC	A-2, A-4, A-6	0-10	75-100	75-100	75-90	20-45	15-30	3-15
	54-60	Loamy sand, sand, gravelly loamy coarse sand.	SM, SC-SM, SW-SM, SP-SM	A-2, A-1-b, A-3	0-10	80-100	75-100	40-95	10-30	<25	NP-5
776B, 776D2------ Lilah	0-10	Sandy loam-------	SC-SM, SC	A-2, A-4	0-5	90-95	80-90	60-70	25-40	<25	5-10
	10-30	Gravelly sandy loam, sand, very gravelly coarse sand.	SW, SW-SM, SP, SP-SM	A-1-b	0-10	70-90	50-90	30-50	3-12	---	NP
	30-60	Loamy sand, gravelly loamy sand, coarse sand.	GP, SP, GP-GM, SP-SM	A-1-b	0-10	50-100	40-100	30-50	3-12	---	NP
777, 777B-------- Wapsie	0-13	Loam-------------	CL, ML, CL-ML	A-4	0	100	90-100	70-90	50-75	25-35	5-10
	13-32	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	85-95	80-95	70-85	40-60	20-35	5-15
	32-60	Gravelly loamy sand, gravelly sand, gravelly coarse sand.	SW, SM, SP, SP-SM	A-1	0	60-90	60-85	20-40	3-25	---	NP
781B, 781C2------ Lourdes	0-8	Loam-------------	CL, ML	A-6, A-7	0	100	100	90-95	65-80	35-45	10-20
	8-20	Loam, clay loam	CL	A-6	0	100	95-100	80-90	50-70	30-40	10-20
	20-51	Clay loam--------	CL	A-6	2-5	90-95	85-95	80-90	55-70	35-40	15-20
	51-60	Clay loam--------	CL	A-6	2-5	90-95	85-95	80-90	55-70	35-40	15-20
782B, 782C2------ Donnan	0-11	Loam-------------	CL, ML	A-4, A-6	0	100	100	85-95	65-80	30-40	5-15
	11-28	Clay loam, silty clay loam, loam.	CL	A-6	0-5	95-100	90-95	80-90	60-75	30-40	10-20
	28-46	Clay, silty clay	CH	A-7	0-5	95-100	90-95	80-90	60-75	55-70	30-40
	46-60	Clay loam, loam	CL	A-6, A-7	2-5	95-100	85-95	80-90	55-75	35-45	15-25
783B, 783C, 783C2----------- Cresco	0-13	Loam-------------	CL	A-6	0	100	100	90-100	70-80	30-40	10-20
	13-25	Loam, clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-70	30-40	10-20
	25-44	Clay loam--------	CL	A-6	2-5	95-100	85-95	80-90	55-70	30-40	10-20
	44-60	Clay loam--------	CL	A-6	2-5	95-100	85-95	80-90	55-70	30-40	10-20
784B------------- Riceville	0-14	Loam-------------	CL	A-6, A-7	0	100	100	85-95	60-75	35-45	15-20
	14-60	Clay loam--------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
797-------------- Jameston	0-10	Silty clay loam	OL, MH, OH	A-7	0	100	100	85-95	70-80	45-55	15-20
	10-16	Silty clay loam, silt loam, loam.	CL	A-6, A-7	0	100	100	85-95	70-80	30-45	10-20
	16-49	Silty clay loam, loam, clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
	49-60	Clay loam--------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
798B------------- Protivin	0-15	Loam-------------	CL	A-7, A-6	0	100	100	85-95	60-75	30-45	10-25
	15-20	Loam, silt loam, silty clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	35-40	15-20
	20-60	Clay loam--------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
809C------------- Bertram	0-13	Sandy loam-------	SC-SM, SC, SM	A-2, A-4	0	100	95-100	85-95	30-50	25-35	5-10
	13-27	Sandy loam, fine sandy loam.	SC-SM, SC	A-2, A-4	0	100	95-100	80-90	25-40	15-25	5-10
	27-33	Sandy clay loam, clay loam.	SC, CL	A-6, A-7	0	85-95	80-90	70-80	45-65	35-45	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
1585*: Coland----------	0-8	Clay loam--------	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	8-58	Clay loam, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	65-80	35-50	15-25
	58-60	Loam, clay loam, silt loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	90-100	60-70	40-60	20-40	5-15
Spillville------	0-48	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	48-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SC-SM, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
1936*: Spillville------	0-48	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	48-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SC-SM, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
Udifluvents-----	0-60	Sandy loam-------	---	---	---	---	---	---	---	---	NP-15
	60-80	Variable---------	---	---	---	---	---	---	---	---	---
5010*. Pits, sand and gravel											
5030*. Pits, limestone quarries											
5040*------------ Orthents	0-60	Clay loam--------	---	---	---	---	---	---	---	---	15-30
	60-80	Variable---------	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	g/cc	In/hr	In/in	pH				
63C-------------- Chelsea	0-6	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2
	6-60	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-6.5	Low-----------	0.17		
83B, 83C--------- Kenyon	0-14	18-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	5	6
	14-53	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28		
	53-60	20-24	1.65-1.75	0.6-2.0	0.17-0.19	6.6-8.4	Low-----------	0.37		
83C2------------- Kenyon	0-14	18-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	5	6
	14-53	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28		
	53-60	20-24	1.65-1.75	0.6-2.0	0.17-0.19	6.6-8.4	Low-----------	0.37		
84--------------- Clyde	0-20	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate------	0.24	5	6
	20-36	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate------	0.37		
	36-40	10-22	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37		
	40-60	20-24	1.65-1.75	0.6-2.0	0.17-0.19	6.6-8.4	Moderate------	0.37		
135-------------- Coland	0-8	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24	5	6
	8-58	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24		
	58-60	12-35	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low-----------	0.28		
151-------------- Marshan	0-14	27-35	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.28	4	6
	14-23	25-35	1.40-1.55	0.6-2.0	0.17-0.22	5.6-7.3	Moderate------	0.28		
	23-26	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low-----------	0.28		
	26-60	0-5	1.55-1.65	6.0-20	0.02-0.05	6.1-7.3	Low-----------	0.15		
152-------------- Marshan	0-18	27-35	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.28	4	6
	18-34	25-35	1.40-1.55	0.6-2.0	0.17-0.22	5.6-7.3	Moderate------	0.28		
	34-38	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low-----------	0.28		
	38-60	0-5	1.55-1.65	6.0-20	0.02-0.05	6.1-7.3	Low-----------	0.15		
153-------------- Shandep	0-33	27-32	1.35-1.40	0.6-2.0	0.20-0.23	6.1-7.3	Moderate------	0.24	5	6
	33-49	26-32	1.40-1.60	0.6-2.0	0.17-0.20	6.1-7.3	Moderate------	0.24		
	49-60	2-8	1.60-1.70	6.0-20	0.02-0.04	6.1-8.4	Low-----------	0.15		
171B, 171C, 171C2----------- Bassett	0-13	18-25	1.45-1.50	0.6-2.0	0.19-0.21	5.1-7.3	Low-----------	0.28	5	6
	13-49	20-28	1.55-1.65	0.6-2.0	0.17-0.19	4.5-7.3	Low-----------	0.28		
	49-60	20-24	1.65-1.75	0.6-2.0	0.17-0.19	5.1-8.4	Low-----------	0.37		
173-------------- Hoopeston	0-12	8-18	1.35-1.70	2.0-6.0	0.12-0.15	5.1-6.5	Low-----------	0.20	4	3
	12-21	12-18	1.45-1.70	2.0-6.0	0.12-0.17	5.1-7.8	Low-----------	0.28		
	21-60	2-10	1.50-1.70	6.0-20	0.05-0.10	4.5-8.4	Low-----------	0.17		
175B, 175C------- Dickinson	0-8	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.20	4	3
	8-38	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low-----------	0.17		
	38-46	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low-----------	0.20		
	46-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-7.3	Low-----------	0.15		
177, 177B-------- Saude	0-13	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	4	6
	13-27	12-18	1.40-1.50	0.6-6.0	0.15-0.19	5.1-6.0	Low-----------	0.28		
	27-60	2-8	1.50-1.75	>20	0.02-0.06	5.1-6.5	Low-----------	0.10		
198B------------- Floyd	0-19	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24	5	6
	19-32	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low-----------	0.32		
	32-42	6-12	1.60-1.65	2.0-6.0	0.11-0.13	6.6-7.3	Low-----------	0.32		
	42-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.6-8.4	Low-----------	0.32		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
213B------------- Rockton	0-17	18-27	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.28	4	6
	17-31	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28		
	31-35	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High----------	0.28		
	35	---	---	2.0-20	---	---	-------------	----		
214B, 214C------- Rockton	0-14	18-27	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.28	4	6
	14-19	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28		
	19-24	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High----------	0.28		
	24	---	---	2.0-20	---	---	-------------	----		
221B------------- Palms	0-8	---	0.30-0.40	0.2-6.0	0.35-0.45	5.1-7.8	-------------	----	5	2
	8-34	---	0.15-0.30	0.2-6.0	0.35-0.45	5.1-7.8	-------------	----		
	34-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low-----------	0.37		
225-------------- Lawler	0-18	18-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	4	6
	18-26	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low-----------	0.28		
	26-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low-----------	0.10		
226-------------- Lawler	0-23	18-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	4	6
	23-33	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low-----------	0.28		
	33-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low-----------	0.10		
284, 284B, 284C-- Flagler	0-23	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low-----------	0.20	4	3
	23-33	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low-----------	0.20		
	33-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low-----------	0.20		
284C2------------ Flagler	0-7	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low-----------	0.20	4	3
	7-25	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low-----------	0.20		
	25-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low-----------	0.20		
285, 285B, 285D-- Burkhardt	0-10	5-13	1.35-1.55	2.0-6.0	0.11-0.15	5.1-6.5	Low-----------	0.20	3	3
	10-15	8-18	1.55-1.65	2.0-6.0	0.10-0.19	5.1-6.5	Low-----------	0.24		
	15-60	1-6	1.50-1.80	>6.0	0.02-0.04	5.6-6.5	Low-----------	0.10		
302B, 302C------- Coggon	0-18	18-24	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Low-----------	0.28	5	6
	18-45	22-28	1.50-1.70	0.6-2.0	0.17-0.19	4.5-6.0	Low-----------	0.32		
	45-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	5.1-7.8	Low-----------	0.32		
323B------------- Terril	0-35	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.24	5	6
	35-40	22-30	1.40-1.65	0.6-2.0	0.16-0.18	6.1-7.3	Low-----------	0.28		
	40-60	2-8	1.65-1.75	6.0-20	0.05-0.07	6.1-8.4	Low-----------	0.10		
391B*:										
Clyde-----------	0-20	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.24	5	6
	20-36	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37		
	36-40	10-22	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37		
	40-60	20-24	1.65-1.75	0.6-2.0	0.17-0.19	6.6-8.4	Moderate-----	0.37		
Floyd-----------	0-19	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6
	19-32	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low-----------	0.32		
	32-42	6-12	1.60-1.65	2.0-6.0	0.11-0.13	6.6-7.3	Low-----------	0.32		
	42-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.6-8.4	Low-----------	0.32		
394B, 394C, 394C2----------- Ostrander	0-16	18-27	1.45-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.28	5	6
	16-49	18-27	1.45-1.55	0.6-2.0	0.17-0.20	5.1-7.3	Low-----------	0.28		
	49-60	18-27	1.60-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.37		
398-------------- Tripoli	0-17	28-32	1.40-1.45	0.6-2.0	0.19-0.21	6.1-7.3	Moderate-----	0.24	5	6
	17-50	22-28	1.45-1.70	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.24		
	50-60	20-28	1.65-1.75	0.6-2.0	0.17-0.19	7.4-8.4	Low-----------	0.28		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	g/cc	In/hr	In/in	pH				
399, 399B-------- Readlyn	0-15	18-24	1.35-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.24	5	6
	15-42	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low-----------	0.32		
	42-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Low-----------	0.32		
407B------------- Schley	0-22	18-22	1.40-1.45	0.6-2.0	0.19-0.21	4.5-7.3	Moderate------	0.28	5	6
	22-36	18-28	1.45-1.65	0.6-2.0	0.12-0.16	4.5-5.5	Low-----------	0.32		
	36-60	20-28	1.65-1.80	0.6-2.0	0.16-0.18	5.1-7.8	Low-----------	0.32		
408B, 408C------- Olin	0-32	12-18	1.45-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	5	3
	32-42	20-28	1.50-1.70	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.37		
	42-60	20-28	1.65-1.75	0.6-2.0	0.17-0.19	6.1-8.4	Low-----------	0.37		
412C, 412E------- Emeline	0-6	12-27	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	Moderate------	0.28	1	4L
	6	---	---	<0.06	---	---	--------------	----		
457-------------- Du Page	0-54	18-27	1.40-1.60	0.6-2.0	0.22-0.24	6.6-8.4	Moderate------	0.28	5	6
	54-60	18-27	1.45-1.65	0.6-2.0	0.10-0.20	7.4-8.4	Low-----------	0.28		
471, 471B-------- Oran	0-14	16-24	1.40-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Low-----------	0.24	5	6
	14-49	22-30	1.45-1.70	0.6-2.0	0.17-0.19	4.5-6.5	Low-----------	0.32		
	49-60	20-26	1.65-1.75	0.6-2.0	0.17-0.19	7.4-7.8	Low-----------	0.37		
472-------------- Havana	0-7	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-6.5	Low-----------	0.32	5	6
	7-23	24-32	1.35-1.50	0.2-0.6	0.15-0.19	5.6-6.5	Moderate------	0.32		
	23-48	20-30	1.50-1.65	0.2-0.6	0.17-0.19	5.1-7.3	Moderate------	0.32		
	48-60	18-27	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low-----------	0.32		
482B, 482C2------ Racine	0-13	18-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.32	5	6
	13-40	18-32	1.55-1.65	0.6-2.0	0.15-0.19	4.5-6.0	Low-----------	0.32		
	40-60	18-27	1.65-1.80	0.6-2.0	0.16-0.19	6.6-7.8	Moderate------	0.32		
485-------------- Spillville	0-48	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate------	0.24	5	6
	48-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low-----------	0.28		
585*:										
Coland----------	0-8	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24	5	6
	8-58	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate------	0.24		
	58-60	12-35	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low-----------	0.28		
Spillville------	0-48	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate------	0.24	5	6
	48-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low-----------	0.28		
621B------------- Houghton	0-6	---	0.30-0.45	0.2-6.0	0.35-0.45	4.5-7.8	--------------	----	5	2
	6-60	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	--------------	----		
713B------------- Winneshiek	0-10	18-24	1.45-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Low-----------	0.24	4	6
	10-32	20-32	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.3	Low-----------	0.28		
	32-36	40-55	1.50-1.60	0.06-0.2	0.12-0.15	5.6-7.3	High----------	0.32		
	36	---	---	<0.06	---	---	--------------	----		
714B------------- Winneshiek	0-10	18-24	1.45-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Low-----------	0.24	4	6
	10-24	20-32	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.3	Low-----------	0.28		
	24-28	40-55	1.50-1.60	0.06-0.2	0.12-0.15	5.6-7.3	High----------	0.32		
	28	---	---	<0.06	---	---	--------------	----		
725-------------- Hayfield	0-11	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low-----------	0.32	4	6
	11-24	18-30	1.40-1.55	0.6-2.0	0.17-0.22	5.1-6.0	Low-----------	0.32		
	24-60	<5	1.55-1.65	6.0-20	0.02-0.04	5.6-7.8	Low-----------	0.15		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
728------------- Udolpho	0-8	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	4	6
	8-19	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.43		
	19-28	18-30	1.40-1.55	0.6-2.0	0.16-0.22	5.1-6.5	Low----------	0.37		
	28-60	0-5	1.55-1.65	6.0-20	0.02-0.08	5.6-7.8	Low----------	0.10		
775B, 775C------- Billett	0-8	7-15	1.45-1.65	2.0-6.0	0.14-0.16	5.6-7.8	Low----------	0.20	5	3
	8-24	10-18	1.40-1.70	2.0-6.0	0.10-0.15	5.1-7.3	Low----------	0.20		
	24-54	8-18	1.50-1.70	2.0-6.0	0.05-0.12	5.6-7.3	Low----------	0.20		
	54-60	2-7	1.60-1.70	6.0-20	0.02-0.10	5.1-7.8	Low----------	0.10		
776B, 776D2------ Lilah	0-10	8-16	1.50-1.55	2.0-6.0	0.11-0.13	5.1-7.3	Low----------	0.20	3	3
	10-30	2-10	1.55-1.80	>20	0.02-0.04	4.5-6.0	Low----------	0.10		
	30-60	2-6	1.55-1.85	>20	0.02-0.04	4.5-6.0	Low----------	0.10		
777, 777B-------- Wapsie	0-13	12-18	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Low----------	0.24	4	5
	13-32	12-22	1.45-1.50	0.6-2.0	0.15-0.17	5.1-6.0	Low----------	0.28		
	32-60	2-10	1.50-1.75	>20	0.02-0.06	5.1-7.3	Low----------	0.10		
781B, 781C2------ Lourdes	0-8	18-27	1.45-1.60	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28	5	6
	8-20	24-33	1.45-1.60	0.6-2.0	0.16-0.18	4.5-5.5	Low----------	0.32		
	20-51	30-35	1.45-1.60	0.2-0.6	0.15-0.17	4.5-7.3	Moderate-----	0.37		
	51-60	28-33	1.60-1.70	0.2-0.6	0.15-0.17	7.4-7.8	Moderate-----	0.37		
782B------------- Donnan	0-11	20-26	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.28	4	6
	11-28	20-30	1.45-1.55	0.6-2.0	0.17-0.19	5.1-5.5	Moderate-----	0.28		
	28-46	45-55	1.50-1.60	<0.06	0.11-0.14	5.1-6.5	High---------	0.28		
	46-60	24-32	1.60-1.70	0.2-0.6	0.17-0.19	5.1-6.5	Moderate-----	0.28		
782C2------------ Donnan	0-11	20-26	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.32	4	6
	11-28	20-32	1.45-1.55	0.6-2.0	0.17-0.19	5.1-5.5	Moderate-----	0.28		
	28-46	45-55	1.50-1.60	<0.06	0.11-0.14	5.1-6.5	High---------	0.28		
	46-60	24-32	1.60-1.70	0.2-0.6	0.17-0.19	5.1-6.5	Moderate-----	0.28		
783B, 783C, 783C2----------- Cresco	0-13	20-26	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.28	5	6
	13-25	20-32	1.50-1.60	0.6-2.0	0.15-0.17	5.1-5.5	Moderate-----	0.32		
	25-44	30-35	1.55-1.65	0.2-0.6	0.17-0.19	4.5-5.5	Moderate-----	0.37		
	44-60	28-35	1.55-1.65	0.2-0.6	0.17-0.19	6.1-8.4	Moderate-----	0.37		
784B------------- Riceville	0-14	22-27	1.45-1.50	0.6-2.0	0.18-0.20	4.5-7.3	Moderate-----	0.28	5	6
	14-60	30-35	1.70-1.85	0.2-0.6	0.05-0.10	4.5-7.8	Moderate-----	0.37		
797-------------- Jameston	0-10	27-30	1.40-1.45	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.37	5	7
	10-16	24-35	1.40-1.45	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.37		
	16-49	26-36	1.50-1.70	0.2-0.6	0.17-0.19	6.6-7.8	Moderate-----	0.37		
	49-60	30-35	1.75-1.85	0.2-0.6	0.05-0.10	7.4-8.4	Moderate-----	0.37		
798B------------- Protivin	0-15	20-30	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.28	5	6
	15-20	20-30	1.50-1.60	0.2-0.6	0.17-0.19	5.1-6.5	Moderate-----	0.37		
	20-60	28-35	1.60-1.70	0.2-0.6	0.15-0.17	5.6-7.8	Moderate-----	0.37		
809C------------- Bertram	0-13	8-15	1.50-1.55	2.0-6.0	0.12-0.14	6.1-7.3	Low----------	0.20	4	3
	13-27	12-18	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.0	Low----------	0.20		
	27-33	20-32	1.60-1.80	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
	33	---	---	<0.06	---	---	-------------	----		
1585*:										
Coland----------	0-8	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6
	8-58	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24		
	58-60	12-35	1.50-1.65	0.6-6.0	0.13-0.17	6.1-7.8	Low----------	0.28		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	g/cc	In/hr	In/in	pH				
1585*:										
Spillville------	0-48	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.24	5	6
	48-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28		
1936*:										
Spillville------	0-48	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.24	5	6
	48-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28		
Udifluvents-----	0-60	2-18	1.50-1.70	0.6-2.0	0.08-0.14	---	Low----------	0.24	5	3
	60-80	---	---	0.06-2.0	---	---	-------------	----		
5010*. Pits, sand and gravel										
5030*. Pits, limestone quarries										
5040*------------ Orthents	0-60	18-35	1.45-1.65	0.06-2.0	0.12-0.18	---	Moderate-----	0.32	5	6
	60-80	---	---	0.06-2.0	---	---	-------------	----		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
63C-------------- Chelsea	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
83B, 83C, 83C2---- Kenyon	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
84--------------- Clyde	B/D	None--------	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
135-------------- Coland	B/D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
151, 152---------- Marshan	B/D	None--------	---	---	0.5-2.5	Apparent	Oct-Jun	>60	---	High-----	High-----	Moderate.
153-------------- Shandep	B/D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Moderate.
171B, 171C, 171C2- Bassett	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
173-------------- Hoopeston	B	None--------	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	Low------	Moderate.
175B, 175C-------- Dickinson	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
177, 177B--------- Saude	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
198B-------------- Floyd	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
213B, 214B, 214C-- Rockton	B	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	Low------	Low.
221B-------------- Palms	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
225, 226---------- Lawler	B	None--------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
284, 284B, 284C, 284C2------------ Flagler	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
285, 285B, 285D: Burkhardt	B	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
302B, 302C: Coggon	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
323B: Terril	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
391B*:												
Clyde	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High	High	Low.
Floyd	B	None	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High	High	Low.
394B, 394C, 394C2: Ostrander	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
398: Tripoli	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
399, 399B: Readlyn	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
407B: Schley	B	None	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	High.
408B, 408C: Olin	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
412C, 412E: Emeline	D	None	---	---	>6.0	---	---	4-12	Hard	Moderate	Low	Low.
457: Du Page	B	Occasional	Brief	Apr-Jun	4.0-6.0	Apparent	Feb-Jun	>60	---	Moderate	Low	Low.
471, 471B: Oran	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
472: Havana	B	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High	High	Moderate.
482B, 482C2: Racine	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
485: Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
585*:												
Coland	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
585*:												
Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
621B Houghton	A/D	None	---	---	0-1.0	Apparent	Sep-Jun	>60	---	High	High	Moderate.
713B, 714B Winneshiek	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Moderate.
725 Hayfield	B	None	---	---	2.5-5.0	Apparent	Nov-Jun	>60	---	High	Low	Moderate.
728 Udolpho	B/D	None	---	---	1.0-3.0	Apparent	Oct-Jun	>60	---	High	High	Moderate.
775B, 775C Billett	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
776B, 776D2 Lilah	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
777, 777B Wapsie	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
781B, 781C2 Lourdes	C	None	---	---	3.0-5.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
782B, 782C2 Donnan	C	None	---	---	2.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
783B, 783C, 783C2 Cresco	C	None	---	---	3.0-5.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
784B Riceville	C	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
797 Jameston	C/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
798B Protivin	C	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
809C Bertram	B	None	---	---	>6.0	---	---	20-36	Hard	Moderate	Low	Moderate.
1585*:												
Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
Spillville	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1936*:												
Spillville	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
Udifluvents	---	Frequent	Brief to very long.	Jan-Dec	>6.0	---	---	>60	---	---	---	---
5010*. Pits, sand and gravel												
5030*. Pits, limestone quarries												
5040* Orthents	---	None	---	---	>6.0	---	---	>60	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bassett	Fine-loamy, mixed, mesic Mollic Hapludalfs
Bertram	Coarse-loamy, mixed, mesic Typic Hapludolls
Billett	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Burkhardt	Sandy, mixed, mesic Typic Hapludolls
Chelsea	Mixed, mesic Alfic Udipsamments
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Coggon	Fine-loamy, mixed, mesic Typic Hapludalfs
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Cresco	Fine-loamy, mixed, mesic Typic Argiudolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Donnan	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Du Page	Fine-loamy, mixed, mesic Cumulic Hapludolls
Emeline	Loamy, mixed, mesic Lithic Hapludolls
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Havana	Fine-loamy, mixed, mesic Mollic Ochraqualfs
Hayfield	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquollic Hapludalfs
Hoopeston	Coarse-loamy, mixed, mesic Aquic Hapludolls
Houghton	Euic, mesic Typic Medisaprists
Jameston	Fine-loamy, mixed, mesic Typic Argiaquolls
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Lilah	Sandy, mixed, mesic Psammentic Hapludalfs
Lourdes	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Olin	Coarse-loamy, mixed, mesic Typic Hapludolls
Oran	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Orthents	Orthents
Ostrander	Fine-loamy, mixed, mesic Typic Hapludolls
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Protivin	Fine-loamy, mixed, mesic Aquic Argiudolls
Racine	Fine-loamy, mixed, mesic Mollic Hapludalfs
Readlyn	Fine-loamy, mixed, mesic Aquic Hapludolls
Riceville	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Schley	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Shandep	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tripoli	Fine-loamy, mixed, mesic Typic Haplaquolls
Udifluvents	Udifluvents
Udolpho	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Ochraqualfs
Wapsie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Winneshiek	Fine-loamy, mixed, mesic Mollic Hapludalfs

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