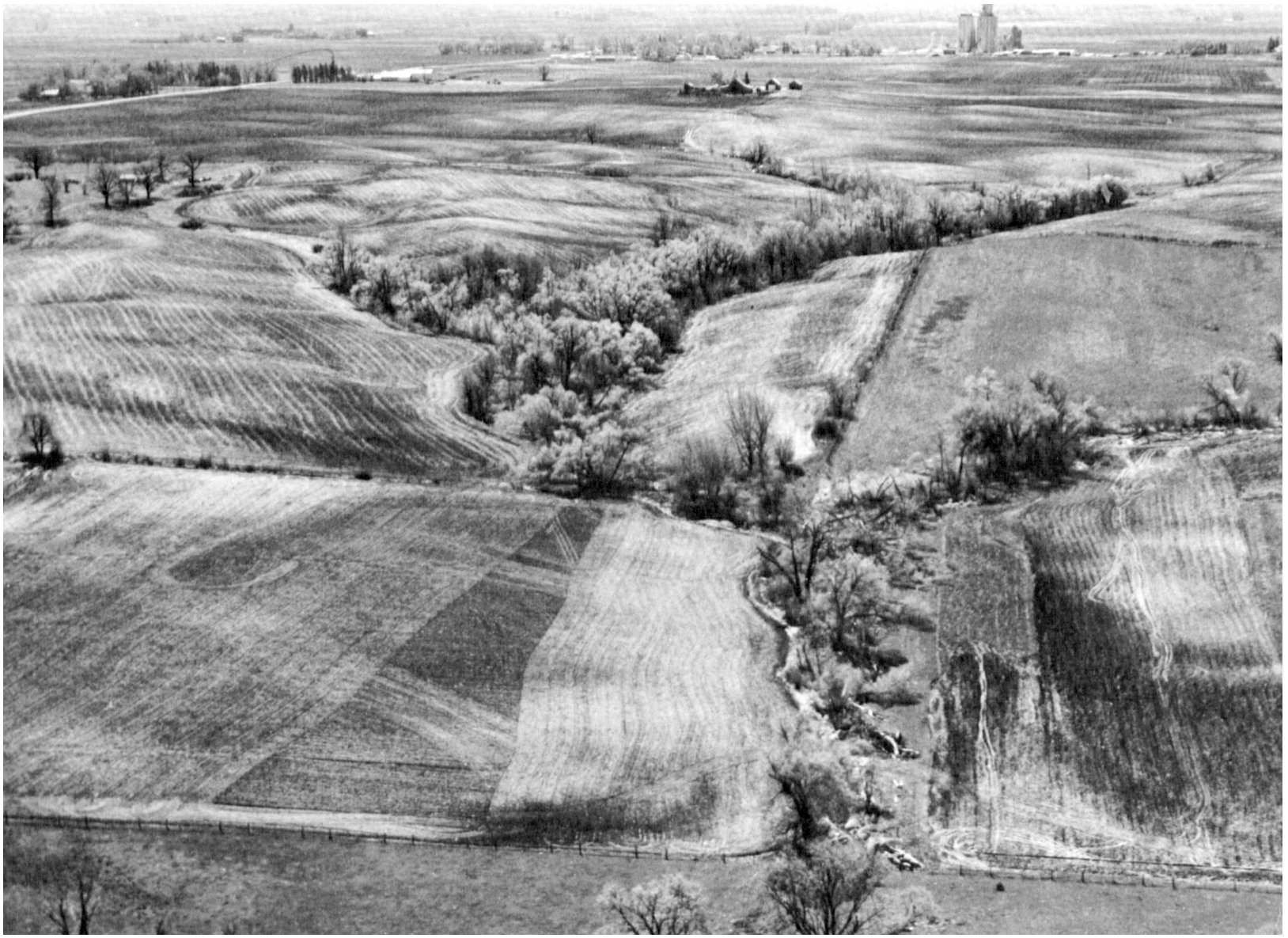
SOIL SURVEY OF

FRANKLIN COUNTY, IOWA



United States Department of Agriculture
Soil Conservation Service
In cooperation with the
Iowa Agriculture and Home Economics Experiment Station, and the
Cooperative Extension Service, Iowa State University, and the
Department of Soil Conservation, State of Iowa

HOW TO USE

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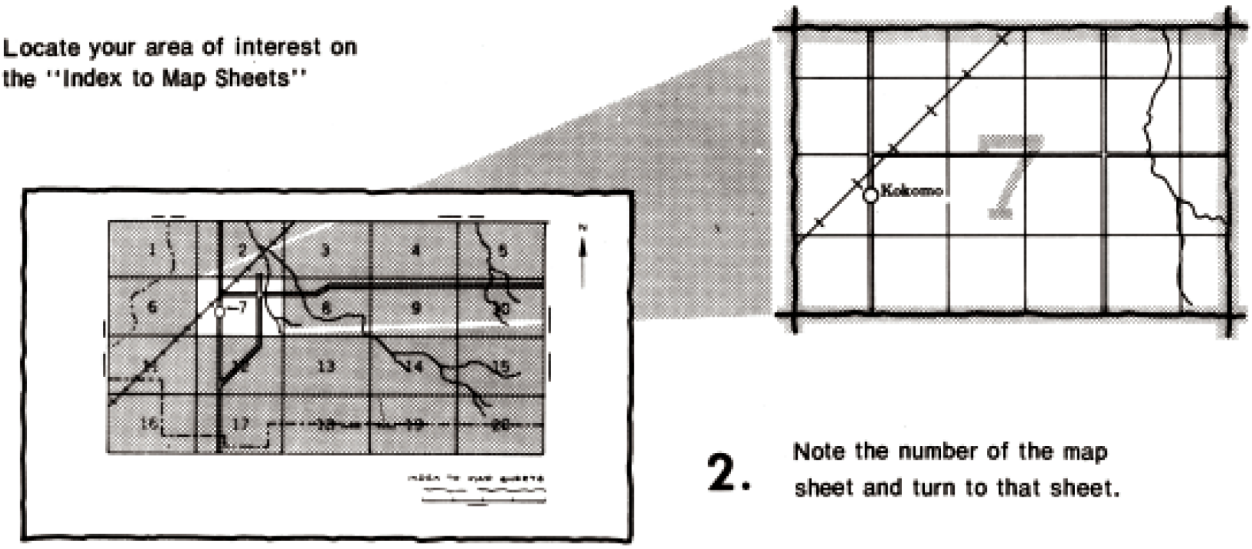

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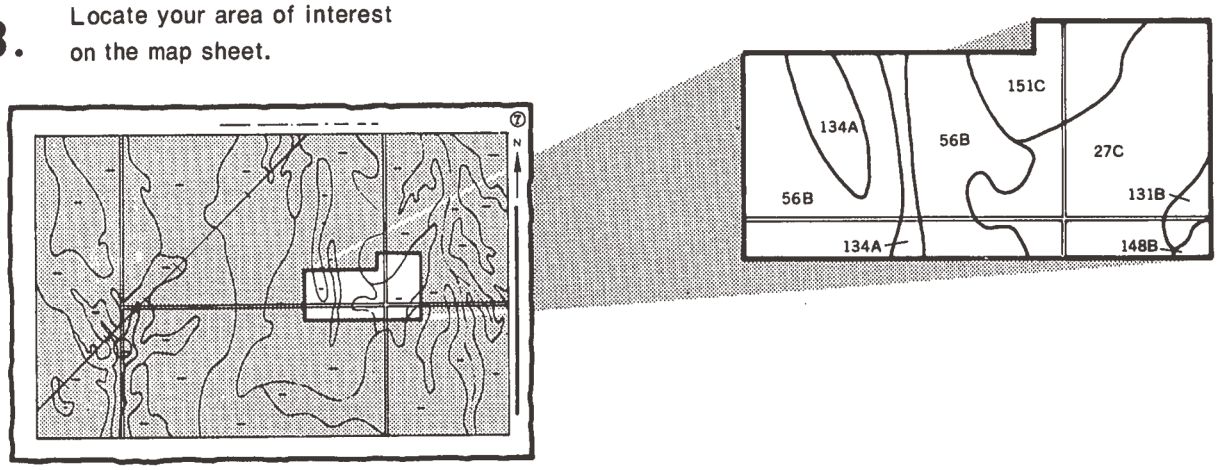

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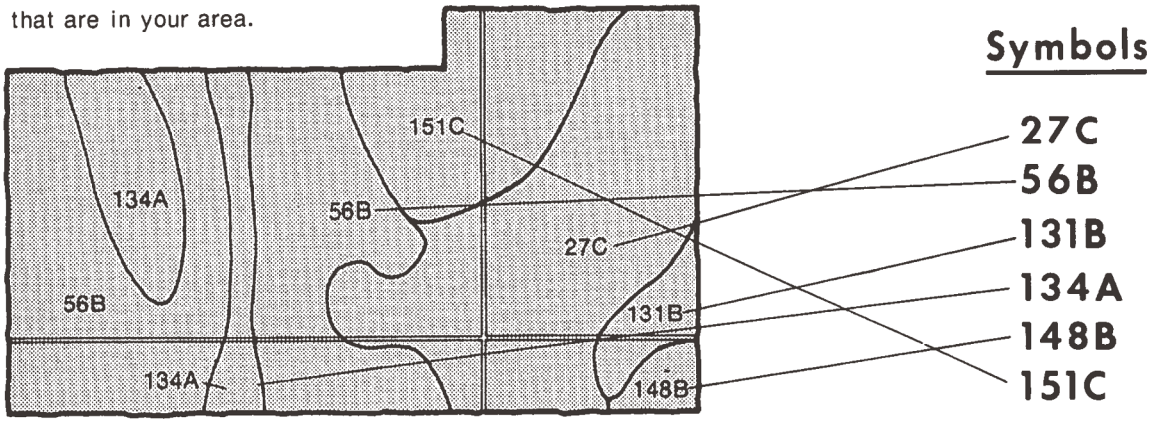
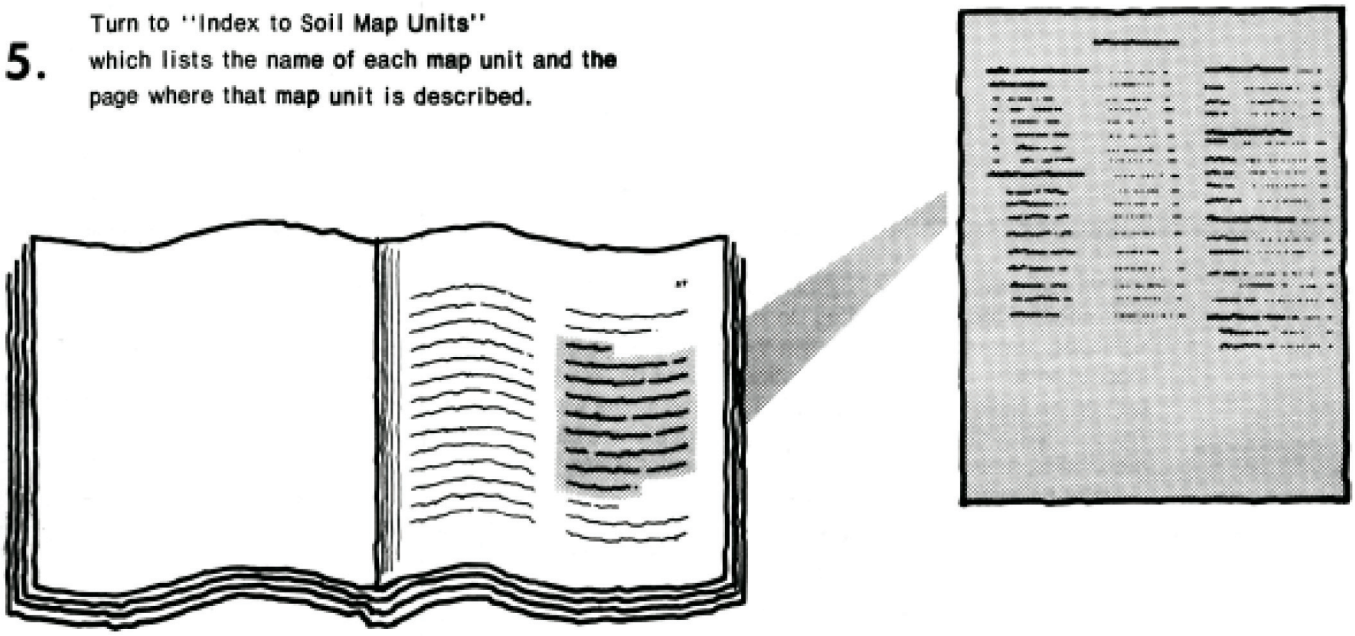
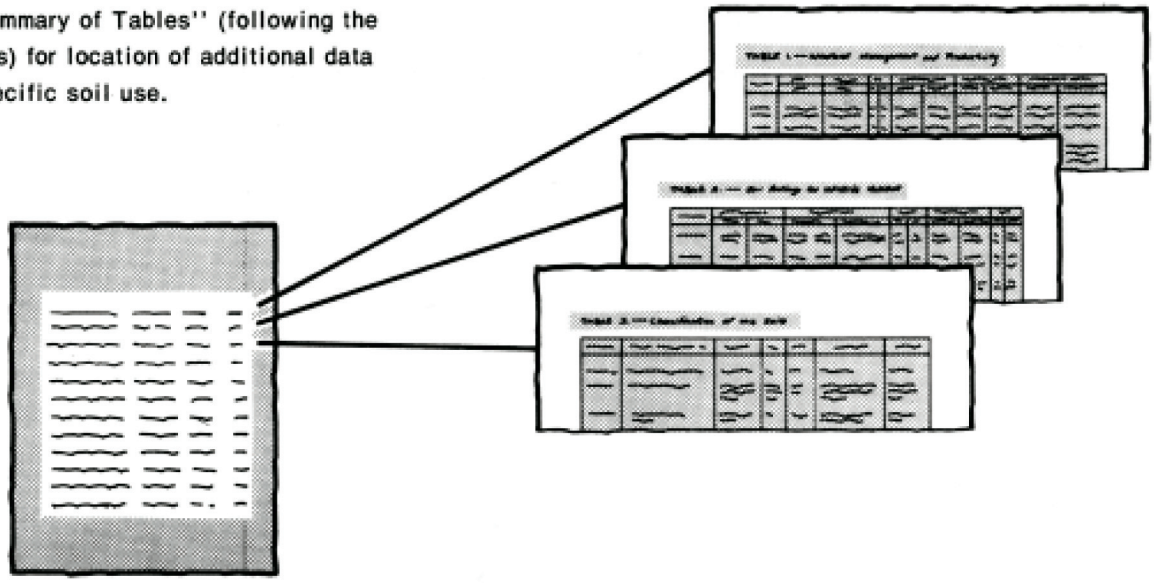


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1971-75. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station; Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Franklin County Soil Conservation District. Funds appropriated by Franklin County were used to defray part of the cost of this 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.

Cover: Moderately sloping to steep areas of Lester soils and Storden soils in the Clarion-Storden-Lester association.

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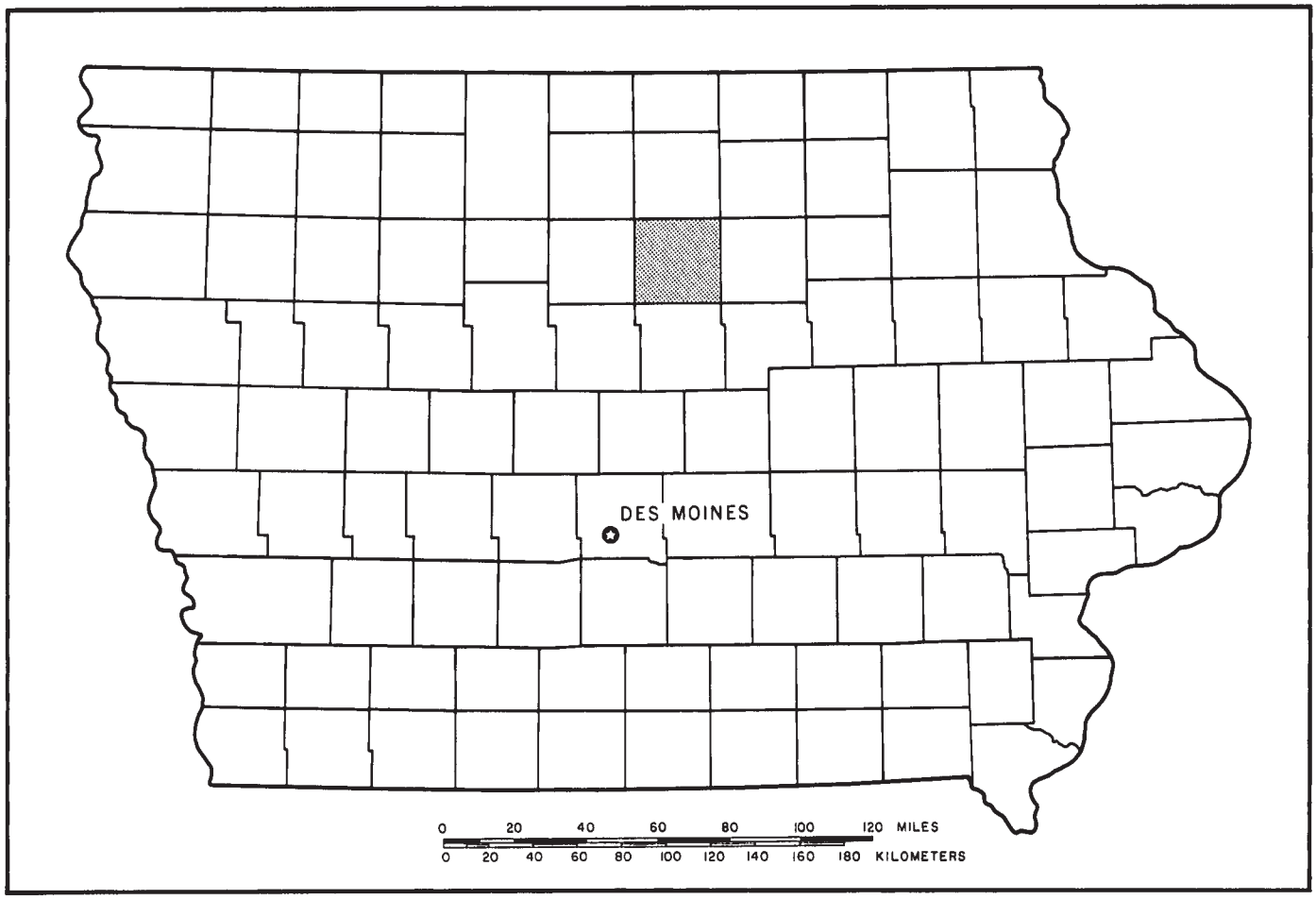
Preface

This soil survey contains information that can be used in land-planning programs in Franklin 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 insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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



Location of Franklin County in Iowa.

SOIL SURVEY OF FRANKLIN COUNTY, IOWA

BY KERMIT D. VOY, SOIL CONSERVATION SERVICE

FIELDWORK BY KERMIT D. VOY, NORMAN L. JOHNSON, THOMAS J. O'CONNOR, AND DARRYL L. TRICKLER
SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
IN COOPERATION WITH THE IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
AND THE COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
AND THE DEPARTMENT OF SOIL CONSERVATION, STATE OF IOWA

Franklin County is in north-central Iowa. It has a total of 375,040 acres. Hampton, the county seat, is near the center of the county. It had a population of 4,450 in 1970.

Farming is the main enterprise in Franklin County. The principal crops are corn, soybeans, oats, hay, and pasture. Corn and soybeans are the principal row crops. The raising of hogs and the feeding of beef cattle are the principal livestock enterprises.

Most of the soils in Franklin County formed under prairie vegetation, and they are dark and fertile. The soils near some of the streams formed under trees and are lighter colored. The climate is subhumid and continental. Winters are cold, summers are warm, and the growing season is long enough for crops to mature.

General nature of the county

This section gives general information concerning the county. It includes a brief discussion of the history, relief and drainage, climate, farming, and transportation in the county.

History

The first settlers came into the territory now occupied by Franklin County about 1850, and the county was organized in 1855. At the time of settlement much of the county was covered with native prairie with woods along the rivers and streams. Much of the prairie in the western half of the county was interspersed with marsh and shallow ponds. With increased agricultural development, drainage ditches and large tile systems drained the marshes, and today nearly all of this area is suitable for grain production. Much of the original woodland, which was located in the eastern part of Franklin County, has been removed over the years. In recent years more and more of this land, too, has been used for grain production and pasture.

Relief and drainage

Most of the soils in Franklin County are nearly level to gently sloping or moderately sloping. Small areas of moderately sloping to steep soils occur throughout the county except in the northwestern part. Larger areas of steeper soils are along Maynes Creek, southeast of Dows, and north and northeast of Hansell.

The West Fork of the Cedar River and its tributaries drain much of Franklin County. A small part of southeastern Franklin County is drained by Beaver Creek. The Iowa River and its tributaries drain the southwestern and far western parts of the county.

The soils in about 38 percent of Franklin County are poorly drained or very poorly drained. Some of these soils, particularly in the western half of the county, formed in old lakebeds or swamp basins that have little natural drainage. In these areas, drainage ditches provide outlets for drains installed underground. Many of the naturally poorly drained and very poorly drained soils throughout the county have been drained sufficiently for crop production. Other areas have insufficient underground and surface drainage for wetter-than-average years, and crops are sometimes damaged. With the increased size of farm machinery, wetness becomes more of a problem in tillage. For this reason, some of the previously drained areas need additional subsurface drainage to speed up soil drying following prolonged wet seasons.

Climate

Franklin County is cold in winter and is quite hot with occasional cool spells in summer. Precipitation during the winter frequently occurs as snowstorms. During the warm months it is chiefly showers, often heavy, when warm moist air moves in from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grains.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Hampton, Iowa, for

the period 1951 to 1973. 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 19 degrees F, and the average daily minimum is 10 degrees. The lowest temperature on record, -35 degrees, occurred in Hampton on March 1, 1962. In summer the average temperature is 70 degrees, and the average daily maximum is 82 degrees. The highest temperature, 103 degrees, was recorded on August 21, 1955.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, 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.

Of the total annual precipitation, 25 inches, or 74 percent, usually falls during the period April through September, which includes the growing season for most crops. Two years in 10, the April-September rainfall is less than 20 inches. The heaviest 1-day rainfall during the period of record was 6.47 inches at Hampton on July 17, 1968. Thunderstorms number about 41 each year, 22 of which occur in summer.

Average seasonal snowfall is 36 inches. The greatest snow depth at any one time during the period of record was 31 inches. On the average, 35 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night in all seasons, and the average at dawn is about 84 percent. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in April.

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

Farming

Most of Franklin County is farmland. The land is used mainly for corn and soybeans but some acreage is in pasture, oats, hay, sweet corn, or woodland. Soybeans and an increasing amount of corn are sold as cash crops. The principal livestock enterprises are raising hogs and feeding beef cattle.

The trend in recent years has been toward a decrease in the number of farms in the county and an increase in their size. The county had a total of 1,040 farms in 1976 according to the 1976 Assessors Annual Farm Census of Iowa. The average size farm was 315 acres.

Transportation

Federal, state, and county highways throughout the county provide routes for auto traffic and for the transportation of farm products. Interstate Highway 35 enters the county from the west just above the southwest corner and proceeds in a generally northerly direction. The county is bisected north to south by U.S. Highway 65 and west to east by Iowa Highway 3. The many graveled and asphalt county roads enable farmers to come to trading centers throughout the year. Railroads or motor freight lines serve every trading center in the county.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each association on the general soil map is a unique natural landscape. Typically, it 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 others 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Nicollet-Canisteo-Webster association

Depressional and nearly level, somewhat poorly drained and poorly drained soils that formed in glacial drift; on uplands

This association is dominantly nearly level soils on broad upland flats. The flats have intermittent depressions that range from a fraction of an acre to 80 acres. The nearly level soils are intermingled with gently sloping soils on ridges throughout the association. Because the association does not have a natural drainage system, manmade ditches are common. Much of the area was marsh and intermittent ponds before artificial drainage was installed.

The soil association makes up about 19 percent of the county. About 22 percent of the association is Nicollet soils, 20 percent is Canisteo soils, 18 percent is Webster soils, and 40 percent is minor soils.

The Nicollet soils are nearly level and are somewhat poorly drained. They have a thick surface layer of black and very dark gray loam. The subsoil is dark grayish brown and grayish brown loam. The Nicollet soils are on low ridges and the lower parts of side slopes.

The Canisteo soils are level and are poorly drained. They have a thick surface layer of black silty clay loam that is calcareous. The subsoil is olive gray and dark gray loam and clay loam. These soils occupy large upland flats, low-gradient waterways, and rims of many of the depressions.

The Webster soils are level or nearly level and are poorly drained. They have a surface layer of thick, black silty clay loam. The subsoil is olive gray and dark gray loam, clay loam, and silty clay loam. The Webster soils are on upland flats and in swales.

The most extensive minor soils in this association are in the Okoboji, Harps, Clarion, and Houghton series. They all formed in glacial sediments or glacial till, except for the Houghton soils, which formed in decomposed organic material.

The Okoboji soils are very poorly drained and occupy depressions (fig. 1). Harps soils are poorly drained and highly calcareous. They are on rims and flats adjacent to depressions. The Houghton soils are very poorly drained and formed in deep organic deposits in some of the large depressions. The Clarion soils are well drained and are on ridges and knolls.

Nearly all of this association is used for cultivated crops. The soils are very well suited to row crops if drainage is adequate. The principal management need is to get rid of excess water. A combination of tile and ditches is used for this purpose. Most of the soils are wet unless drains have been installed, and the soils in depressions are often ponded unless an outlet has been provided. Maintaining fertility is a problem on the Canisteo and Harps soils, which are high in content of lime.

2. Clarion-Nicollet-Webster association

Level to moderately sloping, well drained, somewhat poorly drained, and poorly drained soils that formed in glacial drift; on uplands

This association is dominantly nearly level and gently sloping soils intermingled with moderately sloping soils on ridges (fig. 2). A few areas are strongly sloping. Some areas have intermittent depressions that range from a fraction of an acre to several acres. Many of the poorly drained areas were intermittent ponds before artificial drainage was installed.

This association makes up about 31 percent of the county. About 55 percent of the association is Clarion soils, 16 percent is Nicollet soils, 11 percent is Webster soils, and about 18 percent is minor soils.

The Clarion soils typically are gently sloping, but moderate slopes are common. They are well drained. The gently sloping areas have a thick, black and very dark grayish brown, loam surface layer. Moderately sloping areas have a moderately thick, very dark brown loam surface layer. The loamy subsoil is brown. The Clarion soils are on upland ridge crests and side slopes.

The Nicollet soils are nearly level and are somewhat poorly drained. They have a thick, black and very dark gray loam surface layer. The loamy subsoil is dark grayish brown and grayish brown. These soils are on low ridges and the lower parts of side slopes.

The Webster soils are level or nearly level and are poorly drained. They have a surface layer of thick, black silty clay loam. The subsoil is mottled olive gray and dark gray loam, clay loam, and silty clay loam. The Webster soils are on upland flats and in swales.

The most extensive minor soils in this association are Okoboji, Harps, and Canisteo soils. They formed in sediments derived from glacial till.

The Okoboji soils are very poorly drained and occupy depressions. The Harps soils are poorly drained and

Figure 1.—Dark colored Okoboji soils and Harps soils in the Nicollet-Canisteo-Webster association.

highly calcareous. They are on rims and flats adjacent to depressions. The Canisteo soils are calcareous and are poorly drained. They are on upland flats and in low-gradient swales.

Nearly all of this association is used for cultivated crops. Most of these soils are very well suited to row crops. The principal management needs are erosion control on the sloping soils and drainage of wet soils. Maintaining fertility is a problem on the Harps and Canisteo soils, which are high in lime.

3. Clarion-Storden-Lester association

Moderately sloping to steep, well drained soils that formed in glacial drift; on uplands

This association is dominantly strongly sloping to steep soils on knobs, ridges, and side slopes. These soils are intermingled with moderately sloping, well drained soils and with nearly level wet soils in narrow valleys and potholes.

This association makes up about 3 percent of the county. About 35 percent of the association is Clarion soils, 20 percent is Storden soils, 10 percent is Lester soils, and 35 percent is minor soils.

The Clarion soils are moderately to strongly sloping and well drained. They have a surface layer of moderately thick, very dark brown loam. The subsoil is brown loam. The Clarion soils are on upland ridge crests and side slopes.

The Storden soils are moderately sloping to moderately steep and well drained. They have a surface layer of dark grayish brown loam over a substratum of multicolored loam. The Storden soils are calcareous throughout. They are on upland knobs and side slopes.

The Lester soils are moderately sloping to steep and well drained. They have a surface and subsurface layer of moderately thick, dark grayish brown and very dark grayish brown loam. The multicolored subsoil is loam and clay loam. They are on moderately sloping ridge crests and strongly sloping to steep side slopes.

The most extensive minor soils in this association are Zenor, Coland, and Terril soils. Zenor soils formed in loamy and sandy glacial drift. Coland and Terril soils formed in loamy alluvial sediments.

Zenor soils occupy knobs, ridge crests, and side slopes and are somewhat excessively drained. Coland soils are along small streams and drainageways. They are poorly drained. Terril soils are in upland drainageways and on foot slopes. They are moderately well drained.

The soils of this association are mainly used for cultivated crops. Many of the steeper soils along the creeks are wooded. Other steep soils are used for pasture and hay. These soils are not as well suited to row crops as those in other associations. Fields are often small and irregular in shape. The principal management needs are erosion control on the sloping, cultivated soils and drainage in the often wet, narrow valleys and waterways.

4. Dinsdale-Klinger-Maxfield association

Nearly level to moderately sloping, well drained to poorly drained soils that formed in loess and the underlying glacial till; on uplands

This association is dominantly gently sloping and nearly level. The gently sloping soils are on ridges, and the nearly level soils are on broad upland flats and in low-gradient waterways. Together they form a drain pattern. Moderately sloping soils on ridges are intermingled in some areas of the association.

This soil association makes up about 22 percent of the county. About 55 percent of the association is made up of Dinsdale soils, 21 percent is Klinger soils, 9 percent is Maxfield soils, and 15 percent is minor soils (fig. 3).

The Dinsdale soils are nearly level to moderately sloping and well drained or moderately well drained. They have a surface layer of very dark brown silty clay loam except where eroded. The subsoil is brown silty clay loam in the upper part and yellowish brown and light olive brown loam in the lower part. The Dinsdale soils are on upland flats, ridge crests, and side slopes.

The Klinger soils are nearly level and are somewhat poorly drained. They have a thick, black silty clay loam

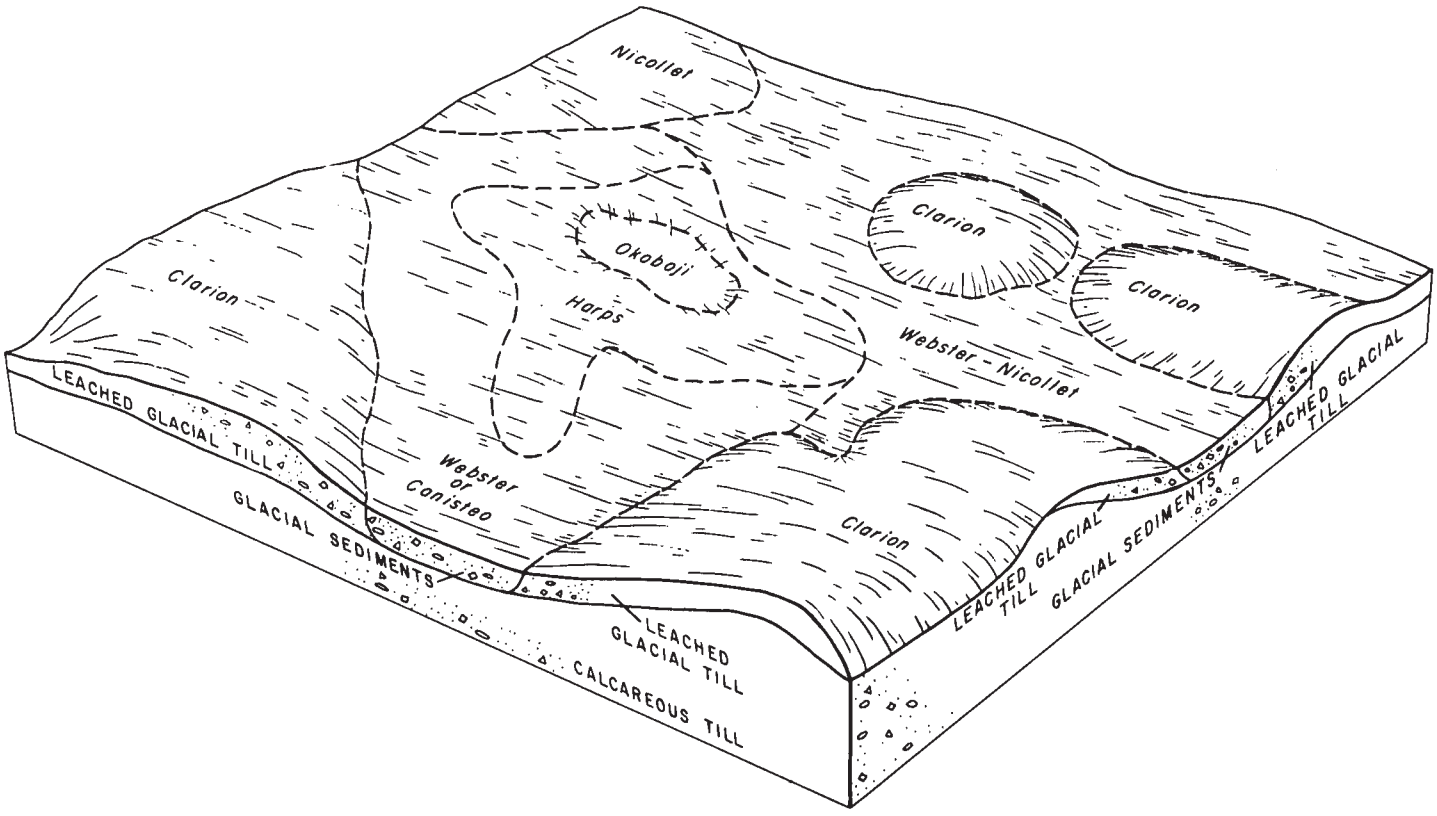


Figure 2.—Typical pattern of soils and parent material in the Clarion-Nicollet-Webster association.

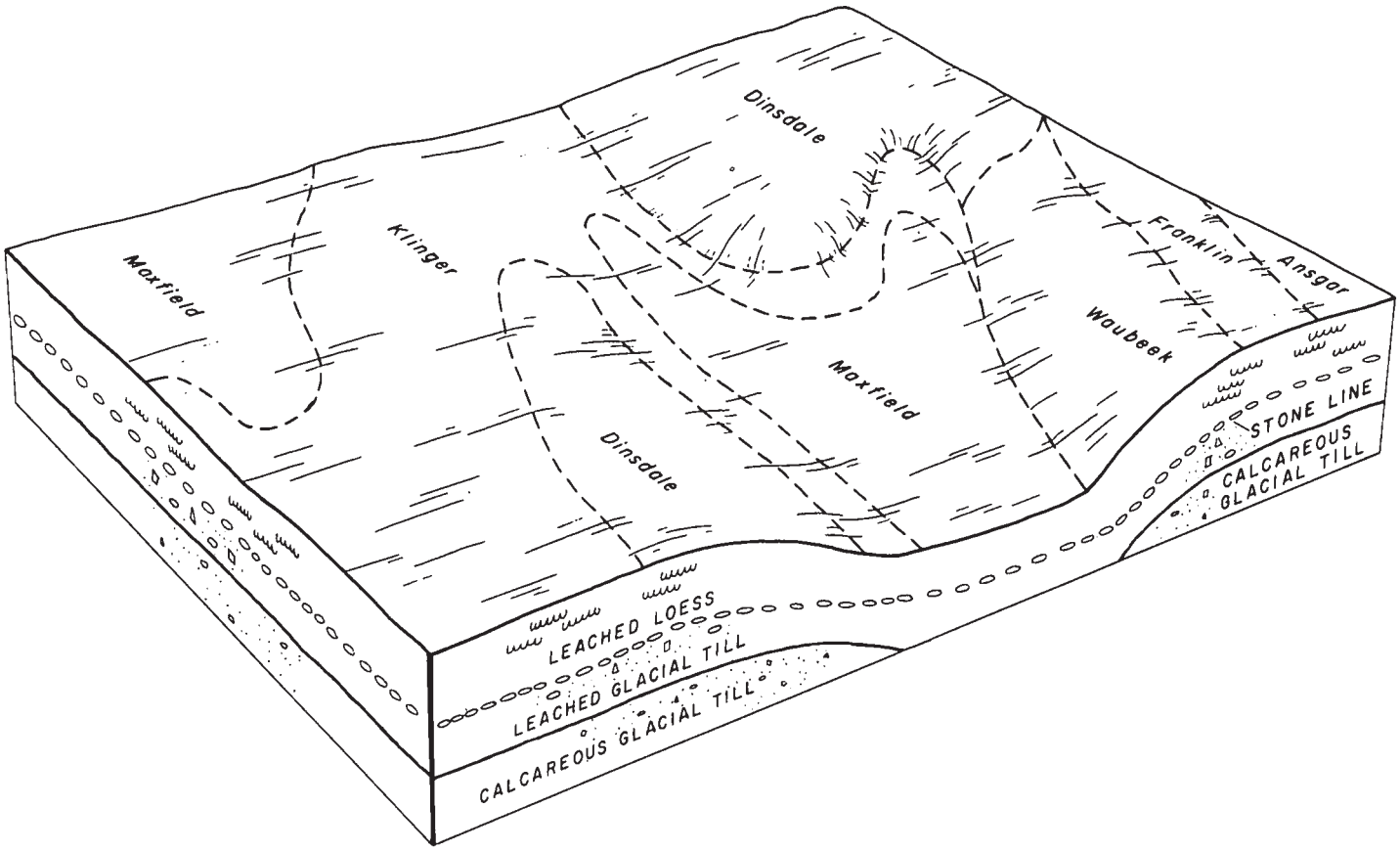


Figure 3.—Typical pattern of soils and parent material in the Dinsdale-Klinger-Maxfield association.

surface layer. The subsoil is grayish brown, dark grayish brown, and light olive brown silty clay loam in the upper part and light olive brown loam in the lower part. The Klinger soils are on broad upland ridges and low-gradient side slopes and at the heads of upland waterways.

The Maxfield soils are level and poorly drained. They have a thick, black silty clay loam surface layer. The subsoil is olive gray and grayish brown silty clay loam in the upper part and multicolored mottled loam in the lower part. The soils are on flats and in shallow drainageways in the uplands.

The most extensive minor soils in this association are Garwin, Muscatine, Waubeek, Ansgar, Franklin, and Kenyon soils. The Muscatine and Garwin soils formed in loess. The Waubeek, Ansgar, and Franklin soils formed in loess and the underlying glacial till. Kenyon soils formed in loamy sediments and the underlying glacial till.

Garwin soils occupy flats and low-gradient swales in the uplands and are poorly drained. Muscatine soils are on low ridges and the lower side slopes in the uplands and are somewhat poorly drained. Waubeek soils occupy ridge crests and side slopes on uplands and are well drained or moderately well drained. Ansgar soils are on flats and on the upper part of drainageways. They are poorly drained. Franklin soils are on ridges, heads of drainageways and side slopes and are somewhat poorly drained. Kenyon soils occupy ridge crests and side slopes and are moderately well drained.

Nearly all of this association is used for cultivated crops. The soils are very well suited to row crops. The principal management needs are erosion control on the sloping soils and tile drainage of the wet soils.

5. Coland-Marshan-Lawler association

Level and nearly level, poorly drained and somewhat poorly drained soils formed in loamy alluvial sediments underlain by sandy and gravelly sediments; on flood plains and benches

This association consists of level and nearly level soils on flood plains and benches that are underlain by sand and gravel at a depth of 2 to 5 feet. Narrow terrace escarpments that occur where the benches join the flood plains have steeper slopes and are shallower to the sand and gravel deposits (fig. 4). Most of the sand and

gravel pits in the county are on the benches in this association.

This soil association makes up about 14 percent of the county. About 23 percent of the association is Coland soils, 23 percent is Marshan soils, 19 percent is Lawler soils, and about 35 percent is minor soils.

The Coland soils are level and nearly level and are poorly drained. They have a surface layer of very thick, black clay loam. The Coland soils are on flood plains along the major streams and in the tributary valleys.

The Marshan soils are nearly level and poorly drained. They have a surface layer of very dark gray and black clay loam. The subsoil is olive gray clay loam. The Marshan soils are on the stream benches.

The Lawler soils are nearly level and somewhat poorly drained. They have a surface layer of black loam. The loam and sandy clay loam subsoil is brown, dark brown, and dark grayish brown. The Lawler soils are on stream benches.

The most extensive minor soils in this association are in the Saude, Sawmill, Turlin, Shandep, Talcot, Harcot, and Waukee series. They all formed in alluvial sediments.

Saude soils occupy broad terrace flats and a few gently to moderately sloping terrace ridges and are well drained. Many of the sand and gravel pits in the county are in Saude soils. Sawmill soils are on low benches and on flood plains of small streams and are poorly drained. Waukee soils occupy terrace flats and side slopes and are well drained. Turlin soils are on flood plains and are somewhat poorly drained. Shandep soils are in depressional areas on benches and are very poorly drained. Talcot and Harcot soils are poorly drained, are calcareous, and are on benches.

The soils of this association, except on the frequently flooded stream bottoms, are mostly used for cultivated crops. They are suited to this use. The principal management needs are drainage, flood protection, or both, on the wet soils. Some of the soils have moderate to low available water capacity and are slightly droughty unless summer rains are frequent.

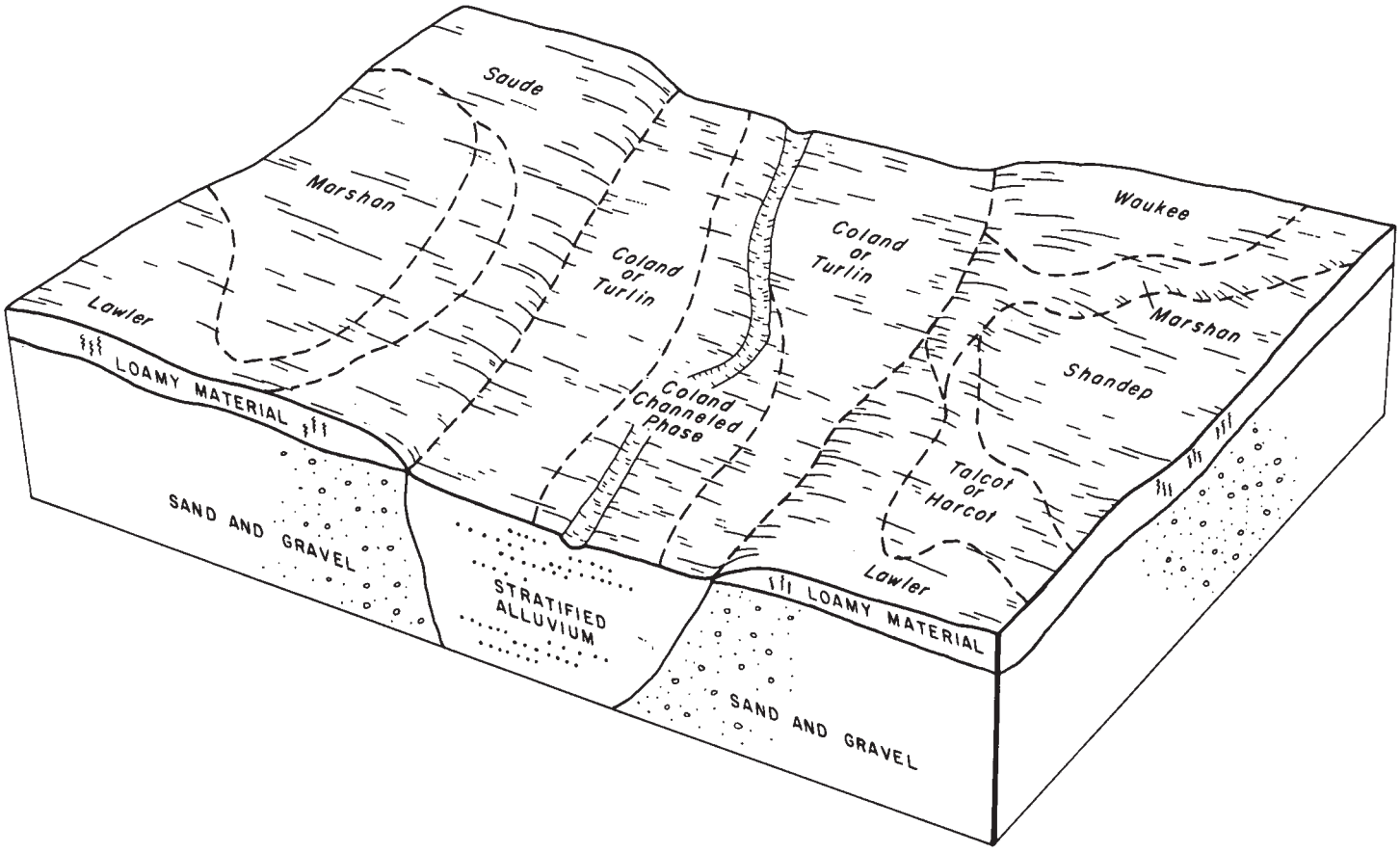


Figure 4.—Typical pattern of soils and parent material in the Coland-Marshan-Lawler association.

6. Floyd-Aredale-Kenyon association

Nearly level to moderately sloping, well drained to somewhat poorly drained soils that formed in loamy material and the underlying glacial till; on uplands

This association is dominantly one of gently sloping soils on ridges and nearly level soils on broad upland flats and in low-gradient swales. Moderately sloping soils on side slopes occur in many areas where this association joins the Dinsdale-Klinger-Maxfield association.

This soil association makes up about 6 percent of the county. About 22 percent is made up of Floyd soils, 20 percent is Aredale soils, 18 percent is Kenyon soils, and 40 percent is minor soils (fig. 5).

The Floyd soils are nearly level and gently sloping and are somewhat poorly drained. They have a surface layer of black loam. The subsoil is dark grayish brown loam and sandy clay loam in the upper part and mottled grayish brown and yellowish brown loam in the lower part. Floyd soils are on foot slopes below Aredale, Kenyon, and other soils.

The Aredale soils are nearly level to moderately sloping and well drained. They have a surface layer of black and very dark brown loam except where eroded. The subsoil is brown, pale brown, and yellowish brown loam and sandy loam. The Aredale soils are on upland flats, ridge crests, and side slopes.

The Kenyon soils are mainly gently to moderately sloping. Kenyon soils are moderately well drained. They have a black and very dark brown loam surface layer except where eroded. The subsoil is multicolored loam and sandy clay loam. The Kenyon soils are on upland ridge crests and side slopes.

The most extensive minor soils in this association are Bolan, Clyde, Dickinson, Schley, and Readlyn soils. The Bolan and Dickinson soils formed in wind-deposited sediments. The Clyde, Schley, and Readlyn soils formed in loamy material and the underlying glacial sediments.

Bolan soils occupy upland ridges and side slopes and are well drained. Clyde soils are in low-gradient upland swales and on side slopes and are poorly drained. Dick-

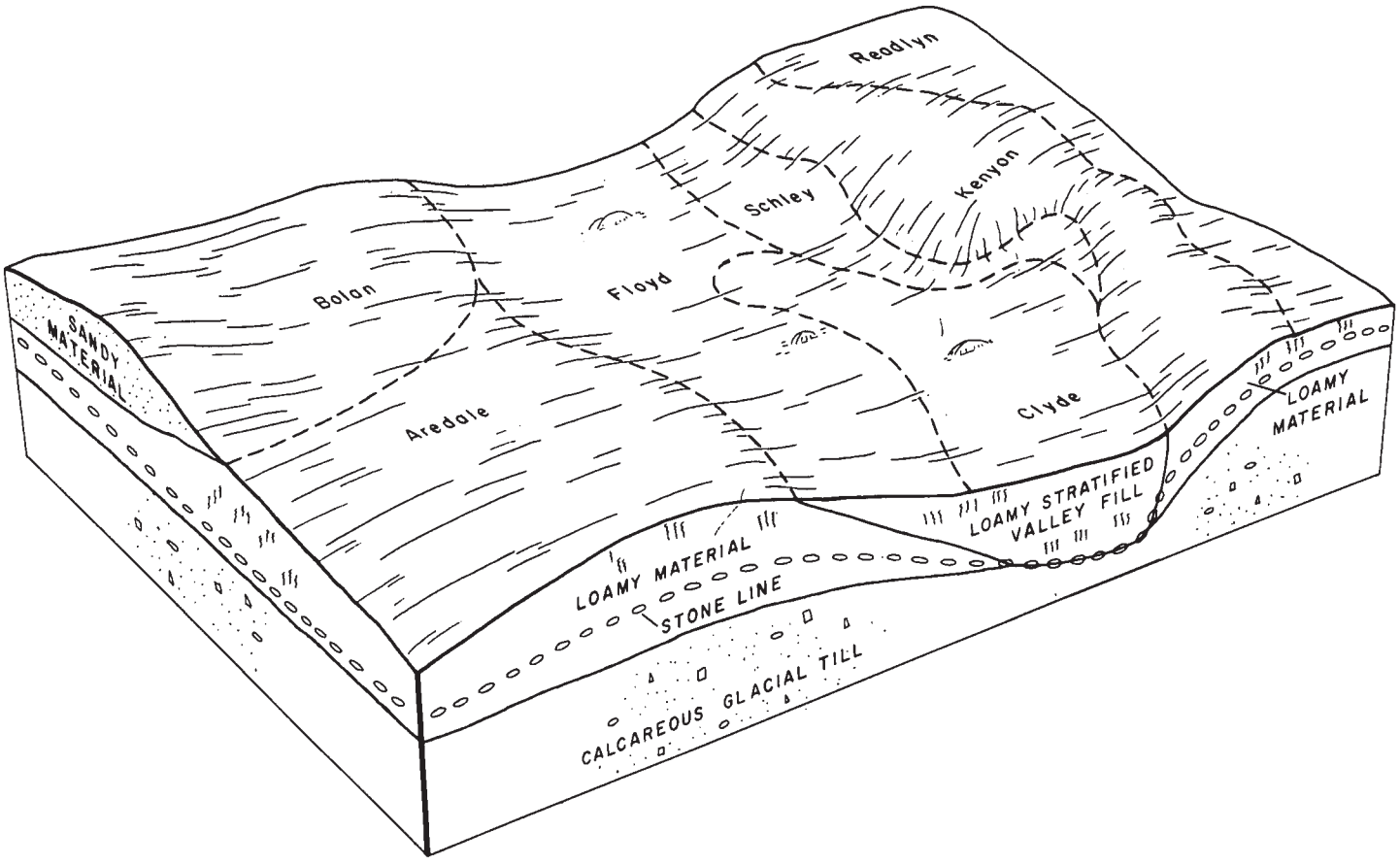


Figure 5.—Typical pattern of soils and parent material in the Floyd-Aredale-Kenyon association.

inson soils occupy dunelike ridges in the upland and are well drained and somewhat excessively drained. Schley soils are on the lower side slopes and in coves and are somewhat poorly drained. Readlyn soils are on broad upland ridges and low-gradient side slopes and are somewhat poorly drained.

Nearly all of this association is used for cultivated crops. The soils are well suited to row crops. The principal management needs are erosion control on the sloping soils and tile drainage of the wet soils.

7. Port Byron-Tama-Tallula association

Gently sloping to steep, well drained soils that formed in deep loess deposits; on uplands

This association is dominantly gently to moderately sloping soils on ridge crests and moderately sloping to steep soils on side slopes. It is dissected by gently sloping soils in small valleys (fig. 6). The soils of this association are typically at a higher elevation than the soils of the nearby Dinsdale-Klinger-Maxfield association.

This soil association makes up about 2 percent of the county. About 50 percent of the association is Port Byron soils, 15 percent is Tama soils, 15 percent is Tallula soils and about 20 percent is minor soils.

The Port Byron soils are moderately sloping to steep and are well drained. They have a surface layer of very dark grayish brown silt loam that is lighter colored in severely eroded areas. The subsoil is brown and yellowish brown silt loam. The Port Byron soils are moderately sloping on ridge crests and moderately sloping to moderately steep on side slopes.

The Tama soils are gently sloping and are well drained. They have a surface layer of thick, black and very dark brown silty clay loam. The subsoil is brown, yellowish brown, and dark yellowish brown silty clay loam and silt loam. The Tama soils are on ridge crests.

The Tallula soils are moderately sloping to strongly sloping and are well drained. They have a surface layer of dark brown silt loam that is yellowish brown in severely eroded areas. The subsoil is brown and yellowish brown, calcareous silt loam. The Tallula soils are moder-

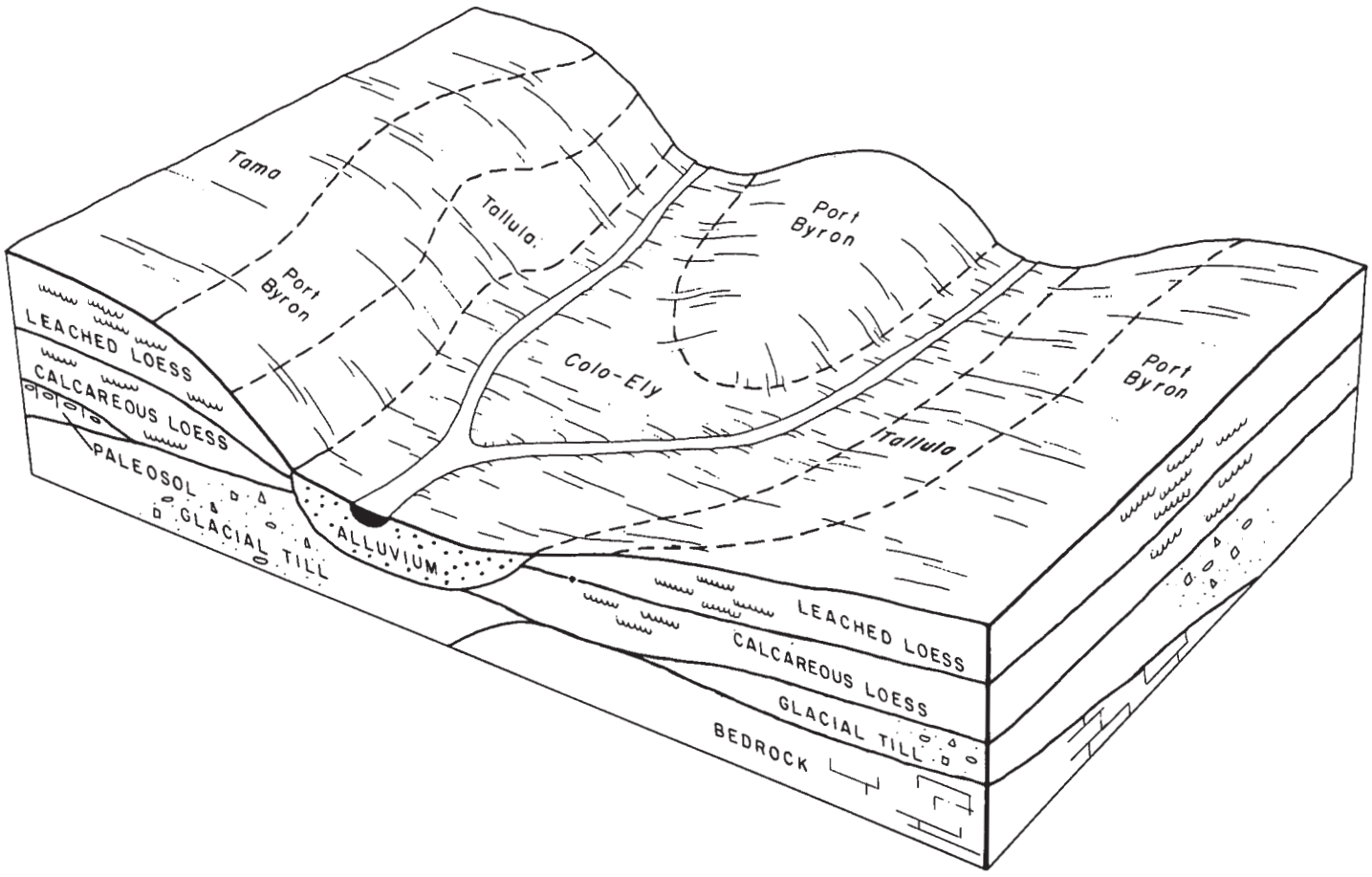


Figure 6.—Typical pattern of soils and parent material in the Port Byron-Tama-Tallula association.

ately sloping on ridge crests and moderately or strongly sloping on side slopes.

The most extensive minor soils in this association are Colo, Ely, and Judson soils. They formed in silty alluvial sediments in the narrow valleys and gently sloping drainageways.

Colo soils occupy the lowest part of the landscape adjacent to the waterways and are poorly drained. Ely soils are at slightly higher elevations in upland drainageways and on alluvial fans and foot slopes and are somewhat poorly drained. Judson soils are in upland drainageways and on foot slopes and are well and moderately well drained.

Nearly all of this association is used for cultivated crops. The soils are suited to row crops except the steeper soils and the small areas that are too frequently flooded. The principal management need is erosion control on the sloping soils. Tile drainage is needed on some of the minor soils. The soils of this association have a greater average slope, are more erodible, and have eroded more than other soils in the county.

8. Rossfield-Jacwin-Rockton association

Nearly level to very steep, well drained to somewhat poorly drained soils that formed in loess or loamy materials underlain by shale or limestone; on uplands

This association has the greatest variety of soils in the county. Nearly level and gently sloping soils are closely associated on the landscape with moderately sloping to very steep soils in many areas. The soils in this association formed over materials that are very different in characteristics, though they are all sedimentary bedrock (fig. 7).

This association makes up about 3 percent of the county. About 22 percent of the association is made up of Rossfield soils, 13 percent is Jacwin soils, 12 percent is Rockton soils, and 52 percent is minor soils.

The Rossfield soils are nearly level to strongly sloping and well drained. They have a surface layer of very dark

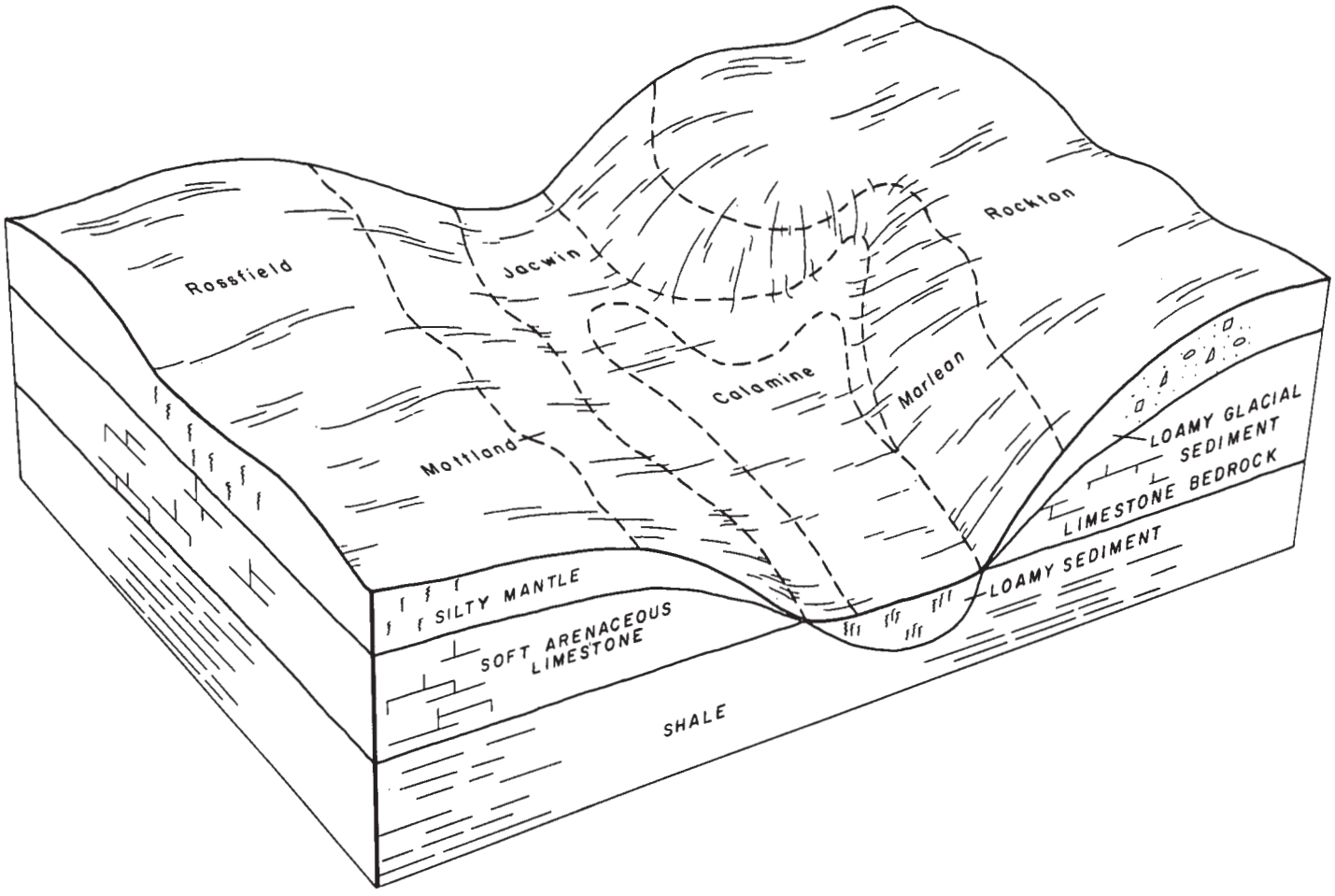


Figure 7.—Typical pattern of soils and parent material in the Rossfield-Jacwin-Rockton association.

brown silt loam except in eroded areas. The subsoil is brown silty clay loam in the upper part and yellowish brown clay loam in the lower part. The substratum is channery sandy loam with many limestone fragments. The Rossfield soils are on upland flats, ridge crests, and side slopes.

The Jacwin soils are nearly level to moderately sloping. They are somewhat poorly drained. Jacwin soils have a surface layer of black and very dark grayish brown loam and clay loam and are underlain by fine textured shale at a depth of 20 to 40 inches. The Jacwin soils are on low ridges and side slopes.

The Rockton soils are gently to moderately sloping and are well drained. They have a surface layer of thick, black, very dark brown, and very dark grayish brown loam. The subsoil is brown clay loam which rests on hard shattered bedrock. The Rockton soils are on ridge crests and side slopes.

The most important minor soils in this association are nearly equal in extent. They are Marlean, Mottland, Calamine, and Ripon soils. These soils formed in sediments over limestone or shale.

Marlean soils are gently sloping to very steep, are on ridges and side slopes, and are well drained. Mottland soils are moderately sloping to moderately steep and are on side slopes and are well drained. Calamine soils are nearly level and are on upland flats, waterways, and the lower side slopes. They are poorly or very poorly drained. Ripon soils are gently and moderately sloping and are on upland ridges and side slopes and are well drained.

The soils in this association are mostly used for cultivated crops. Some of the soils are well suited to row crops, though many are difficult to till because of rock outcrops, seep areas, and steep slopes. Because of these hazards of cultivation, many fields tend to be small and irregular in shape.

Broad land use considerations

Franklin County has a wide variety of soils. Individual characteristics make each kind of soil suitable for a particular use. The county's soils are on upland flats, on gently sloping to steep ridges or side slopes, in former marsh areas, and in stream valleys. Many are well drained and deep. A few soils are shallow to limestone, shale, sand, or gravel. Some have few limitations—others are very erosive when tilled. Some soils are naturally wet—others are droughty or are subject to flooding. Each kind of soil has attributes that determine its best use.

Many areas of Franklin County are well suited to grain production and are used for that purpose. A much smaller acreage is best used as pasture or woodland or for close-growing crops, wildlife, or recreation. The General Soil Map of Franklin County divides the county into eight soil associations for broad land use planning. Each association is a unique natural landscape with a distinct pattern of soils, relief, and drainage.

The soils in associations 1, 2, 4, and 6 have few limitations for farming. Fields are generally large and suitable for cultivation. Corn and soybeans are the main crops. Where erosion and drainage needs are met, these soils are in optimum use.

Soil associations 1 and 2 formerly contained many ponds and marshes. They were drained with ditches and large tile in the early part of this century, as land became more valuable. Although the soil is drained sufficiently for tillage, some of the drainage systems need improvement if the grain production potential is to be realized (fig. 8).

Soil association 5 contains many of the county's rivers and streams and the adjacent bottomland and bench soils. Much of the woodland in the county is in these bottom lands that frequently flood. The streams in this area naturally meander, frequently cutting new channels. They serve as drainageways for floodwater and for normal surface runoff. In some places where channels have been straightened, wildlife habitat is destroyed and cropland of only marginal value is developed. Many of the soils on the stream benches are somewhat droughty. While they are generally suited to intensive grain production, yields are not as consistently high as on the deeper soils that have higher available water capacity.

Soil associations 3, 7, and 8 are more sloping and more dissected by small streams and waterways than those previously mentioned. Fields are often smaller. Small areas unsuited to cultivation are left to grass and woodland. These landscape features generally make the soils less suited to intense grain production and better suited to livestock farming than soils in other associations. Their woods and grassland furnish a favorable habitat for wildlife. These soils are also suited to recreational uses such as hunting, hiking, and nature study.

Soil association 3 consists dominantly of moderately sloping to steep, well drained soils that formed in glacial drift. These soils are not generally suited to intensive grain production. The largest area of these soils is near Maynes Creek. Many of the slopes are long and border narrow, wet waterways. The steeper soils are frequently wooded. Some of the better farm ponds and recreational areas are in this association.

Soil association 7 consists of a series of hills that have gently to moderately sloping crests and moderately sloping to steep sides. It also contains narrow waterways and good sites for recreational impoundments. In some limestone areas, however, water may leak from the pond if special construction measures are not used. Erosion is a severe problem where many of the soils are tilled.

Soil association 8 has contrasting soils that range from level to very steep. Some are well suited to grain production, others are not. Soils underlain by shale are impervious to the downward movement of water. Ponds built in these soils generally will not leak. Soils underlain by limestone are naturally well drained because the underlying creviced bedrock provides good vertical drainage.

Figure 8.—Newly installed drainage system in Clarion-Nicollet-Webster association.

Soil maps for detailed planning

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Clarion loam, 2 to 5 percent slopes, is one of several phases in the Clarion 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 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. Coland-Terril complex, 1 to 5 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, 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

6—Okoboji silty clay loam, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions on uplands. It is subject to ponding by runoff from adjacent areas. Most areas are about 2 to 20 acres in size.

Typically, the surface layer is black silty clay loam about 31 inches thick. The subsoil is about 24 inches thick. It is black, very dark gray, and olive gray, friable silty clay loam. The substratum is olive gray, friable, calcareous silty clay loam. In some places the plow layer is mucky silt loam.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harps soil. They are at slightly higher elevations along the edge of the depression, have a very high lime content, and when dry appear much grayer in color than the Okoboji soil.

The Okoboji soil has high available water capacity and moderately slow permeability. A seasonal high water table is within 1 foot of the surface. Runoff does not occur until the depressions are filled with water. The plow layer is about 10 percent organic matter. Reaction of the plow layer and the upper part of the subsoil is typically neutral. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of Okoboji soils are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is poor for development of building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. It is usually associated with soils that are well suited to these crops.

Wetness and ponding are the chief limitations to cultivation of this soil. Young plants die if they are covered with water for long periods and need to be replaced. Shallow ditches and tile drains with open intakes are needed to remove excess surface water. Tile lines commonly are spaced closer in this soil than in many of the adjacent wet soils.

This soil is in capability subclass IIIw.

8B—Judson silty clay loam, 2 to 5 percent slopes. This is a gently sloping, well drained and moderately well drained soil. It is in drainageways in the uplands and on foot slopes below moderately sloping to moderately steep side slopes. Individual areas typically are long and narrow and about 3 to 15 acres in size.

Typically the surface layer is black, very dark brown, very dark grayish brown, and dark brown silty clay loam about 31 inches thick. The subsoil is about 19 inches thick. It is friable silty clay loam that is dark yellowish brown in the upper part and yellowish brown in the lower part. The substratum is dark grayish brown and brown, friable silty clay loam. A few small areas have slopes that range from 5 to 9 percent.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas that have limestone bedrock at a depth of 35 to 50 inches. These areas are along the upslope of the map unit and adjacent to it.

This Judson soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 5 percent organic matter. Reaction ranges from medium acid to slightly acid in the subsoil, and it varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential of the Judson soil is good to fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. It is subject to sheet and gully erosion if runoff water concentrates. Some areas are subject to excessive runoff from adjacent cultivated areas of higher elevation. In some years crops are damaged by short-duration flooding and sedimentation. Contour farming, terracing, and conservation tillage of this soil and upslope soils help to control erosion and reduce runoff and sedimentation.

This soil is in capability subclass IIe.

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes. These are gently sloping, poorly and somewhat poorly drained soils along waterways and on foot slopes in narrow valleys. Lower lying areas are subject to frequent flooding from adjacent streams or from runoff. Individual areas typically are 15 to 75 acres in size and have equal amounts of each soil. The Colo soil typically is in the center of the drainageway. The Ely soil is on both sides in a band between the drainageway and the higher lying soils on adjacent hillsides. Areas of this map unit are long and narrow, and the two soils occur in such narrow bands that it is not practical to separate them in mapping.

Typically, the Colo soil has a surface layer of black silty clay loam about 40 inches thick. The next layer is about 10 inches thick. It is black and very dark gray, friable silty clay loam. The substratum is gray and olive gray, friable silty clay loam. In a few areas the substratum is sandy loam in texture.

Typically, the Ely soil has a surface layer of black and very dark grayish brown silty clay loam about 30 inches

thick. The subsoil extends to a depth of about 60 inches. It is dark grayish brown, friable silty clay loam in the upper part and yellowish brown, friable silt loam in the lower part. On some of the higher foot slopes the soils are moderately well or well drained.

These soils have high available water capacity and moderate permeability. Colo soil has a seasonal high water table at a depth of 1 to 3 feet, and Ely soil has a seasonal high water table at a depth of 2 to 4 feet. Surface runoff is slow from Colo soil and medium from Ely soil. The plow layers of Colo and Ely soils are about 6 percent organic matter. Reaction is typically neutral or slightly acid throughout Colo soil and slightly acid or medium acid throughout the subsoil of the Ely soil. Reaction of the surface layer of Ely soil varies widely as the result of local liming practices. The subsoil of Colo soil is medium in available phosphorus and potassium. The Ely subsoil is very low in available phosphorus and potassium.

Many areas of these soils are cultivated. They have fair potential for cultivated crops and hay and good potential for pasture. They are usually associated with soils of good to fair potential for these uses. Colo soil has very poor potential for development of building sites and septic tank absorption fields. Ely soil has fair to poor potential for development of building sites and fair potential for development of septic tank absorption fields.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay if properly drained and protected from flooding. Many areas immediately adjacent to the small streams that drain this map unit are difficult to farm because of the frequency of flooding. The Ely soil is at a higher elevation than the Colo soil but crops in some areas are damaged from excessive runoff and siltation from the higher lying adjacent soils. Contour farming, terracing, and conservation tillage of the upslope soils as well as the Ely soil help to control erosion and reduce runoff and siltation damage. Conservation tillage disturbs the soil as little as possible and leaves crop residue on the surface. These Colo-Ely soils are well suited to pasture.

These soils are in capability subclass IIw.

27B—Terril loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is in upland drainageways and on foot slopes, typically below moderately sloping to strongly sloping side slopes. Most areas are long and narrow and range from 3 to 10 acres in size.

Typically the surface layer is very dark brown and very dark grayish brown loam about 28 inches thick. The subsoil is about 28 inches thick and is dark brown, dark yellowish brown, and yellowish brown, friable loam. The substratum is light olive brown, friable loam. Some small areas are moderately sloping.

A few small areas of somewhat poorly drained Turlin soil occur along drainageways. Also included are small areas on foot slopes above stream benches that are underlain by sand and gravel. These inclusions make up about 10 percent of the map unit.

This Terril soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 5 percent organic matter. Reaction is neutral or slightly acid in the subsoil and in the surface layer. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. Potential is good for growing cultivated crops, hay, and pasture. Potential is good to fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. It is subject to sheet and gully erosion if runoff water concentrates. Some areas are subject to excessive runoff from adjacent cultivated areas of higher elevation. In some years crops are damaged by short duration flooding and sedimentation. Contour farming, conservation tillage, and terracing of this soil and also of the soils upslope help to control erosion and reduce local runoff and sedimentation. Conservation tillage disturbs the soil as little as possible and leaves crop residue on the surface.

This soil is in capability subclass IIe.

41B—Sparta loamy fine sand, 2 to 6 percent slopes. This is a gently sloping, excessively drained soil on convex ridges and dunes in the uplands. Most areas are 3 to 10 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown loamy fine sand about 17 inches thick. The subsoil is about 12 inches thick. It is brown, very friable loamy fine sand. The upper part of the substratum is yellowish brown, very friable loamy fine sand, and the lower part is yellowish brown, loose fine sand. There are some moderately sloping Sparta soils and some small eroded areas where the plow layer is mixed with the subsoil.

Included with this soil in mapping are areas of well drained or somewhat excessively drained Dickinson fine sandy loam on the outer edge of the soil delineation.

This Sparta soil has low to moderate water holding capacity and rapid permeability. Surface runoff is slow. The plow layer is about 1 1/2 percent organic matter. Reaction is medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is poor for cultivated crops. Potential is poor to fair for hay, pasture, and woodland. Potential is good for development of building sites and for septic tank absorption fields. There is some danger of pollution of ground water because of the rapid permeability of the lower part of the substratum.

This soil is poorly suited to corn and soybeans. It usually occurs in small areas, however, where it is farmed along with better suited soils that are planted to corn and soybeans. If this soil is used for cultivated crops there is a hazard of wind erosion. Blowing sand

grains damage young plants on Sparta and adjacent soils. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface greatly reduces crop damage and soil loss. This soil is somewhat better suited to pasture and hay crops than to corn and soybeans. Crop yields are limited by inadequate moisture in all but the wettest years. Heavily grazed Sparta soils are also susceptible to wind erosion.

This soil is in capability subclass IVs.

55—Nicollet loam, 1 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on slightly convex low ridges and slightly concave or flat lower slopes on uplands. Individual areas typically range from about 3 to 40 acres in size.

Typically, the surface layer is black and very dark gray loam about 20 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown, friable loam in the upper part and grayish brown, friable loam in the lower part. The substratum is mottled, light olive gray and strong brown, friable loam.

Included with this soil in mapping near the Iowa River is about 150 acres of a soil with a lighter, thinner surface layer. That soil has an ashy subsurface layer and has a more clayey subsoil than the Nicollet soil. It is on similar landscape positions.

This Nicollet soil has high available water capacity and moderate permeability. Surface runoff is medium. Nicollet soil has a seasonal high water table at a depth of 2.5 to 5 feet. The plow layer is about 6 percent organic matter. Reaction is slightly acid or medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and low to very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential of Nicollet soil is fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness hinders cultivation and reduces production unless excess water is removed by tile drainage.

This soil is in capability class I.

62C2—Storden loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained calcareous soil on knolls and on convex side slopes that border waterways and streams in the uplands. The slopes are typically short. Individual areas are irregular in shape and typically range from 3 to 12 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. It is underlain by a substratum that is brown, grayish brown, light olive brown, and light yellowish brown, friable loam. In some places the substratum has layers of sandy loam, and in places the plow layer has mixings of very dark grayish brown. Many areas that have not been plowed have a very dark gray surface layer.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of Clarion soil that are near waterways and on the slope crests. They are noncalcareous.

This Storden soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture when properly fertilized. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. Without fertilization with these nutrients, very low yields are frequent. If this soil is used for cultivated crops there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing help prevent excessive soil loss. The reduced level of organic matter that results from the erosion and the calcareous soil surface are to be considered in the use of herbicides.

This soil is in capability subclass IIIe.

62D2—Storden loam, 9 to 14 percent slopes, moderately eroded. This is a strongly sloping, well drained, calcareous soil on knolls and on convex side slopes that border waterways and streams in the uplands. The slopes are typically short. Individual areas are irregular in shape and typically range from 3 to 10 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. It is underlain by a substratum that is brown, grayish brown, light olive brown, and light yellowish brown, friable loam. In some places the substratum has layers of sandy loam. Many areas that have not been plowed have a very dark gray surface layer.

Included with this soil in mapping and making up 10 percent of the map unit are small areas of Clarion soil that are near waterways and on the crest of the slopes. They are noncalcareous.

This Storden soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is also fair for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture when it is properly fertilized and erosion is controlled. Excessive

lime in this soil reduces the availability of phosphorus and potassium to plants. If this soil is used for cultivated crops there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from the erosion and the calcareous soil surface needs to be considered in the use of herbicides.

This soil is in capability subclass IIIe.

62E2—Storden loam, 14 to 18 percent slopes, moderately eroded. This is a moderately steep, well drained, calcareous soil on knolls and on convex side slopes that border waterways and streams in the uplands. The slopes are typically short. Individual areas are irregular in shape and typically range from 3 to 10 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The substratum is brown, grayish brown, light olive brown, and light yellowish brown, friable loam. In some places the substratum has layers of sandy loam. Many areas that have not been plowed have a very dark gray surface layer.

Included with this soil in mapping and making up 5 percent of the map unit are small areas of Clarion soil that are near waterways and on the slope crest. They are noncalcareous. Also included and making up 5 percent of the map unit are some small areas of Salida soils, which are gravelly and excessively drained and are on similar landscape positions.

This Storden soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated along with less sloping soils. Potential is fair to poor for cultivated crops, and potential is fair for hay and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

Soil slope is a severe limitation for corn and soybeans. It is a moderate limitation for small grains and for grasses and legumes grown for hay and pasture providing the soil is fertilized. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. Harvesting hay and small grain is difficult because of slope. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. If this soil is used for cultivated crops there is a very severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface and contour farming prevent excessive soil loss when this soil is used for occasional row crops. The reduced level of organic matter that results from the erosion and the calcareous soil surface need to be considered in the use of herbicides.

This soil is in capability subclass IVe.

73C—Salida gravelly sandy loam, 2 to 9 percent slopes. This gently sloping to moderately sloping, excessively drained, calcareous soil is on knolls, convex ridges, and side slopes on uplands and on terrace escarpments. Most areas are 3 to 12 acres in size.

Typically, the surface layer is very dark brown, gravelly sandy loam about 7 inches thick. The substratum is brown, loose gravelly coarse sand that grades to yellowish brown and light brownish gray, loose sand. In eroded areas, the surface layer has more gravel and is lighter in color.

Included with this soil in mapping are areas of Zenor soils which are noncalcareous and droughty. They make up about 20 percent of the map unit and are along the outer edges of the soil delineation.

This Salida soil has very low available water capacity and very rapid permeability. Surface runoff is slow. The plow layer is about 1 percent organic matter. Reaction is neutral to moderately alkaline in the surface layer and mildly alkaline or moderately alkaline in the substratum. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is poor for cultivated crops, hay, and pasture. Potential is also poor for development of building sites, and potential is fair for septic tank absorption fields. There is some danger of pollution of ground water because of the very rapid permeability. This soil is not considered a good source of gravel because it is too sandy.

This soil is poorly suited to corn and soybeans. It is better suited to grasses and legumes for hay and pasture. Close grazing of pasture by livestock decreases the effectiveness of meadow crops in controlling erosion. Lack of moisture limits crop production in nearly all years, because the soil has very limited available moisture to supply crops during dry periods. Unless rains are frequent, crop losses due to drought are expected. If this soil is used for cultivated crops, there is a hazard of water and wind erosion. Blowing sand grains damage young plants on Salida and adjacent soils. Contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface greatly reduce soil loss and crop damage. The low level of organic matter and the sandy texture of the soil surface need to be considered in the use of herbicides.

This soil is in capability subclass IIIe.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are typically 5 to 15 acres in size.

Typically, the surface layer is black, very dark brown, and very dark grayish brown loam about 18 inches thick. The subsoil is about 30 inches thick. It is brown, friable loam in the upper part; brown, firm sandy clay loam in the middle part; and olive brown and mottled, dark grayish brown and yellowish brown, firm loam in the lower part. The substratum is multicolored, mottled, firm loam. Along the waterways, drainage is somewhat restricted.

This Kenyon soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

There is a difference in the rate at which water moves through the more permeable upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper part, and when it reaches the less permeable horizons a temporary perched water table develops.

This soil is in capability subclass IIe.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridge crests and side slopes on uplands. Individual areas typically are 3 to 10 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown loam about 8 inches thick. Plowing has mixed subsoil into the surface layer. The subsoil is about 30 inches thick. It is brown, friable loam in the upper part; brown, firm sandy clay loam in the middle part; and olive brown and mottled, dark grayish brown and yellowish brown, firm loam in the lower part. The substratum is multicolored, mottled, firm loam. The surface layer is somewhat thicker on crests of side slopes and near waterways. In some areas on the shoulders of slopes the plow layer is brown and severely eroded.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is also good for development of building sites, and potential is fair for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion of this soil needs to be considered in the use of fertilizers and herbicides.

There is a difference in the rate at which water moves through the more permeable upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper part, and when it reaches the less permeable lower horizons, a temporary perched water table develops.

This soil is in capability subclass IIIe.

83D—Kenyon loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are typically 5 to 10 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown loam about 12 inches thick. The subsoil is about 25 inches thick. It is brown, friable loam in the upper part; brown, firm sandy clay loam in the middle part; and olive brown and mottled, dark grayish brown and yellowish brown, firm loam in the lower part. The substratum is multicolored mottled, firm loam. In some areas the surface layer is lighter colored because of erosion.

This soil has high available water capacity, and permeability is moderate. Surface runoff is rapid. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is also fair for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residues on the surface, contour farming, and terracing prevent excessive soil loss.

There is a difference in the rate at which water moves through the more permeable upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper part, and when it reaches the less permeable lower horizons, a temporary perched water table develops.

This soil is in capability subclass IIIe.

83F—Kenyon loam, 14 to 24 percent slopes. This moderately steep and steep, moderately well drained soil is on short convex side slopes on uplands. In many places it is adjacent to and parallel to flood plains and along small streams and waterways. Individual areas typically are 5 to 10 acres in size, but a few are larger.

Typically, the surface layer is very dark brown and very dark grayish brown loam about 12 inches thick. The subsoil is about 28 inches thick. It is brown, friable loam

in the upper part; brown, firm sandy clay loam in the middle part; and olive brown, and mottled, dark grayish brown and yellowish brown, firm loam in the lower part. The substratum is multicolored, mottled, firm loam. Some areas have a lighter colored surface layer and a higher sand content.

This Kenyon soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Nearly all of this soil is in pasture and woodland. Potential is fair for these uses. Potential is poor for crops and for development of building sites and for septic tank absorption fields.

This soil is suited to grasses and legumes for pasture and to trees for wood products. Machine harvesting of hay is difficult because of slope. This soil is not suited to cultivated crops because of the erosion hazard and the danger of operating farm machinery on the steeper slopes.

There is a difference in the rate at which water moves through the more permeable upper horizons and the less permeable lower horizons of this soil. Water moves more rapidly in the upper part, and when it reaches the less permeable lower horizons, a temporary perched water table develops.

This soil is in capability subclass VIe.

84—Clyde silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil along drainageways and lower concave positions on uplands. It is subject to brief, frequent flooding from adjacent slope runoff. Typical areas are about 10 to 80 acres in size. Lower-lying areas are subject to flooding from the adjacent drainageways.

Typically, the surface layer is about 18 inches thick. It is black silty clay loam; but the lower few inches are black and dark olive gray clay loam. The subsoil is about 27 inches thick. It is olive gray, friable clay loam in the upper part; olive gray, friable loam and sandy loam in the middle part; and grayish brown and light olive brown, mottled, friable loam in the lower part. The substratum is gray, firm loam.

Included with this soil in mapping are areas that have many large stones or boulders on the surface and small seepy areas that have a mucky surface layer. These included soils are in similar positions on the landscape. They make up about 5 percent or less of the map unit.

This Clyde soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 10 percent organic matter. Reaction is typically neutral throughout. The subsoil is low to very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Wetness is, in part, caused by side slope seepage. A drainage system that intercepts laterally moving water is the most successful. Large granite boulders are common in some uncultivated areas and need to be removed before this soil can be used for crops.

This soil is in capability subclass IIw.

90—Okoboji mucky silt loam, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions on uplands. It is subject to ponding by runoff from adjacent areas. Most areas are about 15 to 30 acres in size.

Typically, the surface layer is black mucky silt loam about 10 inches thick underlain by black silty clay loam that extends to a depth of 36 inches. The subsoil is about 19 inches thick. It is very dark gray to olive gray, friable silty clay loam. The substratum is olive gray, friable silty clay loam.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harps soil. They are at a slightly higher elevation along the edge of the depression, have a very high lime content, and, when dry, appear much grayer in color than Okoboji soil.

This Okoboji soil has high available water capacity and moderately slow permeability. Water does not run off until the depressions are filled with water. The plow layer is about 18 percent organic matter. Reaction of the plow layer and the subsoil is typically neutral. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of Okoboji mucky silt loam are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is very poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. It is usually associated with soils that are well suited to these crops.

Wetness and ponding are the chief limitations to cultivation of this soil. Young plants die if they are covered with water for long periods and need replacing. Shallow ditches and tile drains with open intakes are needed to remove excess surface water. Tile lines commonly are placed closer together than in many of the adjacent wet soils, because the Okoboji soil is finer in texture.

This soil is in capability subclass IIIw.

95—Harps loam, 1 to 3 percent slopes. This is a nearly level, poorly drained, calcareous, soil on rims around depressions and on flats that are dotted with small depressions on uplands. Individual areas typically are 4 to 20 acres in size, though some are much larger.

Typically, the surface layer is black, very dark gray, and dark gray loam about 19 inches thick. The subsoil is about 23 inches thick. It is olive gray, friable loam in the upper part and light olive gray, friable loam in the lower part. The substratum is light olive gray, friable loam with thin sandy loam lenses. Some small areas typically do not have as high a lime content.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Okoboji soil that occur in small depressions.

This Harps soil has high available water capacity and moderate permeability. This soil has a naturally high water table and slow surface runoff. The plow layer is about 5 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed and the soil is properly fertilized. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. If this soil is not fertilized with these nutrients, very low yields are common.

This soil is in capability subclass IIw.

96—Turlin loam, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on flood plains. It is subject to occasional flooding from adjacent streams and waterways. Individual areas range from about 3 to 10 acres in size, although a few are much larger.

Typically, the surface layer is black, very dark gray, and very dark grayish brown loam about 35 inches thick. The subsoil is about 17 inches thick. It is dark grayish brown, friable sandy clay loam in the upper part and grayish brown, friable sandy loam in the lower part. The substratum is grayish brown and light olive yellow, mottled, loose loamy sand. Some small areas along the waterways are poorly drained.

This soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 5 percent organic matter. Reaction is typically slightly acid throughout. The subsoil is low to very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for pasture. It is subject to occasional very brief flooding. In years of greater than normal precipitation, wetness may hinder cultivation and reduce crop yields unless excess water is removed.

This soil is in capability class I.

107—Webster silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on upland flats and in irregularly shaped swales and low-gradient drainageways. Individual areas typically range from 5 to 40 acres in size, and larger irregular shaped areas are common.

Typically, the surface layer is black silty clay loam about 22 inches thick. The subsoil is about 24 inches thick. It is dark gray, friable silty clay loam in the upper part; olive gray, friable clay loam in the middle part; and olive gray, friable loam in the lower part. The substratum is olive gray, very friable loam and sandy loam.

Included with this soil in mapping and making up about 20 percent of the map unit are a few small areas of Harps and Canisteo soils that have a high lime content. Also included, making up about 5 percent of the map unit, are a few small areas of Okoboji soil that are in small depressions.

This Webster soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. The reaction is typically neutral in the surface layer and upper part of the subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most areas of this soil.

This soil is in capability subclass IIw.

118—Garwin silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil in shallow drainageways and on a few broad flats in the uplands. Most areas are 8 to 30 acres in size, but a few are much larger.

Typically, the surface layer is black silty clay loam about 22 inches thick. The subsoil is about 22 inches thick. It is olive gray, friable silty clay loam in the upper part; dark gray and olive gray, friable silty clay loam in the middle part; and olive gray, friable silt loam in the lower part. The substratum is gray, friable silt loam. Some areas have a thicker surface layer.

This Garwin soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. Reaction of the plow layer and subsoil is typically neutral or slightly acid. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess

water is removed. Tile drainage has been installed in most areas of this soil.

This soil is in capability subclass IIw.

119—Muscatine silty clay loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on lower concave positions and low gradient convex ridges on uplands. Individual areas typically range from 5 to 20 acres in size.

Typically, the surface layer is black silty clay loam about 19 inches thick. The subsoil is about 26 inches thick. It is dark grayish brown and grayish brown silty clay in the upper part and grayish brown, friable silty clay loam in the lower part. The substratum is grayish brown, friable silt loam. A few small areas of poorly drained soils are along drainageways.

This soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness commonly hinders cultivation and reduces yields unless excess water is removed.

This soil is in capability class I.

120B—Tama silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridge crests and side slopes on uplands. Individual areas are typically long and narrow and about 10 to 50 acres in size. A few areas are much larger.

Typically, the surface layer is black, very dark brown, and very dark grayish brown silty clay loam about 22 inches thick. The subsoil is about 28 inches thick. It is brown, friable silty clay loam in the upper part; dark yellowish brown and yellowish brown, friable silty clay loam in the middle part; and yellowish brown, friable silt loam in the lower part. The substratum is multicolored, friable silt loam. The more sloping areas of this soil have a thinner, lighter colored surface layer.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains of streams. It is subject to frequent flooding from adjacent streams. Individual areas are generally long and narrow and from 10 to 40 acres in size, but a few areas are much larger.

Typically, the surface layer is black silty clay loam about 40 inches thick. The next layer is about 10 inches thick. It is black and very dark gray, friable silty clay loam. The substratum is gray and olive gray, friable silty clay loam. In a few areas the substratum is sandy loam.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small, low lying areas that are cut up by channels. These areas are next to the stream and consist of a variety of soils.

This Colo soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is neutral or slightly acid throughout. The subsoil is medium in available phosphorus and potassium.

This soil is used for cultivated crops and permanent pasture. Potential is good to fair for cultivated crops, hay, and pasture. Potential is very poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, and small grains if it can be properly drained and protected from flooding. Adequate tile outlets are difficult to obtain in some areas. Some areas immediately adjacent to streams are difficult to crop because of stream meanders, frequency of flooding, and the difficulty of flood control. Most of these areas are in permanent vegetation.

This soil is in capability subclass IIw.

135—Coland clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on the flood plains of streams. It is subject to frequent flooding. Individual areas are generally long and narrow and from 10 to 40 acres in size, but some are much larger.

Typically, the surface layer is black clay loam about 40 inches thick. The next layer is about 10 inches thick. It is very dark gray, friable clay loam. The upper part of the substratum is dark gray, friable sandy loam, and the lower part is gray, loose sand and gravel.

Included with this soil in mapping and making up about 10 percent of the map unit are a few small areas that are cut up by channels. These areas are next to the stream and consist of a variety of soils.

This Coland soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is typically neutral or slightly acid throughout. The subsoil is low in available phosphorus and very low in available potassium.

This soil is used for cultivated crops and permanent pasture. Potential is good to fair for cultivated crops, hay, and pasture. Potential is very poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, and small grains if it can be properly drained and protected from flooding. Adequate tile outlets are difficult to obtain in some areas. Some areas immediately adjacent to streams are difficult to farm because of stream meanders, frequency of flooding, and the difficulty of flood control. Most of these areas are left in permanent vegetation.

This soil is in capability subclass IIw.

138B—Clarion loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on convex ridges and side slopes on uplands. Individual areas are typically irregular in shape and 5 to 25 acres in size.

Typically, the surface layer is black and very dark grayish brown loam about 18 inches thick. The subsoil is about 18 inches thick. It is brown, friable loam. The substratum is olive brown and light olive brown, friable loam. In some places the surface layer is silt loam. In small areas slopes are more than 5 percent. In other areas the soil is eroded and the plow layer is mixed with the subsoil. In some areas the substratum is sandy loam. In small areas that are near waterways or lower on the landscape, the soil is somewhat poorly drained.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is medium or slightly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

138C2—Clarion loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on knolls and on convex side slopes that border upland waterways and streams. The slopes typically are short. Individual areas are irregular in shape and typically range from 4 to 25 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed subsoil material into the surface layer. The subsoil is about 18 inches thick. It is brown, friable loam. The substratum is olive brown and light olive brown, friable loam. In places the substratum is sandy loam. Narrow bands of more sloping soils are near waterways and on the shoulders of ridges. Areas of this soil that are not eroded and areas near the base of the slope have a thicker dark colored surface layer than typical. Some small severely eroded knobs and narrow bands on slope shoulders have a brown plow layer.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is medium acid or slightly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from the erosion of this soil needs to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

138D2—Clarion loam, 9 to 14 percent slopes, moderately eroded. This is a strongly sloping, well drained soil. It is on knolls and on convex side slopes that border waterways and streams in the uplands. The slopes typically are short. Individual areas are irregular in shape and typically range from 3 to 12 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed subsoil material into the surface layer. The subsoil is about 18 inches thick. It is brown, friable loam. The substratum is olive brown and light olive brown, friable loam. In some places the surface layer is more than 8 inches thick. In other, more eroded areas the plow layer is brown. In some places the substratum is sandy loam. Narrow bands of soils that have slopes of more than 14 percent are near waterways and on the shoulders of ridges.

Included with this soil in mapping are small areas of severely eroded Storden soils on knobs and shoulders of slopes. These soils have a brown plow layer and are calcareous. They make up 15 percent of the mapped areas.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is

medium acid or slightly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is also fair for development of building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion needs to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

151—Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on stream benches and in outwash areas. Some low lying areas are subject to rare flooding. Individual areas are typically 4 to 30 acres in size.

Typically, the surface layer is black and very dark gray clay loam about 20 inches thick. The subsoil is about 8 inches thick. It is olive gray, friable clay loam. The substratum is mottled, loose sand that is 5 to 10 percent fine gravel. In some places the depth to sand and gravel is more than 32 inches.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harcot and Talcot soils. They have a high lime content and dry to a grayer color than the Marshan soil. They are in higher areas or similar positions on the landscape to the Marshan soil.

This Marshan soil has moderate to low available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. This soil has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. Reaction is neutral or slightly acid throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Placement of tile is difficult in some areas because of loose, unstable sand below a depth of about 2 1/2 to 3 feet.

This soil is in capability subclass IIw.

152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on stream benches and in outwash areas. Some low lying areas are subject to rare flooding. Individual areas are typically 4 to 30 acres in size.

Typically, the surface layer is black and very dark gray clay loam about 20 inches thick. The subsoil is about 17 inches thick. It is olive gray, friable clay loam. The substratum is mottled, loose sand that contains from 5 to 10 percent fine gravel. In some places the depth to sand and gravel is more than 40 inches. In other places the depth to sand and gravel is less than 32 inches.

Included with this soil in mapping and making up about 5 percent of the map unit are a few small areas of Harcot and Talcot soils that have a high lime content and dry to a gray color. They commonly are slightly higher on the landscape than the Marshan soil.

This Marshan soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. This soil has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. Reaction is neutral or slightly acid throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Placement of tile is difficult in some areas because of loose, unstable sand below a depth of about 3 feet.

This soil is in capability subclass IIw.

153—Shandep loam, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions, on stream benches, and in outwash areas. It is subject to ponding by runoff from adjacent areas. Most areas are 4 to 20 acres in size and a few are much larger.

Typically, the surface layer is black and very dark gray loam and clay loam about 29 inches thick. The subsoil is about 16 inches thick. It is dark gray and gray, friable clay loam. The substratum is dark gray, loose loamy sand.

Included with this soil in mapping and making up 5 percent of the map unit are small areas of Talcot soil. This included soil has a very high lime content. It is slightly higher on the landscape and, when dry, appears much grayer in color than the Shandep soil.

This Shandep soil has high available water capacity. Permeability is moderate in the surface layer and subsoil and rapid in the sandy substratum. Water does not run off until it has filled the depressions. The plow layer is about 8 percent organic matter. Reaction is typically neutral to slightly acid throughout. The subsoil is very low in available phosphorus and potassium.

Many areas of Shandep soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is very poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. It is usually associated with soils that are well suited to these crops.

Wetness and ponding are the chief limitations to cultivation of this soil. Young plants die if they are covered with water for long periods and need to be replaced. Shallow ditches and tile drains with open intakes are used to remove excess surface water.

This soil is in capability subclass IIIw.

174B—Bolan loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on convex ridge crests and side slopes on uplands. Individual areas typically are 4 to 40 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown loam about 14 inches thick. The subsoil is about 29 inches thick. It is brown, friable loam in the upper part; dark yellowish brown friable fine sandy loam in the middle part; and yellowish brown, very friable loamy fine sand in the lower part. The substratum is yellowish brown, loose loamy fine sand. In some small eroded areas there is a mixing of brown subsoil in the plow layer.

Included with this soil in mapping and making up 10 percent of the map unit are a few small areas of well drained and somewhat excessively drained Dickinson fine sandy loam. This included soil is near the center of the mapped areas.

This Bolan soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Yields may be reduced in extended dry periods because this soil has moderate available water capacity.

This soil is in capability subclass IIe.

174C2—Bolan loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on convex ridge crests and side slopes on uplands. Individual areas typically are 4 to 25 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. Plowing has mixed subsoil material into the surface layer. The subsoil is about 23 inches thick. It is brown, friable loam in the upper part; dark yellowish brown, very friable fine sandy loam in the middle part; and yellowish brown, very friable loamy fine sand in the lower part. The substratum is yellowish brown, loose loamy fine sand. Some places are strongly sloping. In a few small severely eroded areas there is a mixing of yellowish brown subsoil in the plow layer.

Included with this soil in mapping and making up 10 percent of the map unit are a few small areas of well drained and somewhat excessively drained Dickinson fine sandy loam. The included soil is near the center of mapped areas.

This Bolan soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Yields may be reduced in extended dry periods because this soil has moderate available water capacity. The reduced level of organic matter that results from the erosion of this soil needs to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

175B—Dickinson fine sandy loam, 2 to 5 percent slopes. This is a gently sloping, well drained or somewhat excessively drained soil on convex ridges and dunes in the uplands. Most areas are 3 to 30 acres in size.

Typically, the surface layer is very dark brown and dark brown fine sandy loam about 20 inches thick. The subsoil is about 22 inches thick. It is brown, very friable fine sandy loam in the upper part and yellowish brown, very friable loamy sand in the lower part. The substratum is yellowish brown and brown, mottled, very friable loamy sand. Loam glacial sediments are at a depth of 30 to 40 inches near the margin of the Dickinson soil. In some small eroded areas there is a mixing of brown subsoil in the plow layer.

This Dickinson soil has moderate available water capacity. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Surface runoff

is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses for hay and pasture. If this soil is used for cultivated crops, there is a hazard of wind and water erosion. Blowing sand grains from Dickinson soil cut off young plants on this and adjacent soils. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing help prevent crop damage and excessive soil loss. In years of average or below average precipitation, yields are reduced because this soil has limited available water capacity. In places, small seepy areas are on the lower side slopes. Interceptor tile is used to speed drying, which allows for timely field operations. Care in tiling these areas is necessary so that tile lines do not become filled with sand.

This soil is in capability subclass IIIe.

175C—Dickinson fine sandy loam, 5 to 9 percent slopes. This is a moderately sloping, well drained or somewhat excessively drained soil on convex ridges and dunes in the uplands. Most areas are 3 to 25 acres in size; however, some long narrow areas are larger.

Typically, the surface layer is very dark brown and dark brown fine sandy loam about 17 inches thick. The subsoil is about 22 inches thick. It is brown, very friable fine sandy loam in the upper part and yellowish brown, very friable loamy sand in the lower part. The substratum is yellowish brown and brown, mottled, very friable loamy sand. Loam glacial sediments are at a depth of about 30 to 40 inches near the margin of the Dickinson soil. In some small eroded areas there is a mixing of brown subsoil in the plow layer.

This Dickinson soil has low to moderate available water capacity. Permeability is moderately rapid in the upper part of the profile and rapid in the underlying material. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses for hay and pasture. If this soil is used for cultivated crops, there is a hazard of wind and water erosion. Blowing sand grains from Dickinson soil cut off young plants on this and adjacent soils. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing help prevent crop damage and excessive soil loss. In years of average or below average precipitation, yields are reduced because this soil has limited available water capacity. In places, small seepy areas are on the lower side slopes. Interceptor tile can be installed for timely field operations. It must be done with care, however, so that tile lines do not become filled with sand.

This soil is in capability subclass IIIe.

177—Saude loam, 0 to 2 percent slopes. This is a nearly level, well drained soil on stream benches. Individual areas typically are 4 to 80 acres in size though a few are several hundred acres in size.

Typically, the surface layer is black and very dark brown loam about 15 inches thick. The subsoil is about 21 inches thick. It is dark brown and brown, friable loam in the upper part and brown, very friable loamy sand in the lower part. The substratum is multicolored, loose sand with a few pebbles. In places the depth to sand and gravel is more than 32 inches.

Included with this soil in mapping are a few small lower lying areas of somewhat poorly drained Lawler soil. These areas make up as much as 10 percent of the map unit.

This Saude soil has low to moderate available water capacity. Permeability is moderate or moderately rapid in the loamy upper part and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the very rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. During extended dry periods it is somewhat droughty.

This soil is in capability subclass IIs.

177B—Saude loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil. It is mainly on stream benches, and a few areas are in the uplands. Individual areas typically are 4 to 15 acres in size.

Typically, the surface layer is black and very dark brown loam about 14 inches thick. The subsoil is about 21 inches thick. It is dark brown and brown, friable loam in the upper part and brown, very friable loamy sand in the lower part. The substratum is multicolored loose sand and a few pebbles.

Included with this soil in mapping and making up 10 percent of the map unit are a few small areas of somewhat excessively drained Flagler soil. The included soils are on convex, higher parts of the landscape than the Saude soil.

This Saude soil has low to moderate available water capacity. Permeability is moderate or moderately rapid in the loamy upper part and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the very rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. During extended dry periods it is somewhat droughty. If this soil is used for cultivated crops there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface and contour farming help prevent excessive soil loss.

This soil is in capability subclass IIe.

177C—Saude loam, 5 to 9 percent slopes. This is a moderately sloping, well drained soil. It is mainly on stream benches, and a few areas are in the uplands. Individual areas typically are 3 to 10 acres in size.

Typically, the surface layer is very dark brown loam about 12 inches thick. The subsoil is about 21 inches thick. It is brown, friable loam in the upper part and brown, very friable loamy sand in the lower part. The substratum is multicolored, loose sand and a few pebbles. In some small eroded areas the plow layer has inclusions of brown subsoil.

Included with this soil in mapping and making up 15 percent of the map unit are a few small areas of somewhat excessively drained Flagler soil. This included soil is in higher, convex positions on the landscape than the Saude soil.

This Saude soil has low to moderate available water capacity. Permeability is moderate in the loamy upper part and very rapid in the sandy lower part. Surface runoff is medium. The plow layer is about 3 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the very rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. During extended dry periods it is somewhat droughty. If this soil is used for cultivated crops there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface and contour farming prevent excessive soil loss.

This soil is in capability subclass IIIe.

178—Waukee loam, 0 to 2 percent slopes. This is a nearly level, well drained soil on stream benches and in outwash areas. Individual areas typically are 5 to 12 acres in size.

Typically, the surface layer is black, very dark grayish brown, and dark brown loam about 20 inches thick. The subsoil is about 19 inches thick. It is brown, friable loam in the upper part and dark yellowish brown and yellowish brown, friable sandy loam and very friable loamy sand in the lower part. The substratum is yellowish brown, loose sand and a few pebbles. The surface layer is somewhat thicker in waterways and near soils upslope that have a stronger gradient. In places, the depth to sand and gravel is less than 30 inches.

This Waukee soil has moderate available water capacity. Permeability is moderate in the surface layer and subsoil and very rapid in the sandy substratum. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of the ground water, because of the very rapid permeability of the substratum.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Yields may be reduced in extended dry periods because this soil has moderate water holding capacity.

This soil is in capability subclass IIs.

178B—Waukee loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on stream benches and in outwash areas. Individual areas typically are 3 to 8 acres in size.

Typically, the surface layer is black, very dark grayish brown, and dark brown loam about 17 inches thick. The subsoil is about 19 inches thick. It is brown, friable loam in the upper part and dark yellowish brown and yellowish brown, friable sandy loam and very friable loamy sand in the lower part. The substratum is yellowish brown, loose sand with a few pebbles. The surface layer is somewhat thinner in the more sloping areas, and the depth to sand and gravel is less than 30 inches.

This Waukee soil has moderate available water capacity. Permeability is moderate in the surface layer and

subsoil and very rapid in the sandy substratum. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of the ground water because of the very rapid permeability of the substratum.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface and contour farming prevent excessive soil loss. Yields may be reduced in extended dry periods because the available water capacity is moderate.

This soil is in capability subclass IIe.

184—Klinger silty clay loam, 1 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on broad upland ridges; on low-gradient, slightly convex side slopes; and at the heads of upland waterways. Individual areas typically range from about 5 to 30 acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 21 inches thick. The subsoil is about 20 inches thick. It is dark grayish brown, friable silty clay loam in the upper part; grayish brown and light olive brown, friable silty clay loam in the middle part; and light olive brown, firm loam in the lower part. The substratum is multicolored, firm loam.

Included in mapping are a few areas of a soil in similar positions on the landscape that has a dense clayey layer at a depth of 20 to 36 inches. Also included, along drainageways, are a few small areas of poorly drained Maxfield soils. These included soils make up about 5 percent of the mapped acreage.

This Klinger soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

Klinger soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness commonly hinders cultivation and reduces production unless excess water is removed.

This soil is in capability class I.

198B—Floyd loam, 1 to 4 percent slopes. This is a nearly level to gently sloping, somewhat poorly drained soil along drainageways and on lower parts of side slopes on uplands. Individual areas typically are long and narrow and range from about 4 to 50 acres in size.

Typically, the surface layer is black and very dark gray loam about 19 inches thick. The subsoil is about 25 inches thick. It is dark grayish brown, friable loam and sandy clay loam in the upper part, and grayish brown, and yellowish brown, firm loam in the lower part. The substratum is multicolored, firm loam. A few small areas of poorly drained soils are along drainageways.

This Floyd soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is typically neutral or slightly acid in the surface layer and subsoil. The subsoil is very low in phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Wetness is, in part, caused by sidehill seepage.

There is a difference in the rate at which water moves through the upper and the lower horizons. Permeability is slightly greater in the upper horizons. When water reaches the less permeable horizon, a perched water table develops and water flows laterally downslope. A drainage system that intercepts laterally moving water is the most successful.

This soil is in capability subclass IIw.

201B—Coland-Terril complex, 1 to 5 percent slopes. This map unit consists of nearly level, poorly drained Coland soil along waterways in narrow valleys and the adjacent gently sloping moderately well drained Terril soil on foot slopes. The lower areas are subject to frequent flooding from adjacent streams or slope runoff. Areas of this map unit typically are long and narrow and 10 to 30 acres in size. They contain about 50 percent Coland soil, about 40 percent Terril soil, and about 10 percent other soils. The two soils occur in such intricate patterns that it is impractical to separate them in mapping.

Typically, the Coland soil has a surface layer of black clay loam about 40 inches thick. The next layer is about 10 inches thick. It is very dark gray, friable clay loam. The substratum is dark gray, friable sandy loam in the upper part and gray, loose sand and gravel in the lower part.

Typically, the Terril soil has a surface layer of very dark brown and very dark grayish brown loam about 28 inches thick. The subsoil is about 28 inches thick. It is

dark brown, friable loam in the upper part and yellowish brown and dark yellowish brown, friable loam in the lower part. The substratum is light olive brown, friable loam. Some areas are moderately sloping.

Coland and Terril soils have a high available water capacity and moderate permeability. Coland soil has a high water table. Surface runoff is slow from Coland soil and medium from Terril soil. The plow layer of Coland soil is about 6 percent organic matter, and that of Terril soil is about 5 percent. Reaction is typically neutral or slightly acid throughout in the Coland soil. The subsoil of Terril soil ranges from neutral to medium acid, and the surface layer varies widely as the result of local liming practices. The subsoil of Coland soil is very low in available phosphorus and very low to low in available potassium. The subsoil of Terril soil is low in available phosphorus and very low in available potassium.

Many areas of these soils are cultivated. Potential is fair for growing cultivated crops and hay, and potential is good for pasture. The Coland soil has very poor potential for development of building sites and for septic tank absorption fields.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay if they can be properly drained and protected from flooding. Some areas immediately adjacent to the waterways are difficult to farm because of stream meanders and frequency of flooding. The Terril soil is at a higher elevation than the Coland soil, but crops sometimes are damaged by excessive runoff and sedimentation from still higher soils. Contour farming, terracing, and conservation tillage of upslope soils along with this soil help to control erosion and reduce runoff and sedimentation damage. Conservation tillage disturbs the soil as little as possible and leaves crop residue on the surface. The soils in this map unit are well suited to pasture.

These soils are in capability subclass IIw.

213B—Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on ridge crests and side slopes on uplands and on a few benches near streams. Individual areas typically are 4 to 10 acres in size.

Typically, the surface layer is black, very dark brown, and very dark grayish brown loam about 20 inches thick. The subsoil is about 16 inches thick. It is brown, friable clay loam in the upper part and brown, firm clay loam in the lower part. Shattered limestone bedrock that has earthy material between fragments is at a depth of 36 inches. Hard level-bedded fractured limestone bedrock is at a depth of 66 inches. In the more sloping areas, this soil has a somewhat thinner surface layer. In some areas it is less than 30 inches to limestone.

This Rockton soil has moderate available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is good for development of building sites. Potential is poor for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Terracing plans need to be made cautiously because of the limestone bedrock.

This soil is in capability subclass IIe.

214B—Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This is a gently sloping, well drained soil on ridge crests and side slopes on uplands and on a few benches near streams. Individual areas typically are 3 to 20 acres in size.

Typically, the surface layer is black, very dark brown, and very dark grayish brown loam about 20 inches thick. The subsoil is about 8 inches thick. It is brown, friable clay loam in the upper part and brown, firm clay loam in the lower part. Shattered limestone bedrock that has earthy material between the fragments is at a depth of 28 inches. Hard, level-bedded fractured limestone bedrock is at a depth of 58 inches. In small areas the bedrock is at a depth of 30 to 40 inches. In the more sloping areas the surface layer is somewhat thinner, and in small areas it contains flags of limestone.

This Rockton soil has low available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is fair for development of building sites. It is poor for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Terracing needs to be carefully planned because limestone bedrock is at a depth of about 2 to 2 1/2 feet. During extended dry periods this soil is somewhat droughty.

This soil is in capability subclass IIe.

214C2—Rockton loam, 20 to 30 inches to limestone, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on ridge crests and side slopes on uplands. Individual areas typically are 4 to 15 acres in size.

Typically, the surface layer is very dark brown loam about 9 inches thick. Plowing has mixed subsoil material into the surface layer. The subsoil is about 16 inches thick. It is brown, friable clay loam in the upper part and brown, firm clay loam in the lower part. Shattered limestone bedrock that has earthy material between fragments is at a depth of 25 inches. Hard, level-bedded fractured limestone bedrock is at a depth of 55 inches. In some places the surface layer is thicker and darker colored, and in other places it is lighter colored. In small areas the plow layer contains flags of limestone.

This Rockton soil has low available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is good for development of building sites and poor for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is cultivated there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Terraces need to be carefully planned because limestone bedrock is at a depth of about 1 1/2 to 2 1/2 feet. During extended dry periods this soil is somewhat droughty. The reduction in organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

216C2—Ripon silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on ridge crests and side slopes on uplands. Individual areas typically are long and narrow and range from 4 to 20 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. Plowing has mixed subsoil material into the surface layer. The subsoil is about 16 inches thick. It is brown, friable silty clay loam in the upper part; yellowish brown, friable silty clay loam in the middle part; and dark yellowish brown and yellowish brown, firm clay loam in the lower part. Shattered limestone bedrock that has earthy material between fragments is at a depth of 25 inches. Hard limestone bedrock is at a depth of 55 inches. In some areas the surface layer is thicker and darker colored, and in other areas it is lighter colored. In small areas flags of limestone are in the plow layer.

This Ripon soil has low available water capacity. Permeability is moderate, and surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically slightly acid or medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for development of building sites, but potential is poor for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Terraces need to be carefully planned because limestone bedrock is at a depth of about 1 1/2 to 2 1/2 feet. During extended dry periods this soil is somewhat droughty. The reduction in organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

217B—Ripon silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This is a gently sloping, well drained soil on ridge crests and side slopes on uplands. Individual areas are typically 4 to 15 acres in size.

Typically, the surface layer is very dark brown and dark brown silt loam about 14 inches thick. The subsoil is about 22 inches thick. It is brown, friable silty clay loam in the upper part; yellowish brown, friable silty clay loam in the middle part; and dark yellowish brown and yellowish brown, firm clay loam in the lower part. Shattered limestone bedrock that has earthy material between fragments is at a depth of 36 inches. Hard limestone bedrock is at a depth of 66 inches. In places depth to the limestone is less than 30 inches.

This soil has moderate available water capacity and permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically slightly acid or medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for development of building sites, but it is poor for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. Terraces need to be carefully planned because limestone bedrock is at a depth of about 2 1/2 to 3 1/2 feet.

This soil is in capability subclass IIe.

221—Palms muck, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions that were once old lake beds or swamps. It is subject to ponding

by runoff from adjacent areas. Individual areas are generally 4 to 40 acres in size, but a few are much larger.

Typically, the surface layer is black decomposed swamp vegetation about 34 inches thick. The substratum is dark gray, friable loam and silt loam. A few areas are gently sloping.

This soil has high available water capacity. Permeability is moderately slow to moderately rapid in the organic surface layer and moderate to moderately slow in the underlying material. Runoff does not occur until the depressions are filled with water. The plow layer is about 25 percent organic matter, except in undrained or recently drained areas, where it is about 40 percent. Reaction is typically neutral in the surface layer and mildly alkaline in the substratum. The subsoil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is very poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Damage to crops by frost is more common on this soil than on most other soils in the county. Cold air collects in the depressions and doesn't move out unless there is a breeze. When this soil is drained and cultivated, the rate of decomposition of the organic materials increases and the organic layer gradually subsides.

This soil is in capability subclass IIIw.

225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on stream benches and in outwash areas. Individual areas typically are 4 to 30 acres in size but a few are much larger.

Typically, the surface layer is black and very dark grayish brown loam about 18 inches thick. The subsoil is about 11 inches thick. It is dark grayish brown, friable loam in the upper part and brown and dark brown sandy clay loam in the lower part. The substratum is multicolored, loose sand that is 5 to 10 percent fine gravel. The surface layer is somewhat thicker where the soil is adjacent to swales and waterways.

Included with this soil in mapping are a few small areas of Marshan soils that are poorly drained. They are along waterways and in the lower areas. These included soils make up about 5 percent of the acreage.

This Lawler soil has moderate to low available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. This soil has a seasonally high water table and slow surface runoff. The plow layer is about 5 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is fair to poor for development of building sites and poor for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. During extended dry periods it is somewhat droughty. In years of greater than normal precipitation, wetness hinders cultivation and reduces yields unless the excess water is removed by drainage. Tile can be spaced at wider intervals than is normal for the county. Often tiling of the adjacent, poorly drained soils lowers the water table of the Lawler soils. Tile placement is difficult in some areas because of loose unstable sand.

This soil is in capability subclass IIs.

226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on stream benches and in outwash areas. Individual areas are typically 4 to 30 acres in size but a few are much larger.

Typically, the surface layer is black and very dark grayish brown loam about 18 inches thick. The subsoil is about 19 inches thick. It is dark grayish brown, friable loam in the upper part and brown and dark brown, friable sandy clay loam in the lower part. The substratum is multicolored, loose sand that is 5 to 10 percent fine gravel. In places the depth to sand and gravel is less than 32 inches. The surface layer is somewhat thicker where the soil is adjacent to swales and waterways.

Included with this soil in mapping are a few small areas of Marshan soils that are poorly drained. They are along waterways and in the lower areas. Included soils make up 5 to 10 percent of the acreage.

This Lawler soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. This soil has a seasonally high water table and slow surface runoff. The plow layer is about 5 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is fair to poor for development of building sites and poor for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness hinders cultivation and reduces yields unless excess water is removed by drainage. Tile can be spaced at wider intervals than is normal for the county. Often tiling of the adjacent poorly drained soils lowers the water table of this Lawler soil. Tile placement is difficult in some areas because of loose, unstable sand below a depth of 3 1/2 feet.

This soil is in capability subclass IIs.

236B—Lester loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on convex ridges and

side slopes on uplands. Individual areas typically are irregular in shape and 4 to 15 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer, about 4 inches thick, is dark grayish brown, friable loam. Tho subsoil is about 39 inches thick. It is brown, friable loam and clay loam in the upper part; dark yellowish brown, friable clay loam in the middle part; and yellowish brown and light olive brown, friable loam in the lower part. The substratum is light olive brown, friable loam. In some places, the surface layer is silt loam and in some small areas it is darker and thicker than typical. Some areas are moderately sloping. Small eroded areas have brown subsoil mixed in the plow layer.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is medium or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. When it is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

236C—Lester loam, 5 to 9 percent slopes. This is a moderately sloping, well drained soil on ridges and convex side slopes that border waterways and streams. The slopes typically are short. Individual areas are irregular in shape and range from 4 to 15 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer, about 4 inches thick, is dark grayish brown, friable loam. The subsoil is about 38 inches thick. It is brown, friable loam and clay loam in the upper part and dark yellowish brown, yellowish brown, and light olive brown, friable loam in the lower part. The substratum is light olive brown, friable loam. In some areas erosion has removed so much of the original surface and subsurface layers that the resultant surface layer is lighter colored.

This Lester soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and fair for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where this soil is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIIe.

236D2—Lester loam, 9 to 14 percent slopes, moderately eroded. This is a strongly sloping, well drained soil on narrow ridges and convex side slopes that border waterways and streams. The slopes typically are short. Individual areas are irregular in shape and typically range from 5 to 15 acres in size (fig. 9).

Typically, the surface layer is dark brown loam about 8 inches thick. Plowing has mixed the subsurface layer and some of the subsoil into the plow layer. The subsoil is about 36 inches thick. It is brown, friable loam and clay loam in the upper part, and it is dark yellowish brown, yellowish brown, and light olive brown, friable loam in the lower part. The substratum is light olive brown, friable loam. Narrow areas along waterways are somewhat poorly drained.

Included with this soil in mapping on convex knobs are small areas of Storden soils that have a calcareous surface layer. They make up about 5 percent of the acreage.

This Lester soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is also fair for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

236F—Lester loam, 14 to 24 percent slopes. This is a moderately steep and steep, well drained soil on short, convex side slopes. It is adjacent and parallel to flood plains and along small streams and waterways. Individual areas typically are 5 to 20 acres, but a few are larger.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer, about 3 inches thick, is dark grayish brown, friable loam. The subsoil is about 30 inches thick. It is brown, friable clay

Figure 9.—Farm pond built in waterway in area of moderately sloping to moderately steep Lester soils.

loam in the upper part, and it is dark yellowish brown, yellowish brown, and light olive brown, friable loam in the lower part. The substratum is light olive brown, friable loam. In some places the substratum is sandy loam. In small eroded areas, the surface layer is brown. Included in mapping are a few small areas of calcareous Storden soils and somewhat excessively drained Zenor soil. These included soils are on small convex knobs and make up about 5 percent of the acreage.

This Lester soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and potassium.

Nearly all of this soil is in pasture and woodland. Potential is fair for these uses. Potential is poor for crops. It is also poor for development of building sites and for septic tank absorption fields.

This soil is suited to grasses and legumes grown for pasture and to trees grown for wood products. Machine harvesting of hay is difficult because of slope. This soil is not suited to cultivated crops because of the erosion hazard and the danger of operating farm machinery on the stronger slopes.

This soil is in capability subclass VIe.

284B—Flagler sandy loam, 1 to 5 percent slopes. This is a nearly level to gently sloping, somewhat excessively drained soil on stream benches and in a few areas on uplands. Most areas are 3 to 12 acres in size but a few are larger.

Typically, the surface layer is very dark brown and very dark grayish brown sandy loam about 18 inches thick. The subsoil is about 22 inches thick. It is brown, friable sandy loam in the upper part; dark brown, friable sandy loam in the middle part; and dark brown, very friable loamy sand with a few pebbles in the lower part. The substratum is dark yellowish brown, loose loamy sand and sand that contains a few pebbles. In a few small areas the surface layer is gravelly sand.

This Flagler soil has low to moderate available water capacity. Permeability is moderately rapid in the loamy upper part and very rapid in the sandy lower part. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low to low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the very rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Lack of moisture limits crop production in many years because the soil has limited ability to supply moisture to crops during extended dry periods. Unless rains are timely, crops are frequently lost as a result of drought. Where this soil is cultivated, there is a hazard of wind and water erosion. Blowing sand grains from the Flagler soil cuts off young plants on Flagler soil and also on adjacent soils. Contour farming where practical and using conservation tillage that leaves as much plant residue on the soil surface as possible, greatly reduce crop damage and soil loss.

This soil is in capability subclass IIIe.

284C—Flagler sandy loam, 5 to 9 percent slopes. This is a moderately sloping, somewhat excessively drained soil on bench escarpments and in outwash areas in the uplands. Most areas are 3 to 10 acres in size but a few are much larger.

Typically, the surface layer is very dark brown and very dark grayish brown sandy loam about 12 inches thick. The subsoil is about 20 inches thick. It is brown, friable sandy loam in the upper part; dark brown, friable sandy loam in the middle part; and dark brown, very friable loamy sand with a few pebbles in the lower part. The substratum is dark yellowish brown, loose loamy sand and sand that contains a few gravel-size particles. In a few small eroded areas the surface layer is brown, gravelly sand, and in a few small areas loamy glacial sediments are in the substratum.

This Flagler soil has low to moderate available water capacity. Permeability is moderately rapid in the loamy upper part and very rapid in the sandy lower part. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low to low in available phosphorus and low in available potassium.

Most areas of this soil are cultivated. It has fair to poor potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the very rapid permeability of the substratum.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Unless rains are timely, crop yields are reduced by the limited amount of available water held by this soil. Where this soil is cultivated, there is a hazard of wind and water erosion. Blowing sand grains from the Flagler soil cut off young plants on Flagler soil and also adjacent soils. Contour farming where practical and using conservation tillage, which leaves as much plant residue on the soil surface as possible, greatly reduce crop damage and soil loss.

This soil is in capability subclass IIIe.

329—Webster-Nicollet complex, 1 to 3 percent slopes. This complex consists of level and nearly level, poorly drained and somewhat poorly drained soils on uplands. Individual areas typically range from 5 to 50 acres in size. They are irregular in shape and typically are closely associated with well drained soils. Areas are about 45 to 55 percent Webster soils, 30 to 40 percent Nicollet soils, and other soils make up the rest. The Webster soils are on flats and in swales. Nicollet soils are on low ridges and lower side slopes. The two soils are so intricately mixed, or so small in size, that it is not practical to separate them in mapping.

Typically, the Webster soil has a surface layer of black silty clay loam about 22 inches thick. The subsoil is about 24 inches thick. It is dark gray, friable silty clay loam in the upper part; olive gray, friable clay loam in the middle part; and olive gray, friable loam in the lower part. The substratum is olive gray, very friable loam and sandy loam.

Typically, the Nicollet soil has a surface layer of black and very dark gray loam about 20 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown, friable loam in the upper part and grayish brown, friable loam in the lower part. The substratum is mottled, light olive gray and strong brown, friable loam.

Included with these soils in mapping and making up 5 to 20 percent of the unit are small areas of Clarion, Okoboji, and Canisteo soils. Clarion soils are well drained and are on convex knobs. Canisteo soils are calcareous and poorly drained. They are in similar positions to the Webster soil on the landscape. Okoboji soils are very poorly drained and are in depressions.

The Webster and Nicollet soils have high available water capacity and moderate permeability. Surface runoff is slow on the Webster soil and medium on the Nicollet soil. The Webster soil has a naturally high water table,

and the Nicollet soil has a seasonally high water table. The plow layer of Webster soil is about 7 percent organic matter; that of the Nicollet soil is about 6 percent. Reaction in the surface layer and upper part of the subsoil is neutral in the Webster soil and is slightly acid or medium acid in the Nicollet soil. The subsoil of both these soils is usually very low in available phosphorus and potassium.

Most areas of these soils are cultivated. Potential is good for cultivated crops, hay, and pasture. The Webster soil has poor potential for development of building sites and for septic tank absorption fields. The Nicollet soil has fair potential for building site development and for septic tank absorption fields.

These soils are well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most of the Webster soil in this complex.

These soils are in capability subclass IIw.

335—Harcot loam, 0 to 2 percent slopes. This nearly level soil is poorly drained and calcareous. It is on stream benches and in outwash areas. Individual areas typically are irregular in shape and 10 to 60 acres in size, but some are much larger.

Typically, the surface layer is black and very dark gray loam about 20 inches thick. The subsoil is about 17 inches thick. It is olive gray, friable loam. The substratum is gray, loose loamy sand in the upper part and is yellowish red and light olive brown, loose loamy sand in the lower part. In small depressions the surface soil is thicker, and water ponds in wet seasons.

This soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid to very rapid in the sandy lower part. Surface runoff is slow. This soil has a naturally high water table. The plow layer is about 5 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good to fair potential for cultivated crops, hay, and pasture plants. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed and if adequate fertilizer is applied. Excess lime in this soil reduces the amount of phosphorus and potassium available to plants. Tile placement is difficult in some areas because the substratum is loose and unstable.

This soil is in capability subclass IIw.

373C2—Tallula silt loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil that occupies long narrow bands on side slopes and on a few narrow crests of slopes. Individual areas typically are 5 to 15 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. Plowing has mixed subsoil into the plow layer. The subsoil is about 15 inches thick. It is brown, friable silt loam in the upper part and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown, very friable silt loam. In a few small areas the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of a severely eroded soil that has a calcareous, lighter colored surface layer. These are convex areas that make up about 10 percent of the acreage.

This Tallula soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is typically neutral or mildly alkaline in the surface layer and subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

373D2—Tallula silt loam, 9 to 14 percent slopes, moderately eroded. This is a strongly sloping, well drained soil that occupies long narrow bands on side slopes and a few narrow crests of slopes on uplands. Individual areas typically are 4 to 25 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. Plowing has mixed subsoil into the plow layer. The subsoil is about 13 inches thick. It is brown, friable silt loam in the upper part and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown, very friable silt loam. In a few small areas the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of a severely eroded, calcareous soil that has a lighter colored surface layer. These are convex areas that make up about 10 to 15 percent of the acreage.

This Tallula soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is typically neutral or mildly alkaline in the surface layer and subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops and good for hay and pasture. It is fair for building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where this soil is cultivated, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as

possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss in cropped areas. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

377—Dinsdale silty clay loam, 0 to 2 percent slopes. This is a nearly level, well drained and moderately well drained soil on flats and ridge crests on uplands. Individual areas typically are 10 to 20 acres, but some are much larger.

Typically, the surface layer is black and very dark brown silty clay loam about 20 inches thick. The subsoil is about 40 inches thick. It is brown, friable silty clay loam in the upper part; light olive brown, firm loam in the middle part; and yellowish brown, firm loam in the lower part. Narrow areas along waterways are somewhat poorly drained.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. They are in similar positions on the landscape to the Dinsdale soils and make up less than 5 percent of the acreage.

This Dinsdale soil has high available water capacity and moderate permeability. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

This soil is in capability class I.

377B—Dinsdale silty clay loam, 2 to 5 percent slopes. This is a gently sloping, well drained and moderately well drained soil on long convex side slopes and ridge crests on uplands. Individual areas typically are 10 to 20 acres in size, but some are much larger.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 14 inches thick. The subsoil is about 46 inches thick. It is brown, friable silty clay loam in the upper part; light olive brown, firm loam in the middle part; and yellowish brown, firm loam in the lower part. Narrow areas along waterways are somewhat poorly drained, and a few areas are moderately sloping. In small eroded areas the plow layer is mixed with brown subsoil.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. They are in similar positions on the landscape to the Dinsdale soil and make up less than 5 percent of the acreage.

This Dinsdale soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

377C—Dinsdale silty clay loam, 5 to 9 percent slopes. This is a moderately sloping, well drained and moderately well drained soil on long side slopes and ridge crests in the uplands. Individual areas typically are 4 to 12 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown silty clay loam about 14 inches thick. The subsoil is about 46 inches thick. It is brown, friable silty clay loam in the upper part; light olive brown, firm loam in the middle part; and yellowish brown, firm loam in the lower part. Small eroded areas have brown subsoil material mixed in the plow layer. Also a few small areas on the steeper part of the slopes have a loam surface layer.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. These are similar to the Dinsdale soil in landscape position and make up less than 5 percent of the acreage.

This Dinsdale soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where this soil is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as

possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIIe.

377C2—Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained and moderately well drained soil on long side slopes and ridge crests in the uplands. Individual areas typically are 4 to 12 acres in size, but some are much larger.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed subsoil into the plow layer. The subsoil is about 40 inches thick. It is brown, friable silty clay loam in the upper part; light olive brown, firm loam in the middle part; and yellowish brown, firm loam in the lower part. A few small areas of the more sloping soil have a loam surface layer, and a few small severely eroded areas on the shoulder slopes have a brown plow layer.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. They are in similar positions on the landscape to the Dinsdale soil and make up less than 5 percent of the acreage.

This Dinsdale soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

382—Maxfield silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on broad flats and in shallow drainageways in the uplands. Most areas are about 5 to 40 acres in size, though a few are much larger.

Typically, the surface layer is black and very dark gray silty clay loam about 18 inches thick. The subsoil is about 29 inches thick. It is olive gray and grayish brown, friable silty clay loam in the upper part; grayish brown and yellowish brown, friable silty clay loam in the middle part; and light olive gray and strong brown, firm loam in the lower part. The substratum is multicolored, firm loam. The surface layer is somewhat thicker where the soil is adjacent to waterways.

This soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. Reaction is typically neutral or slightly acid in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Subsurface drainage has been installed in most areas.

This soil is in capability subclass IIw.

391B—Clyde-Floyd complex, 1 to 4 percent slopes. This complex consists of nearly level and gently sloping, poorly drained and somewhat poorly drained soils in waterways and on lower side slopes in the uplands. The lower areas are subject to brief, frequent flooding by runoff from adjacent slopes. Individual areas are 8 to 40 acres in size and contain about equal amounts of each soil. The Clyde soil typically is in the center of the drainageway, and the Floyd soil is on both sides in a band between the drainageway and the higher ridges. Areas typically are long and narrow, and bands of the two soils are so narrow that it is impractical to separate them in mapping.

Typically, the Clyde soil has a surface layer of black and dark olive gray silty clay loam about 18 inches thick. The subsoil is about 27 inches thick. It is olive gray, friable clay loam in the upper part; olive gray, friable loam and very friable sandy loam in the middle part; and grayish brown and light olive brown, friable loam in the lower part. The substratum is gray, firm loam.

Typically, the Floyd soil has a surface layer of black and very dark gray loam about 19 inches thick. The subsoil is about 25 inches thick. It is dark grayish brown, friable loam and sandy clay loam in the upper part. It is grayish brown, dark grayish brown, and yellowish brown, firm loam in the lower part. The substratum is multicolored, firm loam.

Included with these soils in mapping are small areas of Schley soils that have a thinner, lighter colored surface layer. They make up about 5 percent of the acreage and are in similar positions on the landscape to the Clyde-Floyd complex.

These Clyde and Floyd soils have a high available water capacity and moderate permeability. The Clyde soil has a high water table, and the Floyd soil has a seasonally high water table. Surface runoff is slow from Clyde soil and medium from Floyd soil. The plow layer of the Clyde soil is about 10 percent organic matter; that of the Floyd soil is about 6 percent. Reaction is typically neutral

throughout the Clyde soil and neutral or slightly acid in the surface layer and subsoil of the Floyd soil. The subsoil of both soils is very low in phosphorus and potassium.

Most areas of these soils are cultivated. Potential is good for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

These soils are well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed.

There is a difference in the rate at which water moves through the upper and the lower horizons of the Floyd soil. Permeability is greater in the upper horizons. When water reaches the less permeable lower horizons, a perched water table develops and water flows laterally downslope. For this reason a drainage system that intercepts laterally moving water is the most successful.

This soil is in capability subclass IIw.

398—Tripoli silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad upland flats and at the heads of broad, shallow drainageways. Most areas are about 5 to 40 acres in size.

Typically, the surface layer is black and very dark gray silty clay loam and clay loam about 18 inches thick. The subsoil is about 25 inches thick. It is olive gray, friable clay loam in the upper part; olive, friable loam in the middle part; and olive gray, firm loam in the lower part. The substratum is multicolored, firm loam.

This soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. The reaction is typically neutral or slightly acid in the surface layer and upper part of the subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Tile drainage has been installed in most areas.

There is a difference in the rate at which water moves through the more permeable upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper horizons. When it reaches the less permeable horizons, a perched water table develops.

This soil is in capability subclass IIw.

399—Readlyn loam, 1 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on broad upland ridges and low-gradient, slightly convex side slopes. Individual areas typically range from about 5 to 40 acres in size.

Typically, the surface layer is black and very dark grayish brown loam about 19 inches thick. The subsoil, about 30 inches thick, is grayish brown and light olive brown, firm loam in the upper part and light olive brown, firm loam in the lower part. The substratum is light olive gray, firm loam. In a few small areas the lower part of the subsoil is sandy loam.

Included with this soil in mapping are a few small areas of poorly drained Tripoli soil. They occur in the lower areas and drainageways and make up about 10 percent of the acreage.

The Readlyn soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 5 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness hinders cultivation and reduces crop yields unless excess water is removed.

There is a difference in the rate at which water moves through the upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper horizons. When it reaches the less permeable horizons, a perched water table develops.

This soil is in capability class I.

407B—Schley silt loam, 1 to 4 percent slopes. This is a nearly level to gently sloping, somewhat poorly drained soil on slightly concave to convex lower side slopes or coves on uplands. Individual areas typically are long and narrow and range from 3 to 20 acres in size, but a few are much larger.

Typically, the surface layer is black silt loam about 8 inches thick. The subsoil is about 52 inches thick. It is very dark grayish brown, friable silt loam and dark grayish brown and yellowish brown, friable silty clay loam in the upper part; grayish brown, friable loam and olive gray, friable sandy loam in the middle part; and light olive gray and strong brown, firm loam in the lower part. In places the surface layer is loam. Along waterways the surface layer is somewhat thicker and darker in color.

Included with this soil in mapping are a few small areas of Donnan soil that have very firm silty clay subsoil. They make up about 5 percent of the acreage and are in similar positions to the Schley soil on the landscape.

This Schley soil has high available water capacity and moderate permeability. It has a seasonally high water table and slow surface runoff. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local

liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. It has poor potential for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Wetness is, at least in part, caused by sidehill seepage.

There is a difference in the rate at which water moves through the upper horizons and the less permeable lower horizons. Water moves more rapidly in the upper horizons. When it reaches the less permeable horizons, a perched water table develops and water flows laterally downslope. A drainage system that intercepts laterally moving water is, therefore, the most successful.

This soil is in capability subclass IIw.

426—Aredale loam, 0 to 2 percent slopes. This is a nearly level, well drained soil on flats and ridge crests in the uplands. Individual areas typically are 5 to 40 acres in size, but some are larger.

Typically, the surface layer is black, very dark brown, and dark brown loam about 20 inches thick. The subsoil is about 40 inches thick. It is brown, friable loam in the upper part; dark yellowish brown and yellowish brown, friable sandy loam in the middle part; and yellowish brown and pale brown, mottled, firm loam in the lower part. The substratum is multicolored, firm sandy clay loam. In some places the surface layer is silt loam.

Included with this soil in mapping are a few small areas of somewhat excessively drained Dickinson soils on low ridges and somewhat poorly drained Floyd soils near waterways. These included soils make up about 10 percent of the acreage.

This Aredale soil has moderate available water capacity and moderate permeability. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

This soil is in capability class I.

426B—Aredale loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on ridge crests and convex side slopes on uplands. Individual areas are typically 5 to 60 acres in size, but some are larger.

Typically, the surface layer is black, very dark brown, and dark brown loam about 17 inches thick. The subsoil is about 39 inches thick. It is brown, friable loam in the upper part; dark yellowish brown and yellowish brown, friable sandy loam in the middle part; and yellowish brown and pale brown, firm loam in the lower part. The substratum is multicolored, firm sandy clay loam. In some places the surface layer is silt loam, and in a few places, it is sandy loam. Narrow areas along waterways are somewhat poorly drained. A few areas are moderately sloping. In small areas the soil is eroded and brown subsoil material is mixed in the plow layer.

This Aredale soil has moderate available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for building sites and septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

426C—Aredale loam, 5 to 9 percent slopes. This is a moderately sloping, well drained soil on ridge crests and long convex side slopes on uplands. Individual areas typically are 5 to 40 acres in size, but some are larger.

Typically, the surface layer is very dark brown and dark brown loam about 14 inches thick. The subsoil is about 36 inches thick. It is brown, friable loam in the upper part; dark yellowish brown and yellowish brown, friable sandy loam in the middle part; and yellowish brown and pale brown, firm loam in the lower part. The substratum is multicolored, firm sandy clay loam. In some places the surface layer is silt loam, and in a few places it is sandy loam. Narrow areas near waterways are somewhat poorly drained.

This soil has moderate available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for building sites and septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIIe.

426C2—Aredale loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on ridge crests and long convex side slopes on uplands. Individual areas typically are 5 to 40 acres in size, but some are larger.

Typically, the surface layer is very dark brown loam about 8 inches thick. Plowing has mixed subsoil material into the plow layer. The subsoil is about 36 inches thick. It is brown, friable loam in the upper part; dark yellowish brown and yellowish brown, friable sandy loam in the middle part; and yellowish brown and pale brown, mottled, firm loam in the lower part. The substratum is multicolored, firm sandy clay loam. In some places the surface texture is silt loam, and in a few places it is sandy loam. Narrow areas near waterways are somewhat poorly drained. In a few small severely eroded areas on the shoulders of slopes the plow layer is brown.

This soil has moderate available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for building sites and septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

428B—Ely silty clay loam, 2 to 5 percent slopes. This is a gently sloping, somewhat poorly drained soil in waterways and on alluvial fans and foot slopes in the uplands. Individual areas typically are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay loam about 30 inches thick. The subsoil extends to a depth of about 60 inches. It is dark grayish brown, friable silty clay loam in the upper part and light yellowish brown, friable silt loam in the lower part. Narrow areas along the waterways are poorly drained.

This soil has high available water capacity and moderate permeability. It has a seasonally high water table and medium surface runoff. The plow layer is about 6 percent organic matter. Reaction is slightly acid or medium acid throughout the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture and is usually associated with soils that have good to fair potential for these uses. Potential is fair to poor for development of building sites and fair for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses or legumes for hay and pasture. It is subject to slight sheet and gully erosion if runoff water concentrates. Some areas receive excessive runoff from adjacent cultivated soils at higher elevations. In some years crops are damaged by short periods of flooding and sedimentation. Contour farming, terracing, and conservation tillage of upslope soils along with this soil help to control erosion and reduce local runoff and sedimentation. In years of greater than normal precipitation, wetness hinders cultivation and reduces crop yields unless excess water is removed. Wetness is, at least in part, caused by sidehill seepage. For this reason a drainage system that intercepts laterally moving water is the most successful.

This soil is in capability subclass IIe.

444B—Jacwin loam, 1 to 5 percent slopes. This is a nearly level to gently sloping, somewhat poorly drained soil on slightly convex to concave lower side slopes in the uplands. Most areas are 5 to 40 acres in size, but a few are larger.

Typically, the surface layer is black and very dark grayish brown loam and clay loam about 17 inches thick. The subsoil is about 15 inches thick. It is dark grayish brown, friable clay loam in the upper part; light olive brown, friable loam in the middle part; and light olive gray, firm silty clay in the lower part. The substratum is gray and yellowish brown, firm silty clay. In some areas the soil is moderately sloping and has a thinner surface layer. A few pockets and channels of coarser textured material are in the substratum.

Included with this soil in mapping are a few small areas of poorly drained Calamine soils. In a few small areas firm silty clay shale is in the plow layer. These included soils are in similar positions on the landscape to the Jacwin soil and make up about 10 percent of the acreage.

This Jacwin soil has high available water capacity. Permeability is moderate in the loamy upper part and very slow in the clayey lower part. Surface runoff is slow to medium. This soil has a seasonally high water table. The plow layer is about 6 percent organic matter. Reaction is typically neutral in the surface layer and subsoil. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is fair to poor for development of building sites and very poor for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture, although wet-

ness is a limitation in years of above normal rainfall. Providing adequate drainage is difficult because of the very slowly permeable substratum. Because there are a few pockets and channels of coarser textured material throughout the substratum, however, subsurface drainage is sometimes successful.

Where this soil is cultivated, the more sloping areas are subject to erosion. The loss of topsoil is particularly damaging to this soil because of the undesirable characteristics of the substratum. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface and contour farming decrease runoff and erosion. They also increase the wetness, however, by permitting more water to be absorbed into the soil.

Water moves more rapidly in the upper horizons of this soil. When it reaches the very slowly permeable substratum, a perched water table develops that flows laterally downslope. For this reason a drainage system that intercepts laterally moving water is the most successful. This is particularly true if more permeable soils are upslope. Water moves through these soils vertically until it reaches the shale and then flows downslope onto the Jacwin soil. Drainage installed at the base of the ridge of the more permeable soils will usually reduce the wetness of the Jacwin soil.

This soil is in capability subclass IIw.

444C2—Jacwin loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, somewhat poorly drained soil on convex ridge crests and side slopes on uplands. Individual areas typically are 4 to 10 acres in size.

Typically, the surface layer is very dark brown and very dark grayish brown loam about 8 inches thick. Plowing has mixed subsoil material into the plow layer. The subsoil is about 14 inches thick. It is grayish brown, friable silty clay loam in the upper part and light olive gray, very firm silty clay in the lower part. The substratum is very firm silty clay. Small areas of severely eroded soil on the shoulders of slopes have a grayish brown plow layer.

This Jacwin soil has high available water capacity. Permeability is moderate in the upper part and very slow in the lower part. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically slightly acid or neutral in the surface layer and subsoil. The subsoil is low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair to poor potential for cultivated crops, hay, and pasture. Potential is fair for development of building sites but very poor for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of herbicides.

Water moves more rapidly in the upper horizons of this soil, and when it reaches the more slowly permeable horizons, a perched water table develops. Water often flows laterally downslope and causes seepy areas to develop.

This soil is in capability subclass IIIe.

506—Wacousta silt loam, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions on uplands. It is subject to ponding by runoff from adjacent areas. Individual areas are generally 5 to 20 acres in size, but a few are much larger.

Typically, the surface layer is black silt loam and silty clay loam about 14 inches thick. The subsoil is about 9 inches thick. It is olive gray, firm silty clay loam. The substratum is olive gray, firm silty clay loam and silt loam.

Included with this soil in mapping are a few small areas of Harps soil that are very high in lime. They are along the rims of the depressions and make up about 5 percent of the acreage.

This Wacousta soil has high available water capacity and moderate permeability. Runoff does not occur until the depressions become filled with water. The plow layer is about 8 percent organic matter. Reaction of the surface layer is typically neutral and that of the subsoil is mildly alkaline. The subsoil is very low in available phosphorus and very low to low in available potassium.

Most areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is very poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. It is usually associated with soils that are well suited to these crops.

Wetness and ponding are the chief hazards to cultivation of this soil. Because young plants die if they are covered with water for long periods, replanting is often necessary. Shallow ditches and tile drains with open intakes are needed to remove excess surface water.

This soil is in capability subclass IIIw.

507—Canisteo silty clay loam, 0 to 2 percent slopes. This is a level, poorly drained, calcareous soil on upland flats and in irregularly shaped swales and low-gradient drainageways. Individual areas typically range from 5 to 60 acres in size.

Typically, the surface layer is black and very dark gray silty clay loam about 20 inches thick. The subsoil is about 16 inches thick. It is dark gray, friable clay loam in the upper part and olive gray, friable loam in the lower part. The substratum is olive gray and light olive gray, friable loam and sandy loam in the upper part and light olive gray, firm loam in the lower part.

Included with this soil in mapping are small areas of Harps soil that have a higher lime content. They are on rims of depressions. Also included are a few small areas

of very poorly drained Okoboji soil in small depressions. These soils make up about 10 percent of the acreage.

This Canisteo soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 7 percent organic matter. Reaction is mildly alkaline or moderately alkaline in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed and if adequate fertilizer is used. Excess lime in this soil reduces the availability of phosphorus and potassium to plants. Tile drainage, however, has been installed in most areas.

This soil is in capability subclass IIw.

512C—Marlean loam, 2 to 9 percent slopes. This is a gently sloping to moderately sloping, well drained soil on ridge crests and side slopes in the uplands. Individual areas typically are 4 to 10 acres in size.

Typically, the surface layer is black and very dark brown loam about 12 inches thick. It is underlain by a substratum of hard, fractured limestone bedrock. The upper foot of the substratum is about 70 percent limestone fragments and 30 percent brown, friable loam fillings between the fragments. The underlying 3 feet is 65 to 80 percent limestone fragments with yellowish brown and brownish yellow sandy loam and loamy sand between the fragments. Hard limestone bedrock is below a depth of 5 feet. In a few small areas bedrock is at a depth of 20 to 30 inches. In other small areas limestone outcrops are at the surface.

This soil has low available water capacity. Permeability is moderate in the loamy mantle and moderately rapid in the underlying creviced bedrock. Surface runoff is medium. The plow layer is about 3 percent organic matter. Reaction is neutral or slightly acid. This soil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is poor for intertilled crops such as corn and soybeans. It is fair for hay and pasture. Potential is good to fair for development of building sites. It is poor for septic tank absorption fields.

This soil is severely limited for corn and soybeans by droughtiness. It is usually cropped with larger areas of more suitable soils (fig. 10). Cultivation is difficult because of the numerous outcrops of limestone bedrock. Although limitations are moderate for growing small grains and grasses and legumes for hay and pasture, this is usually the best use of the Marlean soil. Unless summer rains are frequent, yields are limited by the lack of available water.

This soil is in capability subclass IVs.

512E—Marlean loam, 9 to 18 percent slopes. This is a strongly sloping to moderately steep, well drained soil on side slopes in the uplands. Individual areas are typically 4 to 10 acres in size.

Typically, the surface layer is very dark brown and dark brown loam about 12 inches thick. It is underlain by a substratum of hard, fractured limestone bedrock. The upper foot of the substratum is about 70 percent fractured limestone fragments and 30 percent dark brown, friable loam fillings between the fragments. The underlying 2 feet is 65 to 80 percent limestone fragments with yellowish brown and brownish yellow sandy loam and loamy sand between the fragments. Hard limestone bedrock is below a depth of 5 feet. In a few small areas bedrock is at a depth of 20 to 30 inches. Other small areas have limestone bedrock outcrops.

This soil has low available water capacity. Permeability is moderate in the loamy mantle and moderately rapid in the underlying creviced bedrock. Surface runoff is rapid. The plow layer is about 3 percent organic matter. Reaction is neutral or slightly acid. This soil is very low in available phosphorus and potassium.

Some areas of this soil are cultivated. Potential is poor for corn and soybeans. It is fair to poor for hay and pasture. Potential is good to fair for development of building sites and poor for septic tank absorption fields.

This soil has severe limitations for corn and soybeans because it is droughty and is subject to severe erosion when cultivated. Where cultivated, it is usually cropped with larger areas of more suitable soils. Cultivation is difficult because of the outcrops of limestone. This soil has moderate to severe limitations for small grains and growing grasses and legumes for hay. Harvesting hay and small grains is difficult because of slope and the rock outcrops. Although this soil has moderate to severe limitations for pasture, this is generally its best use. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. Erosion is especially serious on this soil because it is shallow to bedrock. Contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface prevent excessive soil loss when this soil is used for occasional row crops.

This soil is in capability subclass IVs.

512G—Marlean loam, 18 to 40 percent slopes. This is a steep and very steep, well drained soil on side slopes in the uplands. Individual areas typically are 4 to 20 acres in size.

Typically, the surface layer is very dark brown and dark brown loam about 10 inches thick. It is underlain by a substratum of hard, fractured limestone bedrock. The upper foot of the substratum is about 70 percent fractured limestone fragments and 30 percent dark brown, friable loam fillings between the fragments. The underlying 2 feet is 65 to 80 percent limestone fragments with yellowish brown and brownish yellow sandy loam and loamy sand between the fragments. Hard, massive lime-

Figure 10.—Area of Marlean and Rockton soils. Marlean soil in center is too shallow to cultivate.

stone bedrock is at a depth of 5 feet. In a few small areas bedrock is at a depth of 20 to 30 inches. In numerous small areas limestone bedrock outcrops.

This Marlean soil has low available water capacity. Permeability is moderate in the loamy mantle and moderately rapid in the underlying creviced bedrock. Surface runoff is very rapid. The plow layer is about 2 1/2 percent organic matter. Reaction is neutral or slightly acid. This soil is very low in available phosphorus and potassium.

A few areas of this soil are cultivated. Potential is very poor for intertilled crops such as corn and soybeans. It is fair to poor for hay and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil has very severe limitations for corn and soybeans. It is droughty and is subject to very severe erosion when cultivated. The few areas cultivated are cropped with larger areas of more suitable soils. Cultivation or harvesting crops is very difficult and hazardous because of the steep slope and numerous outcrops of limestone. This soil has severe limitations for small grains and growing grasses and legumes for hay. Harvesting hay and small grains is difficult because of slope. Although this soil has severe limitations for pasture, this is generally its best use. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. Erosion is especially serious on this soil because it is shallow to bedrock.

This soil is in capability subclass VIIs.

551—Calamine silty clay loam, 1 to 3 percent slopes. This is a level and nearly level, poorly drained to

very poorly drained soil on broad upland flats, along waterways, and in lower concave positions. Most areas are 5 to 40 acres in size but a few are larger.

Typically, the surface layer is black and dark olive gray silty clay loam about 24 inches thick. The subsoil is about 12 inches thick. It is olive, firm clay loam in the upper part and gray, firm silty clay in the lower part. The substratum is gray, firm silty clay. In some places the surface layer is thinner. A few areas are gently sloping.

This soil has high available water capacity. Permeability is moderate to slow in the upper part and very slow in the lower part. This soil has a naturally high water table and slow surface runoff. The plow layer is about 8 percent organic matter. Reaction is typically neutral or mildly alkaline in the surface layer and subsoil. The subsoil is low in available phosphorus and potassium.

Many areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is very poor for development of building sites and for septic tank filter fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed by drainage. Providing adequate drainage is difficult because the substratum is very slowly permeable. Because there are a few pockets and channels of coarser textured material in the subsoil and substratum, subsurface drainage is sometimes successful. Backfilling the trenches with more porous material increases percolation and may partially compensate for the slow horizontal movement of water in the substratum.

Water moves more rapidly in the upper horizons of this soil. When it reaches the very slowly permeable shale substratum, a perched water table develops and may flow slowly downslope. For this reason a drainage system that intercepts laterally moving water may be the most successful. This is particularly true where more permeable, better drained soils are on ridges upslope. Water moves through these soils vertically until it reaches the deep, underlying shale and then flows downslope. A tile system installed at the base of the ridge of the more permeable soils may reduce the wetness of the Calamine soil.

This soil is in capability subclass IIIw.

559—Talcot clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This is a nearly level, poorly drained, calcareous soil on stream benches and in outwash areas. Individual areas typically are 10 to 50 acres in size but some are much larger.

Typically, the surface layer is black and very dark gray clay loam about 19 inches thick. The subsoil is about 19 inches thick. It is dark gray and gray, friable silty clay loam in the upper part; olive gray, friable clay loam and loam in the middle part; and light olive gray, very friable sandy loam in the lower part. The substratum is olive gray, loose gravelly loamy sand in the upper part and multicolored, loose gravelly sand in the lower part. In some places the subsoil is thinner and the sand and gravel substratum is shallower. In a few small depressions the layer is somewhat thicker. The depressions pond water in wet seasons.

This Talcot soil has moderate available water capacity. Permeability is moderate in the loamy upper part and rapid in the sandy lower part. Surface runoff is slow. The soil has a naturally high water table. The plow layer is about 7 percent organic matter. Reaction is mildly alkaline or moderately alkaline in the surface layer and subsoil. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed and if adequate fertilizer is used. Excess lime in this soil reduces the availability of phosphorus and potassium to plants. Tile placement is difficult in most areas because loose, unstable sand is below a depth of about 3 feet.

This soil is in capability subclass IIw.

595—Harpster silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained calcareous soil in drainageways and on broad flats in the uplands. Individual areas typically range from 5 to 20 acres in size.

Typically, the surface layer is black and very dark gray silty clay loam about 19 inches thick. The subsoil is about 17 inches thick. It is dark gray, friable silty clay loam in the upper part and olive gray and olive, friable silt loam in the lower part. The substratum is grayish brown, friable silt loam in the upper part and gray, firm loam in the lower part. In a few small areas the surface layer is neutral.

This soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is moderately alkaline or mildly alkaline throughout. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed, and if adequate fertilizer is applied. Excess lime in this soil reduces the availability of phosphorus and potassium to plants.

This soil is in capability subclass IIw.

612C2—Mottland loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained calcareous soil on narrow, convex ridge crests and side slopes in the uplands. Individual areas typically are 3 to 12 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. It is underlain by friable flaggy loam weathered from limestone. In places plowing has mixed soft limestone into the plow layer. In a few areas the flaggy loam is at a depth of 20 to 30 inches. In a few small areas hard, fractured limestone bedrock is at a depth of 8 to 20 inches.

This Mottland soil has moderate available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying soft limestone. Surface runoff is medium. The plow layer is about 1 percent organic matter. Reaction is mildly alkaline or moderately alkaline. This soil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

This soil is suited to corn and soybeans. It is well suited to small grains and to grasses and legumes for hay and pasture. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. Where this soil is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion and the calcareous surface layer are factors to be considered in the use of herbicides. If the underlying, soft weathered limestone is exposed in terrace excavation, 6 to 8 inches of topsoil needs to be replaced.

This soil is in capability subclass IIIe.

612E2—Mottland loam, 9 to 18 percent slopes, moderately eroded. This is a strongly sloping to moderately steep, well drained, calcareous soil that occupies long, narrow, horizontal bands on side slopes. Individual areas typically are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. It is underlain by friable flaggy loam weathered from limestone. In places plowing has mixed soft limestone into the plow layer. In places the flaggy loam is as deep as 20 or 30 inches. In other areas fractured limestone bedrock is at a depth of 8 to 20 inches.

This soil has moderate available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying soft limestone. Surface runoff is rapid. The plow layer is about 1 percent organic matter. Reaction is mildly or moderately alkaline. This soil is very low in available phosphorus and potassium.

Many areas of this soil are cultivated. It has fair to poor potential for cultivated crops and fair potential for hay and pasture. Potential is fair to poor for building sites and poor for septic tank absorption fields.

The use of this soil for corn and soybeans is severely limited by slope. It is moderately limited for small grains and for grasses and legumes grown for hay and pasture. Excessive lime in this soil reduces the availability of phosphorus and potassium to plants. Harvesting hay and small grain is difficult because of slope. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. Where this soil is cultivated, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss when this soil is used for occasional row crops. The reduced level of organic matter that results from erosion and the calcareous surface layer are factors to be considered in the use of herbicides. If the underlying soft weathered limestone is exposed in terrace excavation, 6 to 8 inches of topsoil need to be replaced.

This soil is in capability subclass IVe.

613—Rossfield silt loam, 0 to 2 percent slopes. This is a nearly level, well drained soil on flats and ridge crests in the uplands. Individual areas are 10 to 40 acres in size, though a few are much larger.

Typically, the surface layer is very dark brown, very dark grayish brown, and dark brown silt loam and silty clay loam about 15 inches thick. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is olive yellow, friable channery sandy loam weathered from limestone.

This soil has moderate to high available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying weathered limestone. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is neutral or slightly acid in the surface layer and in the upper part of the subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture.

This soil is in capability class I.

613B—Rossfield silt loam, 2 to 5 percent slopes. This is a gently sloping, well drained soil on ridge crests and side slopes. Individual areas typically are long and narrow and 5 to 100 acres in size.

Typically, the surface layer is very dark brown, very dark grayish brown and dark brown silt loam and silty clay loam about 14 inches thick. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is olive yellow, friable channery sandy loam weathered from limestone. In a few small areas weathered limestone is at a depth of 12 to 20 inches.

This soil has moderate to high available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying weathered limestone. Surface runoff is slow. The plow layer is about 4 percent organic matter. Reaction is neutral or slightly acid in the surface layer and in the upper part of the subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. If the underlying soft limestone is exposed in terrace excavation, 6 to 8 inches of topsoil need to be replaced.

This soil is in capability subclass IIe.

613C—Rossfield silt loam, 5 to 9 percent slopes. This is a moderately sloping, well drained soil on ridge crests and side slopes. Individual areas typically are long and narrow and are 4 to 12 acres in size.

Typically, the surface layer is very dark brown, very dark grayish brown, and dark brown silt loam and silty clay loam about 13 inches thick. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is olive yellow, friable channery sandy loam weathered from limestone. In a few small areas weathered limestone is at a depth of 8 to 20 inches.

This soil has moderate to high available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying weathered limestone. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is neutral or slightly acid in the surface layer and in the upper part of the subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites. It is fair for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. If the underlying soft limestone is exposed in terrace excavation, 6 to 8 inches of topsoil need to be replaced.

This soil is in capability subclass IIIe.

613C2—Rossfield silt loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil on ridge crests and side slopes. Individual areas typically are long and narrow and are 4 to 12 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. Plowing has mixed subsoil material into the plow layer. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is fine textured shale below a depth of about 5 feet. In a few small areas weathered limestone is at a depth of 8 to 20 inches. In small eroded areas on the shoulders of slopes, the plow layer is brown.

This soil has moderate to high available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying weathered limestone. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is neutral or slightly acid in the surface layer and in the upper part of the subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and fair for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides. If the underlying soft limestone is exposed in terrace excavation, 6 to 8 inches of topsoil needs to be replaced.

This soil is in capability subclass IIIe.

613D2—Rossfield silt loam, 9 to 14 percent slopes, moderately eroded. This is a strongly sloping, well drained soil on side slopes. Individual areas typically are long and narrow and are 3 to 10 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. Plowing has mixed subsoil material into the plow layer. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and yellowish brown, friable clay loam in the lower part. The substratum is olive yellow, friable channery sandy loam weathered from limestone. In a few small areas weathered limestone is at a depth of 8 to 20 inches. In small severely eroded areas on the shoulders of slopes, the plow layer is brown.

This soil has moderate to high available water capacity. Permeability is moderate in the silty mantle and moderately rapid in the underlying weathered limestone. Surface runoff is rapid. The plow layer is about 2 percent organic matter. Reaction is neutral or slightly acid in the surface layer and in the upper part of the subsoil. The subsoil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. If the underlying limestone is exposed in terrace channels, 6 to 8 inches of topsoil need to be replaced. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

620C—Port Byron silt loam, 5 to 9 percent slopes. This is a moderately sloping, well drained soil on convex ridge crests and side slopes on uplands. Individual areas typically are long and narrow and about 5 to 15 acres in size. A few areas are much larger.

Typically, the surface layer is very dark brown and very dark grayish brown silt loam about 15 inches thick. The subsoil is about 28 inches thick. It is dark brown, friable silt loam in the upper part; brown and dark yellowish brown, friable silt loam in the middle part; and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown friable silt loam and loam. In eroded areas brown subsoil material is mixed in the plow layer.

This soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 4 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIIe.

620C2—Port Byron silt loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, well drained soil that occupies convex ridges and long narrow bands on side slopes in the uplands. Individual areas typically are 10 to 100 acres in size.

Typically, the plow layer is very dark grayish brown silt loam about 8 inches thick. It has been mixed with subsoil material. The subsoil is about 34 inches thick. It is dark brown, friable silt loam in the upper part; brown and dark yellowish brown, friable silt loam in the middle part; and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown, friable silt loam that grades to loam with depth. Areas of this soil near waterways and on the slope crest have a thicker surface layer. Areas of severely eroded soil on the shoulders of slopes have a brown plow layer.

This Port Byron soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is also good for building sites and septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

620D2—Port Byron silt loam, 9 to 14 percent slopes, moderately eroded. This is a moderately steep, well drained soil that occupies long narrow bands on side slopes in the uplands. Individual areas typically are 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed subsoil material into this layer. The subsoil is about 30 inches thick. It is dark brown, friable silt loam in the upper part; brown and dark yellowish brown, friable silt loam in the middle part; and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown, friable silt loam that grades to loam with depth. Areas of this soil near waterways and on the slope crest have a thicker surface layer. Areas of severely eroded soil on the shoulders of slopes have a brown plow layer.

This Port Byron soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops and good potential for hay and pasture. Potential is fair for building sites and septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a severe hazard of erosion. Conserva-

tion tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss when row crops are planted. Harvesting hay and small grain may be difficult because of slope. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IIIe.

620E2—Port Byron silt loam, 14 to 20 percent slopes, moderately eroded. This is a steep, well drained soil that occupies long narrow bands on side slopes in the uplands. Individual areas typically are 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. Plowing has mixed subsoil material into this layer in many areas. The subsoil is about 28 inches thick. It is dark brown, friable silt loam in the upper part; brown and dark yellowish brown, friable silt loam in the middle part; and yellowish brown, friable silt loam in the lower part. The substratum is yellowish brown, friable silt loam that grades to loam with depth. Areas of this soil near waterways and on the slope crest have a thicker surface layer. Areas of severely eroded soil on the shoulders of slopes have a brown plow layer.

This Port Byron soil has high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or slightly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is medium in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. Potential is fair to poor for cultivated crops and fair for hay and pasture. It is poor for building sites and septic tank absorption fields.

Soil slope is a severe limitation for corn and soybeans. It is a moderate limitation for small grains and for grasses and legumes grown for hay and pasture. Harvesting hay and small grains is difficult because of slope. Close grazing by livestock decreases the effectiveness of meadow crops in controlling erosion. Where this soil is cultivated, there is a very severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss when this soil is used for occasional row crops. The reduced level of organic matter that results from erosion is a factor to be considered in the use of fertilizers and herbicides.

This soil is in capability subclass IVe.

621—Houghton muck, 0 to 1 percent slopes. This is a level, very poorly drained soil in depressions that were once old lakebeds or swamps. It is subject to ponding as a result of runoff from adjacent areas. Individual areas are generally 4 to 40 acres in size, but a few are much larger.

Typically, this soil is black, decomposed swamp vegetation more than 60 inches thick. In a few areas a mineral soil is at a depth of as little as 30 inches, and in a few areas the soil is gently sloping.

This Houghton soil has high available water capacity and moderately slow to moderately rapid permeability. Runoff does not occur until the depressions become filled with water. The plow layer is about 25 percent organic matter, except in undrained or recently drained areas where it is about 40 percent. Reaction of the surface layer is typically neutral, and that of the substratum mildly alkaline. This soil is low in available phosphorus and very low in available potassium.

Many areas of this soil are cultivated. Potential is fair for cultivated crops, hay, and pasture. It is very poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Damage to crops by frost is more common on this soil than on most other soils in the county. Cold air collects in depressions and doesn't move out unless there is a breeze. When this soil is drained and cultivated, the rate of decomposition of the organic materials increases and the organic layer gradually subsides.

This soil is in capability subclass IIIw.

638C2—Clarion-Storden loams, 5 to 9 percent slopes, moderately eroded. These are moderately sloping, well drained soils. They are on knolls, convex ridges, and side slopes that border waterways and streams in the uplands. The slopes typically are short. Individual areas typically are long and irregular in shape and range from 6 to 30 acres. Areas are 50 to 60 percent Clarion soils, 30 to 45 percent Storden soils, and up to 20 percent other soils. The Storden soils are calcareous and are on the more convex parts of the knolls and ridges. The Clarion soils are on the ridge crests, in shallow waterways, and on the lower part of the side slopes. The two soils are intricately mixed or so small in extent that is is not practical to separate them in mapping.

Typically, the Clarion soil has a surface layer of very dark brown loam about 8 inches thick. Plowing has mixed subsoil material into the plow layer. The subsoil is about 18 inches thick. It is brown, friable loam. The substratum is olive brown and light olive brown friable loam. In some places the substratum is sandy loam.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. In places plowing has mixed the brown substratum into the surface layer. The surface layer is underlain by a friable, loamy substratum. It is brown, grayish brown, and light olive brown loam in the upper part and light yellowish brown loam in the lower part. In some places the substratum is sandy loam.

These soils have high available water capacity and moderate permeability. Surface runoff is medium. The

plow layer of the Clarion soil is about 2 percent organic matter, and that of the Storden soil is about 1 percent organic matter. Reaction is typically medium acid or slightly acid in the upper part of the Clarion subsoil and mildly alkaline or moderately alkaline in the surface layer and subsoil of the Storden soil. The subsoil of both these soils is very low in available phosphorus and potassium.

Most areas of these soils are cultivated. Potential is good to fair for cultivated crops, hay, and pasture. Potential is good for development of building sites and fair for septic tank absorption fields.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if properly fertilized. Excess lime in the Storden soils reduces the amount of phosphorus and potassium available to plants. If these soils are used for cultivated crops, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter that results from erosion and the calcareous surface layer of the Storden soils need to be considered if herbicides are used.

These soils are in capability subclass IIIe.

638D2—Clarion-Storden loams, 9 to 14 percent slopes, moderately eroded. This map unit consists of strongly sloping, well drained soils. They are on knolls, narrow convex ridges, and side slopes that border waterways and streams in the uplands. The slopes typically are short. Individual areas typically are long and narrow and range from 5 to 12 acres. They are about 50 to 60 percent Clarion soils, 30 to 45 percent Storden soils, and up to 20 percent other soils. The Storden soils are on the more convex parts of the knolls and ridges. The Clarion soils are on the ridge crests, in shallow waterways, and on the lower part of the side slopes. The two soils are so intricately mixed or so small in extent that it is not practical to separate them in mapping.

Typically, the Clarion soil has a surface layer of very dark brown loam about 8 inches thick. Plowing has mixed subsoil into the plow layer. The subsoil is about 18 inches thick. It is brown, friable loam. The substratum is olive brown and light olive brown, friable loam. In some places the substratum is sandy loam.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. In places plowing has mixed the brown substratum into the surface layer. The surface layer is underlain by a friable, loamy substratum. It is brown, grayish brown, and light olive brown loam in the upper part and light yellowish brown loam in the lower part. In some places the substratum is sandy loam.

These soils have high available water capacity and moderate permeability. Surface runoff is rapid. The plow layer of the Clarion soil is about 2 percent organic matter. That of the Storden soil is about 1 percent organic matter, and it is calcareous. Reaction is typically medium acid or slightly acid in the upper part of the Clarion subsoil and is mildly alkaline or moderately alkaline throughout the Storden soil. The subsoil of both these soils is very low in available phosphorus and potassium.

Many areas of these soils are cultivated. They have fair potential for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if properly fertilized. Excess lime in the Storden soils reduces the availability of phosphorus and potassium to plants. If these soils are used for cultivated crops, there is a severe hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss. The reduced level of organic matter resulting from erosion and the calcareous surface layer of the Storden soils need to be considered in the use of herbicides.

These soils are in capability subclass IIIe.

733—Calco silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained, calcareous soil on flood plains of streams and in low drainageways on uplands. It is subject to frequent flooding from adjacent streams. Individual areas are generally long and narrow and 10 to 80 acres in size.

Typically, the surface layer is black and very dark gray silty clay loam about 35 inches thick. The subsoil is about 5 inches thick. It is dark gray, friable silty clay loam. The substratum is multicolored, friable silt loam in the upper part and dark gray, friable sandy loam in the lower part. In a few small channeled areas next to the streams numerous kinds of soil are intermingled. In a few areas the surface layer is mucky.

This soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is moderately alkaline in the surface layer and moderately alkaline or mildly alkaline in the subsoil. The subsoil is very low in available phosphorus and potassium.

This soil is used for cultivated crops and permanent pasture. Potential is mostly good to fair for cultivated crops, hay, and pasture. It is very poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, and small grains if it can be properly drained and protected from flooding and if it is properly fertilized. Excessive lime reduces the availability of phosphorus and potassium to plants. Adequate tile outlets are difficult to obtain in some areas. Areas immediately adjacent to streams are difficult to crop because of stream meanders, frequency of flooding, and the difficulty of flood control. These areas usually are best left in permanent pasture.

This soil is in capability subclass IIw.

760—Ansgar silt loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on broad upland divides and at the heads of broad, shallow drainageways. Individual areas typically range from 3 to 15 acres in size.

Typically, the surface layer is black and very dark gray silt loam about 7 inches thick. The subsurface layer, about 4 inches thick, is dark gray and dark grayish brown, mottled, friable silt loam. The subsoil extends to a depth of about 60 inches. It is grayish brown, friable silty clay loam in the upper part and multicolored, mottled, firm loam in the lower part. In a few small areas along waterways the surface layer is darker colored and thicker.

This Ansgar soil has high available water capacity and moderate permeability. It has a naturally high water table and slow surface runoff. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available potassium and low to very low in available phosphorus.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed.

This soil is in capability subclass IIw.

761—Franklin silt loam, 1 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on convex ridges and side slopes on uplands. Individual areas typically are 5 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer, about 6 inches thick, is dark grayish brown and grayish brown, friable silt loam. The subsoil extends to a depth of about 60 inches. It is brown and light olive brown, friable silty clay loam in the upper part; yellowish brown and light yellowish brown, firm loam in the middle part; and yellowish brown firm loam and sandy clay loam in the lower part. In the lower areas, the surface layer is darker colored, and somewhat thicker.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. These areas are in similar positions to this Franklin soil on the landscape and make up about 5 percent of the acreage.

This Franklin soil has high available water capacity and moderate permeability. This soil has a seasonally high water table and slow surface runoff. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is fair for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. In years of greater than normal precipitation, wetness hinders cultivation and reduces crop yields unless excess water is removed.

This soil is in capability class I.

771B—Waubeek silt loam, 2 to 5 percent slopes. This is a gently sloping, well drained and moderately well drained soil on long, convex side slopes and ridge crests in uplands. Individual areas typically are 5 to 15 acres in size, but a few are much larger.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 46 inches thick. It is yellowish brown, friable silty clay loam in the upper part; olive gray and strong brown, friable silty clay loam over strong brown, firm loam in the middle part; and strong brown and yellowish brown, firm loam in the lower part. Narrow areas near the waterways are somewhat poorly drained.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. They are on similar landscapes to the Waubeek soil and make up about 5 percent of the acreage.

This Waubeek soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIe.

771C—Waubeek silt loam, 5 to 9 percent slopes. This is a moderately sloping, well drained and moderately well drained soil on long convex side slopes and ridge crests in uplands. Individual areas typically are 4 to 12 acres in size.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil is

about 46 inches thick. It is yellowish brown, friable silty clay loam in the upper part; olive gray and strong brown, mottled, friable silty clay loam over strong brown, firm loam in the middle part; and strong brown and yellowish brown, mottled, firm loam in the lower part. In small eroded areas brown material from the subsurface layer is mixed in the plow layer.

Included with this soil in mapping are a few small areas that have a dense clay layer at a depth of 20 to 36 inches. They are on similar landscapes to this Waubeek soil and make up about 5 percent of the acreage.

This Waubeek soil has high available water capacity and moderate permeability. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is low in available phosphorus and very low in available potassium.

Most areas of this soil are cultivated. Potential is good for cultivated crops, hay, and pasture. It is also good for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If it is cultivated, there is a moderate hazard of erosion. Conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface, contour farming, and terracing prevent excessive soil loss.

This soil is in capability subclass IIIe.

782B—Donnan silt loam, 2 to 5 percent slopes. This is a gently sloping, moderately well drained and somewhat poorly drained soil on long convex ridges and side slopes on uplands. Individual areas typically are 3 to 15 acres in size, though a few are much larger.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is about 51 inches thick. It is brown, friable silt loam in the upper part; grayish brown, firm clay loam in the middle part; and gray, mottled olive gray, and light olive brown, very firm silty clay in the lower part. Pockets and channels of sandy loam occur in the silty clay subsoil.

This soil has high available water capacity. Permeability is moderate in the silty loam mantle and very slow in the clayey lower part. This soil has a seasonally high water table and medium surface runoff. The plow layer is about 3 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. The loss of topsoil is particularly damaging to this soil because of the undesirable characteristics of the subsoil. Wetness is a limitation in years of above normal rainfall. Providing adequate drainage is difficult because the subsoil is very slowly permeable. Tile drainage has been successful in places, possibly because there are a few pockets and channels of sandy materials throughout the subsoil.

Contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface decrease runoff and erosion but cause more water to be absorbed into the soil. Water moves more rapidly in the upper horizons of this soil. When it reaches the more slowly permeable lower horizons, a perched water table develops and flows laterally downslope. For this reason a drainage system that intercepts laterally moving water is the most successful.

This soil is in capability subclass IIe.

782C2—Donnan silt loam, 5 to 9 percent slopes, moderately eroded. This is a moderately sloping, moderately well drained and somewhat poorly drained soil on long convex ridges and side slopes. Individual areas typically are 3 to 15 acres in size, though a few are much larger.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. Plowing has mixed subsoil material into this layer. The subsoil is about 48 inches thick. It is brown, friable silt loam in the upper part; grayish brown, firm clay loam in the middle part; and gray, olive gray, and light olive brown, very firm silty clay in the lower part. Pockets and channels of sandy loam are in the silty clay subsoil. In severely eroded areas on the shoulders of slopes the plow layer is brown.

This Donnan soil has high available water capacity. Permeability is moderate in the loamy mantle and very slow in the clayey lower part. This soil has a seasonally high water table and medium surface runoff. The plow layer is about 2 percent organic matter. Reaction is typically medium acid or strongly acid in the upper part of the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where it is cultivated, there is a moderate hazard of erosion. The loss of topsoil is particularly damaging to this soil because of the undesirable characteristics of the subsoil. Wetness is a limitation in years of above normal rainfall. Providing adequate drainage is difficult because the subsoil is very slowly permeable. The few pockets and channels of sandy materials throughout the subsoil may explain the success of tile drainage in places. The reduced level of organic matter that results from erosion is a

factor to be considered in the use of fertilizers and herbicides.

Contour farming and conservation tillage that disturbs the soil as little as possible and leaves crop residue on the surface decrease runoff and erosion but cause more water to be absorbed into the soil. Water moves more rapidly in the upper horizons of this soil. When it reaches the more slowly permeable lower horizons, a perched water table develops that may flow laterally downslope. For this reason a drainage system that intercepts laterally moving water may be the most successful.

This soil is in capability subclass IIIe.

828B—Zenor sandy loam, 2 to 5 percent slopes. This is a gently sloping, somewhat excessively drained soil on low ridges in the uplands and on stream benches. Most areas are 4 to 15 acres in size.

Typically, the surface layer is black, very dark brown, and very dark grayish brown sandy loam about 20 inches thick. The subsoil is about 10 inches thick. It is brown, very friable sandy loam. The substratum is multicolored, loose loamy sand, sand, and gravelly sand. In a few small areas the substratum is loam and not quite so droughty. Also, in a few small eroded areas, brown subsoil material is mixed in the plow layer.

This Zenor soil has moderate available water capacity. Permeability is moderately rapid in the upper part and rapid in the substratum. Surface runoff is slow. The plow layer is about 2 percent organic matter. Reaction is typically neutral to medium acid in the subsoil and ranges widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is good for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture. Unless rains are timely, yields are reduced because the soil holds only a limited amount of available water. Where this soil is cultivated, there is a hazard of wind and water erosion. Blowing sand grains from Zenor soil cut off young plants on Zenor and adjacent soils. Contour farming, where practical, and using conservation tillage that leaves as much plant residue on the soil surface as possible greatly reduce crop damage and soil loss.

This soil is in capability subclass IIIe.

828C—Zenor sandy loam, 5 to 14 percent slopes. This is a moderately sloping to strongly sloping, somewhat excessively drained soil on knolls and convex ridges and side slopes. Most areas are 3 to 12 acres.

Typically, the surface layer is very dark brown, very dark grayish brown, and dark brown sandy loam about 14 inches thick. The subsoil is about 10 inches thick. It is brown, very friable sandy loam. The substratum is multicolored, loose loamy sand, sand, and gravelly sand. In small eroded areas brown subsoil material is mixed in the plow layer.

Included with this soil in mapping are a few small areas of calcareous Storden soils. They are intermingled with this Zenor soil on the landscape and make up about 10 percent of the acreage.

This Zenor soil has moderate available water capacity. Permeability is moderately rapid in the upper part and rapid in the substratum. Surface runoff is medium. The plow layer is about 2 percent organic matter. Reaction is typically neutral to medium acid in the subsoil and ranges widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has fair potential for cultivated crops, hay, and pasture. Potential is also fair for development of building sites and for septic tank absorption fields. There is a danger of pollution of ground water because of the rapid permeability of the substratum.

This soil is suited to corn, soybeans, and grasses and legumes for hay and pasture. Unless rains are timely, yields are reduced because the soil holds only a limited amount of available water. Where this soil is cultivated, there is a moderate hazard of water erosion and a hazard of wind erosion. Blowing sand grains from Zenor soils cut off young plants on Zenor and adjacent soils. Contour farming, terracing and using conservation tillage that leaves as much plant residue on the surface as possible greatly reduce soil loss and crop damage.

This soil is in capability subclass IIIe.

933—Sawmill silty clay loam, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on flood plains. It is subject to frequent flooding. Individual areas are generally 10 to 40 acres in size, but a few are much larger.

Typically, the surface layer is black and very dark gray silty clay loam about 28 inches thick. The subsoil is about 26 inches thick. It is olive gray, friable silty clay loam in the upper part and light olive gray, friable silt loam in the lower part. The substratum is light olive gray, friable silt loam. The surface layer is somewhat thicker in swales and adjacent to waterways. In a few small areas the surface layer is thinner and has a higher sand content.

This Sawmill soil has high available water capacity. Permeability is moderately slow or moderate. This soil has a naturally high water table and slow surface runoff. The plow layer is about 6 percent organic matter. Reaction is typically slightly acid or neutral throughout. The subsoil is medium in available phosphorus and potassium.

This soil is used for cultivated crops and permanent pasture. In most areas potential is good for cultivated crops, hay, and pasture. Potential is poor for develop-

ment of building sites and for septic tank absorption fields.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed and flooding is not too frequent. Adequate tile outlets are difficult to obtain in some areas. Areas immediately adjacent to streams are difficult to crop because of stream meanders, frequency of flooding, and the difficulty of flood control. These areas are best left in permanent vegetation.

This soil is in capability subclass IIw.

956—Okoboji-Harps complex, 0 to 2 percent slopes. This complex consists of depressional and nearly level, poorly drained and very poorly drained soils on uplands. The depressions are subject to ponding by runoff from adjacent areas. Individual areas typically range from 10 to 40 acres in size, but some are much larger. They are 40 to 50 percent Okoboji soils, 35 to 45 percent Harps soils. The Okoboji soil is in depressions. The Harps soil is on rims and low ridges around and between depressions. The two soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Harps soil has a surface layer of black and very dark gray loam about 19 inches thick. The subsoil is about 24 inches thick. It is olive gray, friable loam in the upper part and light olive gray, friable loam in the lower part. The substratum is light olive gray friable loam and sandy loam. This soil is calareous.

Typically, the Okoboji soil has a surface layer of black and very dark gray silty clay loam about 36 inches thick. The subsoil is about 19 inches thick. It is very dark gray to olive gray, friable, calcareous silty clay loam. In small areas the plow layer is mucky silt loam.

Included with these soils in mapping and making up 15 to 20 percent of the acreage are small areas of Canisteo soils. These soils are poorly drained and mildly alkaline. They are at about the same elevation as the Harps soils.

These Okoboji and Harps soils have high available water capacity. Permeability is moderately slow in the Okoboji soil and moderate in the Harps soil. These soils have a naturally high water table. Runoff does not occur until the Okoboji depressions become filled with water. The plow layer of the Okoboji soil is about 10 percent organic matter; that of the Harps soil is about 5 percent. Reaction is typically moderately alkaline or mildly alkaline throughout in the Harps soil and neutral in the Okoboji soil. The subsoil of both soils is very low in available phosphorus and potassium.

Most areas of these soils are cultivated. The Okoboji soil has moderate potential for cultivated crops, hay, and pasture and very poor potential for development of building sites and septic tank absorption fields. The Harps soil has good potential for cultivated crops, hay, and pasture plants. It has poor potential for development of building sites and for septic tank absorption fields.

These soils are well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture if excess water is removed. Tiles commonly are placed closer together in the Okoboji soil than in the adjacent wet soils because the Okoboji soil is finer textured.

These soils are in capability subclass IIIw.

1135—Coland clay loam, channeled, 0 to 2 percent slopes. This is a nearly level, poorly drained soil on flood plains. It is subject to frequent flooding. Individual areas typically are long and narrow, closely bordering the streams. They range from about 20 acres to several hundred acres. Most areas are dissected by old stream channels that flood frequently. They are kept wet by the recurring floods or by water standing in low places after floods.

Typically, the surface layer is black clay loam about 40 inches thick. The next layer is about 10 inches thick. It is very dark gray, friable clay loam. The substratum is dark gray, friable sandy loam in the upper part and is gray loose sand and gravel in the lower part.

Included with this soil in mapping, closely intermingled and making up about 40 percent of the acreage, are areas of relatively recent sediments. These sediments have a wide range of texture in the surface and subsurface layers and have variable internal drainage. They are mainly dark colored, though the most recently deposited sand bars are light in color. The surface and subsurface texture in many areas ranges from sandy loam to silty clay loam, and the most recent deposits are sand. The available water capacity is highly variable, but in many places it is high.

The Coland soil has high available water capacity and moderate permeability. Surface runoff is slow to very slow, and the low areas impound water after floods. This soil has a naturally high water table. The organic content of the surface layer varies greatly. Reaction of the surface layer ranges from neutral to moderately alkaline. The level of available phosphorus and potassium varies widely.

Nearly all areas of this soil are in permanent pasture or woods. In most areas potential is poor for cultivated crops and fair for hay and pasture. It is poor for development of building sites and for septic tank absorption fields.

This soil is generally not suited to cultivated crops. A few of the higher areas can be cropped after they are diked to protect them from flooding and are leveled by filling in old stream channels. Most areas are best used for permanent pasture and wildlife.

This soil is in capability subclass Vw.

1173—Hoopeston Variant sandy loam, 1 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on the lower parts of side slopes and along drainageways on uplands. Individual areas typically are narrow and irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is black, very dark gray and very dark grayish brown sandy loam about 22 inches

thick. The subsoil is about 15 inches thick. It is dark grayish brown, friable sandy loam in the upper part and grayish brown and light olive brown, friable sandy loam in the lower part. The substratum is multicolored stratified loam, silt loam, and sandy loam. A few small areas are poorly drained. In a few other small areas the surface layer is loamy sand.

This soil has moderate available water capacity. Permeability is moderately rapid in the upper part and moderate in the lower part. This soil has a seasonally high water table and slow runoff. The plow layer is about 3 percent organic matter. Reaction is typically medium acid in the subsoil and varies widely in the surface layer as the result of local liming practices. The subsoil is very low in available phosphorus and potassium.

Most areas of this soil are cultivated. It has good potential for cultivated crops, hay, and pasture. Potential is poor for development of building sites and for septic tank absorption fields.

This soil is suited to growing corn, soybeans, small grains, and legumes for hay and pasture. It has a seasonally high water table, but tile drainage systems may be difficult to install and keep functioning because of the sandy nature of the soil. Wetness is, at least in part, caused by sidehill seepage. The sandy loam surface layer is less stable than that of heavier textured soils. If the soil is cultivated, soil blowing needs to be controlled.

There is considerable difference in the rate at which water moves through the upper horizons and through the lower horizons. When it reaches the less permeable lower horizons, it forms a perched water table and then flows laterally downslope. For this reason a drainage system that intercepts laterally moving water is the most successful.

This soil is in capability subclass IIw.

5010—Pits, gravel. This map unit consists of gravel pits. Some are active, and some have been mined out and abandoned. They vary in size from a few acres to a hundred acres or more. Most are on stream benches.

Some of the larger pits have potential for recreation, especially if they pond water. They have low potential for most other uses even when filled and graded. Fair wildlife habitat or pasture can be developed on some of the pits that have been filled and graded.

Not placed in a capability subgroup.

5030—Pits, quarries. These are quarries resulting from the mining of shale and limestone. Shale is mined just south of Sheffield for clay to be used in the production of brick and tile products. Limestone is mined in several places in the county for agricultural lime and road materials. All of the limestone quarries, with the exception of the Dows quarry, are in the eastern part of the county. These quarries range from about one-quarter acre to 80 acres or more.

Many of the quarries in Franklin County contain water. Some are as much as 20 feet or more deep. Many have been stocked with fish. These areas add to the recreational opportunities in the county. As pits and quarries are abandoned, many that do not contain water revert to weeds and native vegetation and produce habitat for wildlife.

Not placed in a capability subgroup.

5550—Orthents, loamy. These are level to strongly sloping soils that have been used as borrow areas for construction. In some areas the original soil has been removed to a depth of 5 to 20 feet or more, in other areas the topsoil has been redistributed. The internal drainage of these soils is highly variable. It ranges from excessive to poor and is directly related to the kind of material from which the soils were derived and the condition to which the borrow area was restored. Individual areas typically range from 6 to 50 acres in size. Many of them are along Interstate Highway 35.

Typically, the upper 5 feet is calcareous, light olive brown, friable and firm loam. Cobbles and pebbles are common on the surface in many areas. In some areas the color is olive gray. In other areas the texture is sandy loam. In some areas 4 to 10 inches of topsoil has been redistributed over the borrowed area, often unevenly. The surface color in these areas ranges from very dark gray to dark brown.

Included in mapping were small areas of sand and, in a number of places near Sheffield, areas of silty clay. Some areas are very firm in consistence. A few areas that were once dumps or landfills have been covered and are also included in mapping.

Orthents range from moderate to low in available water capacity. Permeability is variable and depends on texture and density. Soil that was once buried 5 to 20 feet or more beneath the surface has less pore space and higher densities than the original surface layer. This previously buried material has not been appreciably affected by the processes of soil development and freezing and thawing. Surface runoff from Orthents ranges from slow to rapid. The content of organic matter is very low unless topsoil has been redistributed over the area. For this reason, a good seedbed is difficult to obtain and drought stress appears more quickly. The total organic matter to a depth of 1 foot is typically less than 3 tons per acre. Reaction is typically moderately alkaline. In most areas Orthents are very low in available phosphorus and potassium.

Some areas of Orthents are cultivated. Others are in permanent pasture or weeds. Orthents range from fair to poor in potential for cultivated crops and pasture. They have fair to poor potential for development of building sites and for septic tank absorption fields.

Many areas of Orthents are not suited to cultivated crops. Areas where topsoil was redistributed are better suited than the others, however, and are used to grow corn and soybeans. Orthents are better suited to small grains and to grasses and legumes for hay and pasture. If they are cultivated, there is a moderate to severe

hazard of erosion in sloping areas. Conservation tillage and other measures that disturb the soil as little as possible and leave crop residue on the surface will help stabilize Orthents.

Orthents have a wide range in suitability for building site development. Slope, drainage, or permeability are moderate to severe limitations for septic tank absorption fields. Each site needs to be examined individually for these uses.

Orthents are not assigned a capability group.

Use and management of the soils

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

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

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

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

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

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

Crops and pasture

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

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

About 338,000 acres in Franklin County were cropland in 1976. Most of these acres were used for row crops, mainly corn and soybeans. The acreage in pasture, woods, hay, and other close-growing crops decreased markedly in recent years as land use shifted to grain production.

Crop production and conservation of our soil resources could be increased by extending known technology to all cropland in the county. This soil survey which gives the basic characteristics of each kind of soil can greatly aid in the application of such technology.

Soil erosion by running water is the major problem on about 41 percent of the cropland and pasture in Franklin County. In addition, many of the level or nearly level soils are subject to wind erosion when not protected. Loss of the topsoil through erosion is damaging for many reasons. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a limited depth of favorable material for root development. Marlean and Rockton soils, for example, have a limited root zone because hard limestone is relatively close to the surface. The Saude and Zenor soils have a limited root zone because they are not sufficiently deep over sand and gravel. Topsoil lost by erosion often becomes a damaging pollutant. By controlling erosion, pollution of streams by sediment can be cut to a minimum. Water quality will improve for municipal use, for recreation, and for fish and wildlife.

Ideal methods of erosion control provide protective surface cover, reduce runoff, and increase infiltration. A cropping system in which vegetation covers the soil for extended periods can keep the amount of soil lost through erosion low enough that it will not reduce the productive capacity of the soil. On livestock farms, which require pasture and hay, the legume and grass forage in the cropping system reduces erosion on sloping land and also provides nitrogen and improves tilth for the following crop.

Franklin County has a great variety of soils and landscape features. Some slopes are so short, steep, and irregular that contour tillage or terracing is not practical. On these soils a cropping system that provides substantial vegetative cover and mimimum tillage are required to control erosion.

Minimizing tillage and leaving crop residue on the surface increase infiltration and reduce runoff and the hazard of erosion. These practices can be adapted to many tillable soils in the county. Where the soils are suitable for continuous cropping of corn and soybeans,

no-tillage is the most effective method of controlling erosion.

Terraces and diversions control runoff and erosion by reducing the length of slope. They are most adaptable and practical on well drained, gently sloping to moderately sloping soils that have smooth slopes. Gently sloping and moderately sloping Aredale, Dinsdale, Tama, Waubeek, and some areas of Clarion soils are well suited to terracing. Except in the Tama soils, however, all or part of the subsoil formed in glacial till. Topsoil should therefore be stockpiled during terrace construction and used to recover the exposed subsoil when the terrace is completed.

Contouring and a limited amount of contour stripcropping help in controlling erosion in Franklin County. These methods are best suited to soils with smooth, uniform slopes such as the Dinsdale, Port Byron, Tama, and some Aredale soils.

Soil blowing is a hazard on the Dickinson, Flagler, Salida, Sparta, and Zenor soils. It can damage these soils in a relatively short time if winds are strong and soils are dry and bare of vegetation or surface mulch. Also, crops on these soils and adjacent heavier textured soils are often damaged by blowing sand. It is not as apparent, but many of the nearly level heavier textured soils, such as the Harps, Canisteo, and Webster soils, are also damaged by wind erosion when conditions are suitable. This usually occurs when these soils are cropped to soybeans and then fall tilled. Maintaining vegetative cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing on all of these soils.

The Technical Guide, available in local offices of the Soil Conservation Service, has information on methods of erosion control for each kind of soil.

Soil drainage is a major management problem on about 40 percent of Franklin County soils. The Clyde, Garwin, Maxfield, Canisteo, and Webster soils are examples of upland soils that are naturally wet and poorly drained. The Houghton, Palms, and Okoboji soils are in upland depressions where drainage outlets are often difficult to obtain. The Colo, Coland, and Sawmill soils in waterways and on bottom lands are poorly drained as are the Harcot, Marshan, and Talcot soils on terraces or benches underlain by sand.

Soil fertility varies widely in Franklin County. Most of the well drained soils on uplands are naturally acid, though Storden and Mottland soils are alkaline. Naturally poorly drained soils are usually nearly neutral in reaction, but the Harps soils are alkaline and the Ansgar soils are strongly acid. Acid soils require the application of ground limestone for good plant growth. Available potash and phosphorus levels vary widely but are particularly low on the wet alkaline soils such as those in the Calco, Harcot, Harps, and Harpster series. On all soils, additions of lime and fertilizer should be based on results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil 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, are generally high in organic matter, and are porous. Regular additions of crop residues, manure, and other organic materials can improve soil structure and reduce crust formation.

Fall plowing is a questionable practice on many Franklin County soils. Sloping soils are subject to damaging erosion if they are fall plowed, and so are many nearly level soils that have been cropped to soybeans.

Field crops suited to the soils and climate of Franklin County area include many that are not commonly grown. Corn and soybeans are by far the most commonly grown, and oats is the most common close-growing crop. Wheat, grain sorghum, sunflowers, potatoes, sugar beets, popcorn, pumpkins, sugar cane, canning peas, and navy beans can be grown if economic conditions are favorable. Rye, barley, buckwheat, and flax could be grown, and grass seed could be produced from bromegrass, redtop, bluegrass, switchgrass, big bluestem, and indiangrass.

The number of special crops grown commercially in Franklin County is limited. At present sweet corn, canning beans, and nursery stock are the only specialty crops grown. Most of the well drained soils in the survey area are suitable for orchards. Soils in low positions where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

Latest information and suggestions for growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. 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 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 insures 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 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management (*9*). The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider 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. These levels are defined in the following paragraphs.

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 slight limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Windbreaks and environmental plantings

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

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold 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 insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

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

Recreation

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

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

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

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

Paths and trails for hiking, horseback riding, and bicycling 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

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

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

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

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

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

ness, and flood hazard. 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, flood hazard, 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 flood hazard. 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, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, 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, seeds, and cones. 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, saltgrass, 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. The 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. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and

recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building site development

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

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

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 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 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 11 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 type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

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

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

Construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of these materials. 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 properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, 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 moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

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

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

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

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 13 gives information on the soil properties and site features that affect water management. The kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds.

The restrictive features that affect drainage, terraces and diversions, and grassed waterways are also given. If there are no restrictions or limitations, the soil is rated favorable.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

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

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

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

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 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 potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of excavation walls caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind 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 wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

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

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

Engineering properties and classifications

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and 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. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, 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, SP-SM.

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. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

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

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are 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 of soils

Table 15 shows estimates of some characteristics and features that affect soil behavior. Estimates are given for the major layers of each soil and are based on field observations and test data for these and similar soils.

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and

organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. They indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. The soils are generally not suitable for crops. They are extremely erodible and difficult to vegetate.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups according to the intake 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. They are mainly deep, well drained to excessively drained sands or gravelly sands. They have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These are 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.

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 and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. 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 shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations made during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation are also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

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 most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and morphology." The soil samples were tested by the Soil Testing Laboratory, Iowa State Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*10*). 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. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is 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 Udoll (*Ud*, meaning humid, 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 Hapludolls (*Hapl*, meaning minimal horizonation, plus *udolls*, the suborder of the Mollisols that have an udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly 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 Hapludolls.

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 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. The soil is compared with similar soils and with nearby soils of other 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 (*8*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*10*). 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 "Soil maps for detailed planning."

Ansgar series

The Ansgar series consists of poorly drained, moderately permeable soils on uplands. These soils are on flats and at the heads and along the upper parts of shallow drainageways. They formed in 24 to 40 inches of loess and in the underlying glacial till. Slope ranges from 0 to 2 percent.

Ansgar soils are similar to Franklin soils and are commonly adjacent to Franklin, Maxfield, and Klinger soils on the landscape. Franklin soils have a browner B horizon and better internal drainage than Ansgar soils. Maxfield and Klinger soils have a thicker, dark colored A horizon.

Typical pedon of Ansgar silt loam, 0 to 2 percent slopes, in pasture 655 feet south and 610 feet east of the northwest corner of section 21, T. 92 N., R. 20 W.

A1—0 to 7 inches; black (10YR 2/1) heavy silt loam grading to very dark gray (10YR 3/1) with depth, dark gray (10YR 4/1) grading to gray (10YR 5/1) dry; few fine strong brown (7.5YR 5/6) mottles; moderate very fine granular structure; friable; strongly acid; clear boundary.

A2—7 to 11 inches; mottled dark gray (10YR 4/1) and dark grayish brown (2.5Y 4/2) silt loam; very dark grayish brown (10YR 3/2) coatings on peds; common fine dark reddish brown (5YR 3/2) and dark brown (7.5YR 4/4) mottles; weak thin and medium platy structure parting to weak very fine granular; friable; strongly acid; clear boundary.

B1t—11 to 18 inches; grayish brown (2.5Y 5/2) light silty clay loam; common fine and medium strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; few thin dark gray (10YR 4/1) clay films on peds; strongly acid; gradual boundary.

B21t—18 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine and medium strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; few dark gray (10YR 4/1) clay films on peds; few dark oxide concretions; strongly acid; clear boundary.

IIB22t—30 to 39 inches; mottled light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) loam; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; firm; few dark gray (10YR 4/1) clay films; moderately thick light gray (10YR 7/1) grainy coatings on prisms; few dark oxides; strongly acid; gradual boundary.

IIB3t—39 to 60 inches; mottled light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) loam;

weak medium prismatic structure; firm; thin light gray (10YR 7/2) discontinuous grainy coatings on prisms; thick dark gray (10YR 4/1) clay flows in channels; medium acid.

The solum ranges from 4 to 6 feet in thickness. The loess is generally 30 to 36 inches thick, but it ranges from 24 to 40 inches in thickness.

The A1 or Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The A2 horizon is 4 to 8 inches thick. It ranges from dark gray (10YR 4/1) to grayish brown (2.5Y 5/2). The B1t horizon ranges from 10YR to 2.5Y in hue, is 4 or 5 in value, and is 1 or 2 in chroma. The B21t horizon has the same colors as the B1t horizon or it has mottles with value and chroma of 4 to 6. The B1t and the B21t horizons range from 30 to 35 percent clay. Some profiles have thin horizons that are more than 35 percent clay. The IIB22t horizon ranges from 10YR to 5Y in hue, is 5 or 6 in value, and has mottles of 10YR and 7.5YR that are high in chroma. It is generally heavy loam or sandy clay loam, but it is light clay loam in places.

Aredale series

The Aredale series consists of well drained, moderately permeable soils on uplands. These soils are on ridge crests and on side slopes. They formed in 24 to 48 inches of loamy material and in the underlying loamy glacial till. Slope ranges from 0 to 9 percent.

Aredale soils are similar to Kenyon soils and commonly adjacent to Floyd, Bolan, and Dinsdale soils on the landscape. Kenyon soils are shallower to the underlying, firm glacial till than Aredale soils. Floyd soils have a grayer B horizon and poorer internal drainage. Bolan soils have loamy fine sand in the substratum. Dinsdale soils have less sand and more clay in the A horizon and the upper part of the B horizon.

Typical pedon of Aredale loam, 2 to 5 percent slopes, in a cultivated field 1,325 feet south and 265 feet west of the northeast corner of section 13, T. 93 N., R. 21 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; clear boundary.

A12—8 to 13 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A3—13 to 17 inches; dark brown (10YR 3/3) heavy loam, brown (10YR 5/3) dry; moderate very fine granular structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.

B21—17 to 24 inches; brown (10YR 4/3) heavy loam; moderate very fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on peds; medium acid; clear boundary.

IIB22—24 to 34 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; brown (10YR 4/3) coatings on peds; medium acid; clear boundary.

IIB31—34 to 40 inches; yellowish brown (10YR 5/4) heavy sandy loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; strongly acid; clear boundary.

IIIB32—40 to 56 inches; mottled yellowish brown (10YR 5/6) and pale brown (10YR 6/3) loam; moderate medium prismatic structure parting to weak coarse subangular blocky; firm; light yellowish brown (2.5Y 6/4) prism exteriors; medium acid; clear boundary.

IIIC—56 to 60 inches; mottled light yellowish brown (10YR 6/4), yellowish red (5YR 5/6), and light brownish gray (2.5Y 6/2) light sandy clay loam; weak medium prismatic structure; firm; few dark oxide concretions; medium acid.

The solum is generally 4 to 5 feet in thickness.

The A3 horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3). The A horizon and the upper part of the B horizon are loam or silt loam that has a high content of sand. The IIB horizon is loam or sandy loam. Mottles that have a chroma of 2 are below a depth of 3 feet in places. A pebble band often occurs at the contact of the IIIB horizon.

Bolan series

The Bolan series consists of well drained soils on upland ridge crests and side slopes. These soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in 24 to 36 inches of loamy sediments over loamy sand. Slope ranges from 2 to 9 percent.

Bolan soils are similar to Saude soils and are commonly adjacent to Dickinson and Aredale soils on the landscape. Dickinson soils have sandy loam in the A horizon and upper part of the B horizon. Aredale soils have glacial till or sediment derived from till in the lower part of the C horizons.

Typical pedon of Bolan loam, 2 to 5 percent slopes, in a cultivated field 1,600 feet east and 145 feet north of the southwest corner of section 2, T. 93 N., R. 21 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; medium acid; abrupt boundary.

A12—9 to 14 inches; very dark grayish brown (10YR 3/2) heavy loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; very dark brown (10YR 2/2) coatings on peds; medium acid; gradual boundary.

B21—14 to 19 inches; brown (10YR 4/3) loam; moderate very fine subangular blocky structure parting to weak fine granular; friable; very dark grayish brown (10YR 3/2) coatings on peds and in root channels; medium acid; gradual boundary.

B22—19 to 26 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure parting to weak very fine granular; friable; medium acid.
B31—26 to 33 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; brown (10YR 4/3) coatings on peds; medium acid; gradual boundary.
B32—33 to 43 inches; yellowish brown (10YR 5/4) loamy fine sand; very weak medium subangular blocky structure; very friable; medium acid.
C1—43 to 53 inches; yellowish brown (10YR 5/4) loamy fine sand; single grain; loose; medium acid; clear boundary.
C2—53 to 57 inches; mottled dark yellowish brown (10YR 4/4) and light yellowish brown (10YR 6/4) loamy fine sand; single grain; loose; sand grains appear to be coated with thin clay films; medium acid; clear boundary.
C3—57 to 60 inches; yellowish brown (10YR 5/6) loamy fine sand; single grain; loose; medium acid.

The solum ranges from 30 to 48 inches.

The A1 or Ap horizon is generally very dark brown (10YR 2/2), but ranges to very dark grayish brown (10YR 3/2). The A horizon is 10 to 20 inches in thickness. The B horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/6). The C horizon ranges from yellowish brown (10YR 5/4) to light yellowish brown (10YR 6/4) or strong brown (7.5YR 5/6).

Calamine series

The Calamine series consists of poorly or very poorly drained soils in the lower concave positions on uplands. These soils are moderately to slowly permeable in the upper part and very slowly permeable in the lower part. They formed in 20 to 36 inches of moderately fine textured material and in material derived from the underlying fine textured shale. Slope ranges from 1 to 3 percent.

Calamine soils are similar to Jacwin soils and are commonly adjacent to Jacwin and Mottland soils on the landscape. Jacwin soils have a browner B horizon and better internal drainage than Calamine soils. Mottland soils are better drained, are shallow to soft limestone, and are above the Calamine soils on the landscape.

Typical pedon of Calamine silty clay loam, 1 to 3 percent slopes, in a cultivated field 1,840 feet north and 60 feet west of the southeast corner of section 7, T. 93 N., R. 19 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam high in content of sand, dark gray (N 4/0) dry; moderate very fine granular structure; friable; neutral; clear boundary.
A12—9 to 20 inches; black (N 2/0) silty clay loam high in content of sand, dark gray (N 4/0) dry; moderate fine granular structure; friable; neutral; gradual boundary.
A3—20 to 24 inches; very dark gray (5Y 3/1) heavy silty clay loam high in content of sand, gray (5Y 5/1) dry; few fine light olive brown (2.5Y 5/6) mottles; moderate fine granular structure; friable; very dark gray (10YR 3/1) coatings on peds; neutral; clear boundary.
B2tg—24 to 30 inches; olive (5Y 4/3) light clay loam; common medium olive yellow (2.5Y 5/6) mottles; moderate very fine subangular blocky structure; firm; pebble band at top of horizon; discontinuous very dark gray (5Y 3/1) coatings on peds; neutral; clear boundary.
IIB3tg—30 to 36 inches; light olive gray (5Y 6/2) silty clay; common fine and medium yellowish brown (10YR 5/6) mottles; weak very fine angular blocky structure; firm; few dark gray (10YR 4/1) clay films in root channels; few small carbonate concentrations; slight effervescence; mildly alkaline; gradual boundary.
IICg—36 to 40 inches; light olive gray (5Y 6/2) silty clay; weak very fine angular blocky structure; firm; strong and violent effervescence; moderately alkaline.

Depth to the fine textured, firm shale residuum ranges from 20 to 36 inches. In some places a small amount of fractured hard limestone or soft arenaceous limestone is interbedded with the shale. The overlying mantle ranges from silty clay loam high in content of sand to clay loam.

The thickness of the A horizon ranges from 16 to 24 inches. The B2tg horizon is neutral or 5Y in hue, is 4 or 5 in value, and is 2 to 4 in chroma.

Calco series

The Calco series consists of poorly drained, moderately permeable, calcareous soils on bottom lands and in low upland drainageways. These soils formed in silty alluvial deposits. Slope ranges from 0 to 2 percent.

Calco soils are similar to Colo, Sawmill, and Coland soils. Colo, Sawmill, and Coland soils are not calcareous.

Typical pedon of Calco silty clay loam, 0 to 2 percent slopes, in pasture 325 feet south and 175 feet east of the northwest corner of section 25, T. 93 N., R. 20 W.

Ap—0 to 5 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; very friable; slight effervescence; moderately alkaline; clear boundary.
A12—5 to 14 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate fine and very fine granular structure; friable; slight effervescence; moderately alkaline; gradual boundary.
A13—14 to 31 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; fine and very fine granular structure; friable; slight effervescence; moderately alkaline; gradual boundary.
A3g—31 to 35 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium pris-

matic structure parting to very fine subangular blocky; friable; slight effervescence; moderately alkaline; gradual boundary.

B2g—35 to 40 inches; dark gray (5Y 4/1) silty clay loam; weak medium prismatic structure parting to weak coarse subangular blocky; friable; very dark gray (10YR 3/1) krotovinas 1 inch in diameter; very dark gray (5Y 3/1) coatings on peds; slight effervescence; moderately alkaline; clear boundary.

C1g—40 to 46 inches; mottled gray (5Y 5/1) and yellowish brown (10YR 5/6) heavy silt loam; some vertical cleavage; friable; dark gray (5Y 4/1) krotovinas; slight effervescence; moderately alkaline; clear boundary.

C2g—46 to 56 inches; mottled strong brown (7.5YR 5/6) and light olive gray (5Y 6/2) silt loam; massive; friable; few clay films on small root channels; dark gray (5Y 4/1) krotovinas; slight effervescence; moderately alkaline; clear boundary.

IIC3g—56 to 60 inches; dark gray (5Y 4/1) heavy sandy loam; massive; friable; few pebbles and rock fragments up to 1/4 inch in diameter; slight effervescence; moderately alkaline.

The solum is generally 36 to 48 inches in thickness. The A horizon is 24 to 36 inches thick. It ranges from 27 to 35 percent clay that has a sand content of 5 to 15 percent and is slightly calcareous to moderately calcareous. The C horizon is below a depth of about 40 inches. It ranges from silty clay loam to sandy loam.

Canisteo series

The Canisteo series consists of poorly drained, moderately permeable, calcareous soils on uplands. These soils occupy flats and irregularly shaped swales surrounding depressions and are in low-gradient drainageways. They formed in loamy glacial drifts. Slope ranges from 0 to 2 percent.

Canisteo soils are similar to Webster, Harps, and Talcot soils and are commonly adjacent to Webster, Harps, and Okoboji soils on the landscape. Webster soils are not calcareous in the A horizon. Talcot soils have stratified coarse textured layers in the substratum. Okoboji soils have a mollic epipedon thicker than 24 inches and are in shallow depressions.

Typical pedon of Canisteo silty clay loam, 0 to 2 percent slopes, in a cultivated field 620 feet east and 75 feet north of the southwest corner of section 9, T. 92 N., R. 21 W.

Ap—0 to 9 inches; black (N 2/0) light silty clay loam, dark gray (N 4/0) dry; cloddy parting to weak very fine subangular blocky structure; firm; strong effervescence; mildly alkaline; clear boundary.

A12—9 to 16 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 2/1) dry; weak fine granular structure; friable; strong effervescence; mildly alkaline; gradual boundary.

A3g—16 to 20 inches; mixed very dark gray (10YR 3/1) and dark gray (5Y 4/1) light silty clay loam high in sand, gray (10YR 3/1) and light gray (5Y 6/1) dry; weak fine granular structure; friable; very dark gray (5Y 3/1) coatings on peds; strong effervescence; mildly alkaline; gradual boundary.

B21g—20 to 26 inches; dark gray (5Y 4/1) light clay loam; weak very fine subangular blocky structure; friable; very dark gray (5Y 4/1) coatings on peds; strong effervescence; mildly alkaline; gradual boundary.

B22g—26 to 36 inches; olive gray (5Y 5/2) loam; weak very fine subangular blocky structure; friable; few very dark gray (5Y 3/1) fills in root channels; gray (5Y 5/1) coatings on peds; few fine red (2.5YR 5/6) oxide concretions; strong effervescence; moderately alkaline; clear boundary.

C1g—36 to 41 inches; olive gray (5Y 5/2) light loam; massive; friable; common fine strong brown (7.5YR 5/6) oxide concretions; strong effervescence; moderately alkaline; clear boundary.

C2g—41 to 50 inches; light olive gray (5Y 6/2) sandy loam; massive; very friable; common fine strong brown (7.5YR 5/6) oxide concretions; slight effervescence; moderately alkaline; clear boundary.

C3g—50 to 60 inches; light olive gray (5Y 6/1) heavy loam; massive; firm; common fine and medium yellowish red (5YR 4/6) oxide concretions; violent effervescence; moderately alkaline.

The solum is generally 2 to 3 feet in thickness.

The A horizon ranges from 16 to 24 inches in thickness and is light clay loam or light silty clay loam. The A3 horizon ranges from black (5Y 2/1) to very dark gray (10YR 3/1) and dark gray (10YR 4/1). The B2g horizon ranges from dark gray (5Y 4/1) to olive gray (5Y 5/2). The C horizon ranges from olive gray (5Y 5/2) to light gray (5Y 6/1) and from heavy loam to sandy loam.

Clarion series

The Clarion series consists of well drained, moderately permeable soils on knobs, ridges, and side slopes on uplands. These soils formed in glacial till. Slope ranges from 2 to 14 percent.

Clarion soils are similar to Nicollet soils and are commonly adjacent to Nicollet, Storden, Lester, and Terril soils on the landscape. Nicollet soils have a grayer B horizon and are not so well drained as Clarion soils. Storden soils lack a mollic epipedon and have an alkaline surface layer. Lester soils have a thinner surface layer and an A2 horizon. Terril soils have a mollic epipedon that is thicker than 20 inches and is lower on the landscape than Clarion soils.

Typical pedon of Clarion loam, 2 to 5 percent slopes, in a cultivated field 1,320 feet west and 975 feet south of the northeast corner of section 32, T. 93 N., R. 22 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; medium acid; clear boundary.
A12—7 to 11 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; medium acid; gradual boundary.
A3—11 to 18 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry, very dark brown (10YR 2/2) coatings on peds; moderate very fine granular structure; friable; few mixings of black (10YR 2/1); slightly acid; gradual boundary.
B21—18 to 27 inches; brown (10YR 4/3) loam; weak fine and medium subangular blocky structure; friable; dark brown (10YR 3/3) coatings on peds; medium acid; gradual boundary.
B22—27 to 36 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; neutral; abrupt boundary.
C1—36 to 40 inches; olive brown (2.5Y 4/4) loam; massive; friable; strong effervescence; mildly alkaline; gradual boundary.
C2—40 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; strong effervescence; moderately alkaline.

The solum is generally 30 to 45 inches thick but ranges from 20 to 50 inches.

The A horizon is the most acid part. It is medium or slightly acid. Texture of the A horizon ranges from light loam or light clay loam to heavy silt loam that is high in content of sand. The B horizon ranges from medium acid to neutral. Texture of the B horizon ranges from light loam to light clay loam. The C horizon ranges from heavy loam to heavy sandy loam. The C horizon typically is 2.5Y in hue, is 4 or 6 in value, and 4 to 6 in chroma.

Clyde series

The Clyde series consists of poorly drained, moderately permeable soils. These soils are in drainageways and in the lower concave positions on uplands. They formed in 20 to 40 inches of moderately fine textured material and the underlying friable glacial till or glacial drift. Slope ranges from 0 to 4 percent.

Clyde soils are similar to Tripoli, Marshan, and Floyd soils and are commonly adjacent to Floyd and Schley soils on the landscape. Tripoli soils do not have very friable stratified layers in the B horizon. Marshan soils are underlain by continuous beds of sand and gravel. Floyd soils have a browner B horizon and have better internal drainage than Clyde soils. Schley soils have a thinner surface layer.

Typical pedon of Clyde silty clay loam, 0 to 2 percent slopes, in a cultivated field 1,130 feet north and 130 feet east of the center of section 15, T. 93 N., R. 19 W.

Ap—0 to 9 inches; black (N 2/0) light silty clay loam that has a high content of sand, dark gray (N 4/0) dry; weak fine granular structure; friable; neutral; clear boundary.
A12—9 to 14 inches; black (N 2/0) light silty clay loam that has a high content of sand, dark gray (N 4/0) dry; moderate very fine granular structure; friable; neutral; gradual boundary.
A3—14 to 18 inches; black (5Y 2/1) and dark olive gray (5Y 3/2) light clay loam, dark gray (5Y 4/1) and olive gray (5Y 5/2) dry; weak fine granular structure; friable; black (5Y 2/1) coatings on peds; neutral; gradual boundary.
B21g—18 to 26 inches; olive gray (5Y 4/2) light clay loam grading to olive gray (5Y 5/2) in the lower part; weak very fine and fine subangular blocky structure; friable; dark olive gray (5Y 3/2) coatings on peds; neutral; clear boundary.
B22g—26 to 31 inches; olive gray (5Y 5/2) loam; many medium light olive brown (2.5Y 5/6) mottles; weak fine prismatic structure parting to weak fine and medium subangular blocky; friable; neutral; clear boundary.
B31g—31 to 37 inches; olive gray (5Y 5/2) heavy sandy loam; many medium light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very friable; neutral; clear boundary.
IIB32—37 to 45 inches; mottled grayish brown (5Y 5/2) and light olive brown (2.5Y 5/6) light loam; weak coarse prismatic structure; friable; neutral; abrupt boundary.
IIC—45 to 60 inches; gray (5Y 6/2) light loam; many medium strong brown (7.5YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is generally 3 to 4 feet in thickness. Depth to unstratified firm loam till ranges from 36 to 60 inches. These soils are generally neutral throughout but range to slightly acid in the most acid part. Depth to carbonates ranges from 36 to 60 inches.

The A horizon ranges from black (N 2/0 or 10YR 2/1) to very dark gray (10YR 3/1) and from 16 to 24 inches in thickness. The A horizon is dominantly silty clay loam that has a high content of sand, but it ranges to clay loam. The B1 and B2 horizons range from dark gray (5Y 4/1) to grayish brown (2.5Y 6/2). The lower part of the IIB3 horizon is generally mottled with gray (5Y 6/1) to grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/8) to olive brown (2.5Y 4/4). It is usually loam, but discontinuous layers of sandy loam, usually 6 inches or less in thickness, are common.

Coland series

The Coland series consists of poorly drained, moderately permeable soils on flood plains of streams. These soils formed in deposits of loamy alluvium. Slope ranges from 0 to 5 percent.

Coland soils are similar to Colo soils and are commonly adjacent to Turlin and Marshan soils on the land-

scape. Colo soils have less sand throughout the solum and do not have stratified, sandy materials in the substratum. Turlin soils have a browner B horizon and better internal drainage than Coland soils. Marshan soils have a mollic epipedon that is less than 20 inches in thickness and they have stratified coarse textured layers at a depth of less than 40 inches.

Typical pedon of Coland clay loam, 0 to 2 percent slopes, in a pasture 1,350 feet north and 570 feet east of the southwest corner of section 1, T. 93 N., R. 20 W.

A11—0 to 9 inches; black (10YR 2/1) light clay loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.
A12—9 to 24 inches; black (10YR 2/1) light clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; gradual boundary.
A13—24 to 40 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; slightly acid; gradual boundary.
AC—40 to 48 inches; very dark gray (10YR 3/1) light clay loam, gray (10YR 5/1) dry; few medium olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure; firm; common medium yellowish red (5YR 4/6) oxide concretions; slightly acid; gradual boundary.
C1g—48 to 55 inches; dark gray (10YR 4/1) light sandy loam; weak coarse prismatic structure; friable; slightly acid; gradual boundary.
IIC2g—55 to 70 inches; gray (5Y 5/1) sand and gravel; common medium light olive brown (2.5Y 5/4) mottles; single grain; loose; neutral.

The solum is 36 to 48 inches thick. Reaction is slightly acid or neutral, and depth to carbonates is more than 60 inches.

The A horizon is black (N 2/0 or 10YR 2/1) or very dark gray (10YR 3/1) and extends to a depth of 36 inches or more. It ranges from silty clay loam to light clay loam. Clay content ranges from 27 to 35 percent. The C1 horizon ranges from black (N 2/0) to gray (5Y 5/1) and from loam or clay loam to sandy loam. The C horizon, below a depth of about 50 inches, is generally stratified loamy sand, sandy loam, or loam that has some gravel.

Colo series

The Colo series consists of poorly drained, moderately permeable soils on flood plains of rivers and narrow intermittent streams. These soils formed in deposits of silty alluvium. Slope ranges from 0 to 5 percent.

Colo soils are similar to Coland and Sawmill soils. They are commonly adjacent to Ely soils on the landscape. Coland soils have more sand throughout the solum than Colo soils and have sandy, stratified materials in the subsoil. Sawmill soils have a thinner mollic epipedon. Ely soils have a browner B horizon and have better internal draingage.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in a pasture 600 feet west and 110 feet north of the center of section 16, T. 92 N., R. 19 W.

A11—0 to 5 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; moderate very fine and fine granular structure; friable; neutral; clear boundary.
A12—5 to 18 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine granular structure; friable; neutral; gradual boundary.
A13—18 to 28 inches; black (N 2/0 and 5Y 2/1) silty clay loam, dark gray (N 4/0 and 5Y 4/1) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; few yellowish red (5YR 4/6) oxide concretions; neutral; gradual boundary.
A14—28 to 40 inches; black (5Y 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few yellowish red (5YR 4/6) oxide concretions; neutral; gradual boundary.
AC—40 to 50 inches; black (5Y 2/1) and very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) and gray (5Y 5/1) dry; common medium olive gray (5Y 5/2) mottles; weak medium subangular blocky structure; friable; few fine yellowish brown (10YR 5/6) and yellowish red (5YR 4/6) oxide concretions; neutral; gradual boundary.
Cg—50 to 60 inches; gray (5Y 5/1) and olive gray (5Y 5/2) silty clay loam; massive; friable; neutral.

The solum is generally 40 to 50 inches thick. The A horizon is black (N 2/0 to 10YR 2/1) or very dark gray (10YR 3/1 or 5Y 3/1) and extends to a depth of 36 inches or more. Clay content ranges from 27 to 35 percent.

The Cg horizon ranges from black (N 2/0) to gray (5Y 5/1) and olive gray (5Y 5/2). Reaction is slightly acid or neutral, and depth to carbonates is generally more than 60 inches.

Dickinson series

The Dickinson series consists of well drained and somewhat excessively drained soils on uplands. They are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. They formed in 24 to 34 inches of fine sandy loam and loamy sand over sand and loamy sand. Slope ranges from 2 to 9 percent.

Dickinson soils are similar to Bolan and Flagler soils and are commonly adjacent to Sparta soils and the Hoopeston Variant. Bolan soils have more clay and less sand in the A horizon and upper part of the B horizon than the Dickinson soils. Flagler soils contain gravel and coarser sand. Sparta soils have less clay and a higher sand content in the A horizon and upper part of the B horizon. The Hoopeston Variant has a grayer B horizon and poorer internal drainage than Dickinson soils.

Typical pedon of Dickinson fine sandy loam, 2 to 5 percent slopes, in a cultivated field 890 feet east and 2,915 feet south of the northwest corner of section 3, T. 93 N., R. 20 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; medium acid; clear boundary.
A12—8 to 13 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; medium acid; gradual boundary.
A3—13 to 20 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.
B2—20 to 31 inches; brown (10YR 4/3) light fine sandy loam; weak medium prismatic structure parting to very weak medium subangular blocky; very friable; dark brown (10YR 3/3) coatings on peds; medium acid; gradual boundary.
B3—31 to 42 inches; yellowish brown (10YR 5/6) loamy sand; weak medium and coarse prismatic structure parting to very weak medium subangular blocky; very friable; medium acid; clear boundary.
C—42 to 60 inches; mottled yellowish brown (10YR 5/6) and brown (10YR 5/3) loamy sand; weak coarse prismatic structure; very friable; slightly acid.

The solum ranges from 30 to 50 inches in thickness. The Ap or A1 horizon is generally very dark brown (10YR 2/2), but it ranges to very dark grayish brown (10YR 3/2). The A horizon is 10 to 20 inches thick. The B horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/6). The C horizon ranges from yellowish brown (10YR 5/4) to light yellowish brown (10YR 6/4) or strong brown (7.5YR 5/8). It ranges from loamy sand to sand.

Dinsdale series

The Dinsdale series consists of well drained or moderately well drained, moderately permeable soils on upland flats, ridge crests, and side slopes. They formed in 24 to 40 inches of loess and the underlying glacial till. Slope ranges from 0 to 9 percent.

The Dinsdale soils in Franklin County differ from the Dinsdale soils in other places in that they typically lack the increase in clay necessary for argillic horizon. This difference does not alter the use or behavior of these soils.

Dinsdale soils are similar to Tama soils and are commonly adjacent to Klinger and Maxfield soils on the landscape. Tama soils formed in loess deposits more than 40 inches deep. Klinger and Maxfield soils have a grayer B horizon and have poorer internal drainage than Dinsdale soils.

Typical pedon of Dinsdale silty clay loam, 2 to 5 percent slopes, in a cultivated field 500 feet east and 50 feet south of the northwest corner of section 2, T. 92 N., R. 20 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; clear boundary.
A12—9 to 14 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; very dark brown (10YR 2/2) coatings on peds; slightly acid; gradual boundary.
B1—14 to 18 inches; brown (10YR 4/3) light silty clay loam; moderate very fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on peds; medium acid; gradual boundary.
B21t—18 to 25 inches; brown (10YR 4/3) light silty clay loam; weak very fine and fine subangular blocky structure; friable; discontinuous dark brown (10YR 3/3) coatings on peds; few discontinuous clay films; medium acid; gradual boundary.
B22t—25 to 32 inches; brown (10YR 4/3) light silty clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; few discontinuous clay films; medium acid; clear boundary.
IIB31t—32 to 40 inches; light olive brown (2.5Y 5/4) heavy loam; common fine and medium grayish brown (2.5Y 5/2) mottles: weak medium prismatic structure parting to weak coarse subangular blocky; firm; few discontinuous clay films; common dark oxide concretions; medium acid; clear boundary.
IIB32—40 to 60 inches; yellowish brown (10YR 5/6) heavy loam; many medium and coarse light brownish gray (2.5Y 6/2) mottles; massive; firm; slightly acid.

The solum is generally 4 to 5 feet thick but ranges from 3 1/2 to 5 feet. The loess generally is 26 to 36 inches thick but ranges from 20 to 40 inches. The underlying till or till-derived material is typically loam but ranges to sandy clay loam and light clay loam. A transitional horizon is between the loess and the till in many places. Discontinuous lenses of sandy loam to sand, 1 to 8 inches thick, are between the loess and the till in places. The exteriors of many prisms and peds in the lower part of the solum appear grainy when dry.

The A11 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2) and is heavy silt loam or light silty clay loam. The B horizon ranges from brown (10YR 4/3) to dark yellowish brown (10YR 4/4). It is loess and till. The sand content of the loess in the A and B horizons ranges from 3 to 10 percent. The sand content is higher near the loess-till contact and in the till.

Donnan series

The Donnan series consists of moderately well drained and somewhat poorly drained, soils on ridge crests and side slopes on uplands. They are moderately permeable in the upper part and very slowly permeable in the lower part. They formed in 20 to 40 inches of dominantly silty materials and the underlying clayey glacial till. Slope ranges from 2 to 9 percent. These soils have siltier upper horizons than Donnan soils in other places, but this difference does not alter the usefulness or behavior of the soils.

Donnan soils are commonly adjacent to Dinsdale, Waubeek, Franklin, and Schley soils on the landscape. These soils all have a IIB horizon that is lower in clay content and more friable than in the Donnan soils. Dinsdale soils also have a thicker A horizon than Donnan soils, and Dinsdale and Waubeek soils have a browner B horizon and better internal drainage.

Typical pedon of Donnan silt loam, 2 to 5 percent slopes, in a cultivated field 1,370 feet west and 345 feet north of the southeast corner section 26, T. 91 N., R. 19 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) heavy silt loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; medium acid; clear boundary.

B1—9 to 16 inches; brown (10YR 4/3) heavy silt loam; moderate very fine subangular blocky structure; friable; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.

B21t—16 to 23 inches; brown (10YR 5/3) heavy silt loam; common fine grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; strongly acid; abrupt boundary.

B22t—23 to 28 inches; grayish brown (2.5Y 5/2) clay loam; common fine and medium yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few thin discontinuous clay films; medium acid; clear boundary.

IIB23t—28 to 50 inches; gray (5Y 5/1) silty clay; weak medium prismatic structure; very firm; few roots along prism surfaces; few thin discontinuous clay films; medium acid; clear boundary.

IIB3t—50 to 60 inches; mottled olive gray (5Y 5/2) and light olive brown (2.5Y 5/4) silty clay; weak medium prismatic structure; very firm; few clay films in root channels; slightly acid.

Depth to the fine textured, very firm layer ranges from 20 to 40 inches. The overlying mantle is dominantly silt loam that has a high content of sand. In some places a thin sandy horizon is between the overlying mantle and the underlying fine-textured material.

The A1 or Ap horizon ranges from very dark brown (10YR 2/2) to black (10YR 2/1) and very dark gray (10YR 3/1). The A2 horizon, where present, is dominantly brown (10YR 4/3) but ranges to dark grayish brown (10YR 4/2). The IIBt horizon ranges from dark gray (10YR 4/1) to grayish brown (10YR 5/2) and olive brown (2.5Y 4/4) that is mottled. It is generally silty clay but the range includes clay. The IIB horizon ranges from 20 to 60 inches in thickness.

Ely series

The Ely series consists of somewhat poorly drained, moderately permeable soils. These soils are in upland waterways, on alluvial fans, and on foot slopes. They formed in silty alluvial sediment. Slope ranges from 2 to 5 percent.

Ely soils are similar to Colo, Judson, and Muscatine soils. They are commonly adjacent to Colo, Port Byron, and Dinsdale soils on the landscape. Colo soils have poorer internal drainage than Ely soils. Judson soils have a browner B horizon and better internal drainage. Muscatine soils have an A horizon less than 20 inches thick. Port Byron and Dinsdale soils have an A horizon less than 20 inches thick, have better internal drainage, and are above the Ely soils on the landscape.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, in a cultivated field 1,840 feet north and 395 feet east of the southwest corner of section 25, T. 92 N., R. 20 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; clear boundary.

A12—9 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A13—16 to 25 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; gradual boundary.

A3—25 to 30 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; very dark gray (10YR 3/1) coatings on peds; slightly acid; gradual boundary.

B2—30 to 36 inches; dark grayish brown (10YR 4/2) light silty clay loam; moderate very fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; slightly acid; gradual boundary.

B3—36 to 60 inches; yellowish brown (10YR 5/4) silt loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; dark grayish brown (10YR 4/2) coatings on prisms and peds; slightly acid; clear boundary.

The solum is generally 4 to 5 feet thick.

The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is 24 to 36 inches thick. The A and B horizons range from medium acid to slightly acid.

Flagler series

The Flagler series consists of somewhat excessively drained soils on stream benches and uplands. They are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They formed in 24 to 36 inches of loamy and sandy material over loamy sand or gravelly sand. Slope ranges from 1 to 9 percent.

Flagler soils are similar to Dickinson and Saude soils. They are commonly adjacent to Saude, Lawler, and Marshan soils on the landscape. Dickinson soils lack coarse sand and gravel. Saude, Lawler, and Marshan soils have more clay and less sand in the A horizon and upper part of the B horizon than Flagler soils. Lawler and Marshan soils also have a grayer B horizon and poorer internal drainage.

Typical pedon of Flagler sandy loam, 1 to 5 percent slopes, in a cultivated field 1,350 feet south and 205 feet west of the center of section 21, T. 93 N., R. 19 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) heavy sandy loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; few fine pebbles; medium acid; clear boundary.

A12—8 to 12 inches; very dark brown (10YR 2/2) heavy sandy loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; few fine pebbles; medium acid; gradual boundary.

A3—12 to 18 inches; very dark grayish brown (10YR 3/2) heavy sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; few fine pebbles; friable; very dark brown (10YR 2/2) coatings on peds; strongly acid; gradual boundary.

B21—18 to 24 inches; brown (10YR 4/3) heavy sandy loam; weak and moderate fine subangular blocky structure; friable; few fine pebbles; dark brown (10YR 3/3) coatings on peds; medium acid; gradual boundary.

B22—24 to 30 inches; dark brown (7.5YR 4/4) sandy loam; weak and moderate medium subangular blocky structure; friable; few fine pebbles; brown (10YR 4/3) coatings on peds; medium acid; clear boundary.

IIB3—30 to 40 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few fine pebbles; slightly acid; clear boundary.

IIC1—40 to 51 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; slight cementation; very friable; few fine pebbles; slightly acid; gradual boundary.

IIC2—51 to 60 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; very few fine pebbles; neutral.

The solum ranges from 30 to 50 inches in thickness. The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is 10 to 20 inches in thickness. It contains a few pebbles in places. The B horizon ranges from dark brown (10YR 3/3) to brown (7.5YR 4/4 and 10YR 4/3) or dark yellowish brown (10YR 4/4). It generally has some gravel. The IIB horizon ranges from brown (10YR 4/3 or 7.5YR 4/4) to yellowish brown (10YR 5/6). The amount of gravel varies, but generally ranges from 5 to 15 percent. The C horizon ranges from dark yellowish brown (10YR 4/4) to light yellowish brown (10YR 6/4) or strong brown (7.5YR 5/8) and from gravelly sand to sand. The content of gravel is highly variable.

Floyd series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on foot slopes and in coves on uplands. They formed in 30 to 45 inches of loamy sediments and in the underlying glacial till. Slope ranges from 1 to 4 percent.

Floyd soils are similar to Readlyn and Klinger soils and are commonly adjacent to Schley and Clyde soils on the landscape. Readlyn soils are less stratified than the Floyd soils and are more acid. Klinger soils developed partially in loess and contain less sand in the upper part of the solum. Schley soils have a thinner A horizon and are more acid. Clyde soils have a grayer B horizon and have poorer internal drainage.

Typical pedon of Floyd loam, 1 to 4 percent slopes, in a cemetery 2,015 feet south and 225 feet east of the northwest corner of section 3, T. 93 N., R. 20 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam; dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; clear boundary.

A12—8 to 12 inches; black (10YR 2/1) heavy loam; dark gray (10YR 4/1) dry; very fine granular structure; friable; neutral; gradual boundary.

A3—12 to 19 inches; very dark gray (10YR 3/1) heavy loam; gray (10YR 5/1) dry; moderate very fine granular structure; friable; neutral; gradual boundary.

B1—19 to 26 inches; dark grayish brown (2.5Y 4/2) heavy loam; moderate very fine subangular blocky structure; friable; very dark grayish brown (2.5Y 3/2) coatings on peds; neutral; gradual boundary.

B2—26 to 36 inches; dark grayish brown (2.5Y 4/2) loam grading to light sandy clay loam with depth; few medium light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; very friable; neutral; abrupt boundary.

IIB3—36 to 44 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) heavy loam; weak medium prismatic structure; firm; mildly alkaline; abrupt boundary.

IIC—44 to 72 inches; mottled olive gray (5Y 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) loam; massive; firm; strong effervescence; mildly alkaline.

The solum is generally 42 to 54 inches thick.

The A1 horizon ranges from 12 to 16 inches in thickness. The A3 horizon is generally very dark grayish brown (2.5Y 3/2) or very dark gray (10YR 3/1). The A horizon is generally heavy loam but ranges to silt loam high in content of sand, light silty clay loam high in content of sand, and light clay loam. The upper part of the B horizon is 2.5Y in hue, is 4 in value, and is 2 to 4 in chroma or is 10YR in hue and is 2 in chroma. It has mottles of higher chroma in places. Depth to firm loam till ranges from 30 to 45 inches. The B horizon ranges from light sandy loam to light sandy clay loam and loam that has horizontal lenses of loamy sand or sand.

Franklin series

The Franklin series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on ridges, heads of drainageways, and side slopes. They formed in 20 to 40 inches of loess and in the underlying till or till-derived material. Slope ranges from 1 to 3 percent.

Franklin soils are similar to Waubeek and Ansgar soils and are commonly adjacent to Klinger and Maxfield soils on the landscape. Waubeek soils have a browner B horizon and better internal drainage than Franklin soils. Ansgar soils have a grayer B horizon and poorer internal drainage. Klinger and Maxfield soils have a thicker A horizon and lack an A2 horizon.

Typical pedon of Franklin silt loam, 1 to 3 percent slopes, in a bluegrass pasture 740 feet south and 635 feet east of the northwest corner of section 21, T. 92 N., R. 20 W.

A1—0 to 8 inches; very dark gray (10YR 3/1) heavy silt loam, gray (10YR 5/1) dry; moderate very fine granular structure, except lower 2 inches of horizon has weak medium platy structure; friable; neutral; clear boundary.

A2—8 to 14 inches; mottled dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; weak medium platy structure parting to moderate very fine subangular blocky; friable; very dark grayish brown (10YR 3/2) coatings on peds; medium acid; clear boundary.

B21t—14 to 24 inches; brown (10YR 5/3) light silty clay loam; few fine yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; dark grayish brown (2.5Y 4/2) coatings on peds; few thin dark grayish brown (10YR 4/2) clay films lining root channels; strongly acid; clear boundary.

B22t—24 to 34 inches; light olive brown (2.5Y 5/4) light silty clay loam; few fine yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; friable; few thin dark grayish brown clay films lining root channels and coating prisms and peds; few dark oxide concretions; very strongly acid; clear boundary.

IIB31—34 to 40 inches; mottled yellowish brown (10YR 5/6) and light yellowish brown (2.5Y 6/2) loam; weak fine and medium prismatic structure parting to weak medium subangular blocky; firm; light brownish gray (2.5Y 6/2) coatings on prisms; few dark oxide concretions; strongly acid; clear boundary.

IIB32—40 to 60 inches; yellowish brown (10YR 5/6) loam and sandy clay loam; many medium light brownish gray (2.5Y 6/2) mottles; weak fine and medium prismatic structure parting to weak medium subangular blocky in upper 10 inches; firm; thick light brownish gray (2.5Y 6/2) sandy rinds coating prism faces, white (10YR 8/1) when dry; few clay films on prism faces; few dark oxide concretions; medium acid.

The solum is generally 4 1/2 to 5 feet thick but ranges from 4 to 6 feet. The loess is generally 28 to 36 inches deep but ranges from 20 to 40 inches. The till or till-derived material is typically loam but ranges to sandy clay loam and, in some places, to light clay loam. In places discontinuous lenses of sandy loam to sand, 1 to 8 inches thick, are between the loess and the till.

The A1 or Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The A2 horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The upper part of the B horizon formed in loess. It ranges from dark grayish brown (10YR 4/2 or 2.5Y 4/2) to brown (10YR 4/3 and 10YR 5/3) or olive brown (2.5Y 4/4) and has a few mottles. Clay content ranges from 27 to 35 percent. The sand content of the A and B horizons ranges from 3 to 10 percent, but it is higher near the till contact. The prism and ped exteriors in the IIB horizon, when dry, have a gray to grayish brown grainy appearance.

Garwin series

The Garwin series consists of poorly drained, moderately permeable soils on uplands. These soils are in drainageways and low concave positions. They formed in loess deposits that are 4 to 8 feet thick over glacial till. Slope ranges from 0 to 2 percent.

Garwin soils are similar to Muscatine and Maxfield soils and are commonly adjacent to Muscatine and Dinsdale soils on the landscape. Muscatine soils have a browner B horizon and better internal drainage than Garwin soils. Maxfield soils formed in 24 to 40 inches of loess and the underlying glacial till. Dinsdale soils have a browner B horizon, have better internal drainage, and formed in 24 to 40 inches of loess and the underlying glacial till.

Typical pedon of Garwin silty clay loam, 0 to 2 percent slopes, in a cultivated field 1,120 feet east and 35 feet south of the northwest corner of section 26, T. 93 N., R. 20 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, dark gray (N 2/0) dry; weak fine granular structure; friable; neutral; clear boundary.

A12—7 to 16 inches; black (N 2/0) silty clay loam, dark gray (N 2/0) dry; weak very fine subangular blocky structure; firm; neutral gradual boundary.

A3—16 to 22 inches; black (5Y 2/1) heavy silty clay loam grading to very dark gray (5Y 3/1) with depth, dark gray (5Y 4/1) grading to gray (5Y 5/1) dry; weak very fine subangular blocky structure; friable; few mixings of olive gray (5Y 4/2) from B horizon; neutral; gradual boundary.

B21g—22 to 27 inches; olive gray (5Y 4/2) silty clay loam; weak very fine subangular blocky structure; friable; very dark gray (5Y 3/1) coatings on peds; few olive (5Y 4/3) mixings; neutral; clear boundary.

B22g—27 to 34 inches; mottled dark gray (5Y 4/1) and olive gray (5Y 5/2) light silty clay loam; weak fine subangular blocky structure; friable; few very dark gray (5Y 3/1) fills in root channels; few dark gray (10YR 4/1) clay films on ped exteriors and in root channels; neutral; gradual boundary.

B3g—34 to 44 inches; olive gray (5Y 5/2) heavy silt loam; common fine light olive brown (2.5Y 5/6) and strong brown (7.5YR 5/6) mottles; medium prismatic structure; friable; few dark concretions of an oxide; few dark root channel fills; neutral; clear boundary.

C—44 to 60 inches; gray (5Y 6/2) silt loam; common fine and medium strong brown (7.5YR 5/6) mottles; massive; friable; neutral.

The solum is generally 40 to 50 inches thick.

The A horizon ranges from 16 to 24 inches in thickness. The A1 horizon ranges from black (N 2/0 to 10YR 2/1) to very dark gray (10YR 3/1) in the lower part. The A3 horizon ranges from black (5Y 2/1) and very dark gray (10YR 3/1 and 5Y 3/1) to dark olive gray (5Y 3/2). If present, the B1 horizon is dark grayish brown (2.5Y 4/2) or olive gray (5Y 4/2) silty clay loam that has mottles that are high chroma, 10YR in hue or redder.

Harcot series

The Harcot series consists of poorly drained, calcareous soils on stream benches and in outwash areas. These soils are moderately permeable in the solum and very rapidly permeable in the substratum. They formed in 30 to 40 inches of loamy alluvial deposits over sandy materials. Slope ranges from 0 to 2 percent.

Harcot soils are similar to Talcot and Harps soils and are commonly adjacent to Talcot, Marshan, and Lawler soils on the landscape. Talcot soils have smaller amounts of free carbonates in the A horizon than Harcot soils. Harps soils lack stratified coarse textured layers in the substratum. Marshan and Lawler soils are not calcareous and lack free carbonates in the solum.

Typical pedon of Harcot loam, 0 to 2 percent slopes, in a cultivated field 920 feet north and 130 feet east of the center of section 27, T. 93 N., R. 19 W.

Apca—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; violent effervescence; moderately alkaline; abrupt boundary.

A12ca—8 to 14 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; violent effervescence; moderately alkaline; gradual boundary.

A3ca—14 to 20 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; few fine olive gray (5Y 5/2) mottles; moderate very fine granular structure; friable; violent effervescence; moderately alkaline; gradual boundary.

B2gca—20 to 26 inches; olive gray (5Y 5/2 and 5Y 4/2) loam; few fine olive (5Y 5/4) mottles; weak medium prismatic structure parting to weak very fine and fine subangular blocky; friable; very dark gray (5Y 3/1) coatings on peds; few fine pebbles; violent effervescence; moderately alkaline; clear boundary.

B3g—26 to 37 inches; olive gray (5Y 5/2) loam; common fine yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few fine pebbles; strong effervescence; moderately alkaline; clear boundary.

IIC1—37 to 56 inches; gray (5Y 5/1 and 5Y 6/1) loamy sand; single grain; loose; few fine pebbles; strong effervescence; moderately alkaline; clear boundary.

IIC2—56 to 60 inches; mottled yellowish red (5YR 5/8) and light olive brown (2.5Y 5/4) loamy sand; single grain; loose; few fine pebbles; strong effervescence; mildly alkaline.

The solum is generally 30 to 40 inches thick.

The A1 horizon is black (N 2/0 to 10YR 2/1). The A3 horizon is generally very dark gray (10YR 3/1 to 5Y 3/1) or very dark grayish brown (2.5Y 3/2) and has olive gray (5Y 5/2) mottles. The A horizon is dominantly loam but ranges to light clay loam. The upper part of the B horizon ranges from dark gray (10YR 4/1 or 5Y 4/1) to dark grayish brown (2.5Y 4/2) or olive gray (5Y 5/2) and from loam to clay loam. The IIC horizon ranges from gravelly loamy sand to sand with some gravel.

Harps series

The Harps series consists of poorly drained, moderately permeable, calcareous soils on uplands. These soils formed in loamy glacial drift on convex rims around depressions and on flats. Slope ranges from 0 to 3 percent.

Harps soils are similar to Canisteo and Harcot soils and are commonly adjacent to Okoboji, Canisteo, and Webster soils on the landscape. Canisteo soils have smaller amounts of free carbonates in the A horizon than Harps soils. Harcot soils have stratified, coarse textured layers in the substratum. Okoboji soils have a mollic epipedon thicker than 20 inches and are in shallow depressions. Webster soils are not calcareous and lack free carbonates in the A horizon.

Typical pedon of Harps loam, 1 to 3 percent slopes, in a cultivated field 1,760 feet west and 60 feet north of the southeast corner of section 17, T. 93 N., R. 22 W.

Apca—0 to 7 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; violent effervescence; moderately alkaline; abrupt boundary.

A12ca—7 to 14 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; black (10YR 2/1) coatings on peds; violent effervescence; moderately alkaline; gradual boundary.

A3ca—14 to 19 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) loam, gray (10YR 5/1) and light gray (10YR 6/1) dry; moderate fine granular structure; friable; black (10YR 2/1) coatings on peds; violent effervescence; moderately alkaline; clear boundary.

B2gca—19 to 25 inches; olive gray (5Y 5/2) loam; weak very fine and fine subangular blocky structure; friable; very dark gray (10YR 3/1) coatings on peds; violent effervescence; moderately alkaline; clear boundary.

B3gca—25 to 42 inches; light olive gray (5Y 6/2) loam; weak medium subangular blocky structure; friable; dark gray krotovinas 1/2 to 1 inch in diameter; few fine yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) oxide concretions; violent effervescence grading to strong effervescence in the lower part; moderately alkaline; clear boundary.

Cg—42 to 61 inches; light olive gray (5Y 6/2) loam with thin strata of sandy loam; common fine and medium yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; massive; friable; strong effervescence grading to slight in the lower part; mildly alkaline; clear boundary.

The solum is generally 30 to 42 inches thick.

The A1 horizon is black (10YR 2/1) to very dark gray (10YR 3/1) and is 12 to 15 inches thick. Texture of the A horizon is generally loam but ranges to light clay loam. The B horizon ranges from 15 to 25 inches thick. It is loam or clay loam that is 18 to 30 percent clay. The C horizon is generally 5Y in hue, 5 or 6 in value, and 1 or 4 in chroma. It typically is loam that contains thin strata of sandy loam. A few glacial pebbles are in all layers in the C horizon.

Harpster series

The Harpster series consists of nearly level, poorly drained, moderately permeable, calcareous soils in upland drainageways and on broad upland flats. These soils formed in silty sediment over loamy sediment or glacial till. Slope ranges from 0 to 2 percent.

Harpster soils are similar to Garwin, Maxfield, Calco, and Harps soils. Garwin and Maxfield soils are not calcareous and lack free carbonates in the A horizon. Calco soils have a mollic epipedon more than 24 inches thick. Harps soils have a higher content of sand than Harpster soils.

Typical pedon of Harpster silty clay loam, 0 to 2 percent slopes, in a cultivated field 1,170 feet east and 80 feet north of the southwest corner of section 6, T. 90 N., R. 19 W.

Apca—0 to 10 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine granular structure; friable; a few small snail shells; violent effervescence; moderately alkaline, clear boundary.

A12ca—10 to 13 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine granular structure; friable; a few small snail shells; violent effervescence; moderately alkaline; gradual boundary.

A3ca—13 to 19 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; black (5Y 2/1) coatings on peds; a few small snail shells; violent effervescence; moderately alkaline; gradual boundary.

B2g—19 to 26 inches; dark gray (5Y 4/1) light silty clay loam; weak fine and medium granular structure; friable; very dark gray (5Y 3/1) coatings on peds; slight effervescence; mildly alkaline; gradual boundary.

B3g—26 to 36 inches; olive gray (5Y 5/2) and olive (5Y 5/3) heavy silt loam; common fine yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine and medium subangular blocky; friable; few very dark gray (10YR 3/1) fills in root channels; slight effervescence; mildly alkaline; clear boundary.

C1—36 to 46 inches; grayish brown (2.5Y 5/2) silt loam; many fine and medium strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; few dark gray (10YR 4/1) fills in root channels; mildly alkaline; clear boundary.

C2—46 to 60 inches; gray (10YR 6/1) loam; many fine and medium strong brown (7.5YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is generally 35 to 40 inches in thickness.

The A1 horizon is black (N 2/0 or 10YR 2/1) and is 12 to 15 inches thick. The B2g horizon is generally light silty clay loam, but ranges to silt loam. The C1 horizon is generally silt loam, but ranges to loam or clay loam that has thin strata of sandy loam.

Hoopeston Variant

The Hoopeston Variant consists of somewhat poorly drained soils on uplands. These soils are moderately rapidly permeable in the solum and moderately permeable in the substratum. They formed in 30 to 40 inches of sandy loam over stratified loamy deposits. Slope ranges from 1 to 3 percent.

The Hoopeston Variant is similar to Floyd soils and is commonly adjacent to Dickinson and Sparta soils. Floyd soils have a higher clay and lower sand content in the A horizon and upper part of the B horizon. Dickinson soils have a browner B horizon, better internal drainage, and lack the loamy substratum. Sparta soils have less clay and more sand throughout, a browner B horizon, and better internal drainage than the Hoopeston Variant.

Typical pedon of Hoopeston Variant sandy loam, 1 to 3 percent slopes, in a cultivated field 930 feet north and 225 feet west of the center of section 24, T. 93 N., R. 19 W.

Ap—0 to 7 inches; black (10YR 2/1) heavy sandy loam, dark gray (10YR 4/1) dry; very fine granular structure; friable; medium acid; clear boundary.

A12—7 to 16 inches; very dark gray (10YR 3/1) heavy sandy loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; medium acid; gradual boundary.

A3—16 to 22 inches; very dark grayish brown (10YR 3/2) heavy sandy loam, grayish brown (10YR 5/2) dry; moderate very fine and fine granular structure; friable; medium acid; gradual boundary.

B2—22 to 26 inches; dark grayish brown (10YR 4/2) heavy sandy loam; weak fine subangular blocky structure; friable; medium acid; clear boundary.

B3—26 to 37 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) sandy loam; weak fine prismatic structure parting to weak fine subangular blocky; friable; slightly acid; clear boundary.

IIC1—37 to 42 inches; grayish brown (2.5Y 5/2) loam; common fine yellowish brown (10YR 5/6) mottles; massive; friable; neutral; clear boundary.

IIC2—42 to 46 inches; grayish brown (2.5Y 5/2) heavy silt loam; massive; friable; few small dark oxide concretions; neutral; clear boundary.

IIC3—46 to 55 inches; light brownish gray (2.5Y 6/2) light silt loam; friable; mildly alkaline.

IIC4—55 to 62 inches; strong brown (7.5YR 5/6) light sandy loam; many fine and medium light brownish gray (2.5Y 6/2) mottles; friable; mildly alkaline; clear boundary.

IIC5—62 to 72 inches; light olive brown (2.5Y 5/4) light sandy loam; common fine light brownish gray (2.5Y 6/2) mottles; friable; strong effervescence; moderately alkaline.

The solum is generally 36 to 42 inches thick. The substratum is stratified. Textures range from loam and silt loam to loamy sand. Loam textured glacial till typically occurs at a depth of 5 to 10 feet.

The A1 horizon ranges from 10 to 18 inches in thickness. It is black (10YR 2/1) or very dark brown (10YR 2/2). The A3 horizon is very dark grayish brown (10YR 3/2 to 2.5Y 3/2) and ranges from heavy to light sandy loam. The B horizon has a color value of 4 and chroma of 2 to 4 in hue of 2.5Y or chroma of 2 in hue of 10Y. It has mottles of higher chroma in places. Texture is typically sandy loam, but loamy sand is common in the lower part of the B horizon.

Houghton series

The Houghton series consists of very poorly drained soils in depressions that formerly were ponds. Permeability of these soils is moderately slow to moderately rapid. They formed in black, decomposed organic material ranging from 51 inches to many feet deep. Slope ranges from 0 to 1 percent.

Houghton soils are similar to Palms soils and are commonly adjacent to Okoboji mucky silt loams and Harps soils on the landscape. The Palms and Okoboji soils have thinner organic layers than the Houghton soils. Harps soils formed in glacial drift, occur as rims above the Houghton soils on the landscape, are calcareous, and have free carbonates in the A horizon.

Typical pedon from an area of Houghton muck, 0 to 1 percent slopes, in a brome grass pasture 1,740 feet south and 70 feet west of the northeast corner of section 32, T. 92 N., R. 22 W.

Oa1—0 to 9 inches; black (N 2/0 or N 1/0) broken face and rubbed sapric material; weak fine granular structure; neutral; clear boundary.

Oa2—9 to 15 inches; black (N 2/0) broken face and rubbed sapric material; weak fine granular structure; neutral; clear boundary.

Oa3—15 to 53 inches; black (N 2/0) broken face and rubbed sapric material; weak medium subangular blocky structure; common fine snail shells; mildly alkaline; gradual boundary.

Oa4—53 to 60 inches; black (N 2/0 to 5Y 2/1) broken face and rubbed sapric material; massive; slightly sticky; many small snail shells; mildly alkaline.

The organic layer is 51 inches to many feet in depth. It has hue of 10YR or 7.5YR, value of 2 and chroma of 0 or 1. Broken faces and rubbed and pressed colors are similar. The organic material is dominantly sapric with relatively few pedons containing thin layers of fibric materials. Reaction is slightly acid to mildly alkaline.

Jacwin series

The Jacwin series consists of somewhat poorly drained soils. These soils are moderately permeable in the upper part and very slowly permeable in the lower part. They formed in loamy sediment and in material derived from the underlying fine textured shale. Slope ranges from 1 to 9 percent.

Jacwin soils are similar to Calamine soils and are commonly adjacent to Calamine and Mottland soils on the landscape. Calamine soils have a grayer B horizon and poorer internal drainage than Jacwin soils. Mottland soils are better drained, are shallow to soft limestone, and are above the Jacwin soils on the landscape.

Typical pedon from an area of Jacwin loam, 1 to 5 percent slopes, in a cultivated field 1,095 feet north and 530 feet west of the southeast corner of section 7, T. 93 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; neutral; clear boundary.

A12—8 to 13 inches; black (10YR 2/1) light clay loam, dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; neutral; gradual boundary.

A3—13 to 17 inches; very dark grayish brown (2.5Y 3/2) light clay loam, grayish brown (2.5Y 5/2) dry; moderate fine granular structure; friable; very dark gray (10YR 3/1) coatings on peds; neutral; gradual boundary.

B1—17 to 21 inches; dark grayish brown (2.5Y 4/2) light clay loam; moderate very fine subangular blocky structure; friable; nearly continuous dark gray (10YR 3/1) coatings on peds; neutral; gradual boundary.

B2—21 to 28 inches; light olive brown (2.5Y 5/4) light clay loam; moderate fine and very fine subangular blocky stucture; friable; discontinuous very dark grayish brown (2.5Y 3/2) coatings on peds; neutral; clear boundary.

IIB3—28 to 32 inches; light olive gray (5Y 6/2) silty clay; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common brownish yellow (10YR 6/6) sandstone pebbles 1/2 to 1 inch in diameter; few very dark gray (10YR 3/1) flows in root channels; strong effervescence; mildly alkaline; gradual boundary.

IIC—32 to 60 inches; mottled gray (5Y 6/1) to yellowish brown (10YR 5/6) silty clay; weak medium prismatic structure grading to massive with depth; firm; strong effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates range from 25 to 40 inches. Depth to silty clay and clay residuum ranges from 20 to 40 inches. Thickness of the mollic epipedon ranges from 12 to 20 inches.

The A horizon has color value of 2 or 3 and chroma of 1 or 2. It is loam or light silty clay loam that is high in content of sand. The B horizon is 10YR, 2.5Y, or 5Y in hue, 4 or 5 in value and 2 to 6 in chroma with the darker colors in the upper part. Reaction is neutral or slightly acid. In some pedons the lower part of the B horizon formed in weathered shale and is mildly alkaline. The C horizon formed in weathered shale and is mildly alkaline. The C horizon is typically mottled and has a wide range of hue, chroma, and value. Texture is silty clay or clay.

Map unit 444C2 is moderately well drained and is shallower to clayey residuum than is typical for the series. This difference does not alter the usefulness or behavior of the soil.

Judson series

The Judson series consists of well or moderately well drained, moderately permeable soils in upland waterways and narrow valleys and on foot slopes adjacent to steep areas. They formed in silty alluvial sediment. Slope ranges from 2 to 5 percent.

Judson soils are similar to Ely soils and are commonly adjacent to Dinsdale, Port Byron, and Rossfield soils on the landscape. Ely soils have a grayer B horizon than Judson soils and have poor internal drainage. Dinsdale, Port Byron, and Rossfield soils have a mollic epipedon of less than 20 inches and are above the Judson soils on the landscape.

Typical pedon of Judson silty clay loam, 2 to 5 percent slopes, in pasture 650 feet east and 95 feet north of the center of section 36, T. 92 N., R. 20 W.

Ap—0 to 16 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; medium acid; gradual boundary.

A12—16 to 24 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine granular structure; friable; black (10YR 2/1) coatings on peds; medium acid; gradual boundary.

A3—24 to 31 inches; very dark grayish brown (10YR 3/2) light silty clay loam grading to dark brown (10YR 3/3) with depth, grayish brown (10YR 5/2) to brown (10YR 5/3) dry; moderate very fine subangular blocky structure; medium acid; gradual boundary.

B2—31 to 42 inches; dark yellowish brown (10YR 4/4) light silty clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; friable; brown (10YR 4/3) coatings on peds; discontinous very dark grayish brown (10YR 3/2) coatings on prisms and in root channels; medium acid; gradual boundary.

B3—42 to 50 inches; yellowish brown (10YR 5/4) light silty clay loam; few fine pale brown (10YR 6/3) and light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; friable; medium acid; gradual boundary.

C—50 to 60 inches; dark grayish brown (2.5Y 4/2) and brown (10YR 4/3) light silty clay loam; few fine dark red (2.5YR 3/6) mottles; weak medium prismatic structure; friable; medium acid.

The solum is 42 to 60 inches thick.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and ranges to very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) in the lower part. The A horizon is 24 to 36 inches thick. The A and B horizons are medium acid or slightly acid.

Kenyon series

The Kenyon series consists of moderately well drained, moderately permeable soils on ridge crests and side slopes on uplands. They formed in 14 to 24 inches of loamy material and the underlying glacial till. Slope ranges from 2 to 24 percent.

Kenyon soils are similar to Aredale and Readlyn soils and are commonly adjacent to Readlyn, Floyd, and Clyde soils on the landscape. Aredale soils are deeper to the underlying firm glacial till than Kenyon soils. Readlyn, Floyd, and Clyde soils have a grayer B horizon, poorer internal drainage, and occur lower on the landscape than Kenyon soils.

Typical pedon of Kenyon loam, 2 to 5 percent slopes, in a cultivated field 2,265 feet north and 55 feet east of the southwest corner of section 27, T. 92 N., R. 19 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear boundary.

A12—7 to 14 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; medium acid.

A3—14 to 18 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; medium acid; gradual boundary.

B1—18 to 22 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; medium acid; clear boundary.

IIB21—22 to 29 inches; brown (10YR 4/3) sandy clay loam; weak fine and medium subangular blocky structure; firm; band of pebbles 1/4 inch to 1 1/2 inches in diameter in the upper part of the horizon; medium acid; clear boundary.

IIB22—29 to 37 inches; olive brown (2.5Y 4/4) loam; weak fine prismatic structure parting to weak fine subangular blocky; firm; medium acid; clear boundary.

IIB3—37 to 48 inches; mottled dark grayish brown (2.5Y 4/2) and yellowish brown (10YR 5/6) loam; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; few fine dark hard oxide concretions; slightly acid; clear boundary.

IIC—48 to 60 inches; mottled grayish brown (2.5Y 5/2), gray (10YR 5/1), and yellowish brown (10YR 5/6) loam, massive; firm; few dark hard oxide concretions; slightly acid.

The solum is 48 to 60 inches thick. The soils are typically leached of carbonates to a depth of 45 to 80 inches.

The A horizon ranges from loam to silt loam that is high in content of sand. The IIB2 horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6) and has some grayish mottles below a depth of 20 to 34 inches. It is generally heavy loam but ranges from loam or sandy clay loam to light clay loam. The B horizon ranges from medium acid to very strongly acid in the upper part and medium to slightly acid in the lower part.

Klinger series

The Klinger series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on ridges, at the heads of drainageways, and on side slopes. They formed in 20 to 40 inches of loess and the underlying till or till-derived material. Slope ranges from 1 to 3 percent.

Klinger soils are similar to Dinsdale and Maxfield soils and are commonly adjacent to Dinsdale, Waubeek, Franklin, and Maxfield soils on the landscape. Dinsdale and Waubeek soils have a browner B horizon and better internal drainage than Klinger soils. Maxfield soils have a grayer B horizon and poorer internal drainage. Franklin soils have a thinner combined Ap and A1 horizon and have an A2 horizon.

Typical pedon of Klinger silty clay loam, 1 to 3 percent slopes, in a bluegrass pasture 1,860 feet east and 80 feet south of the northwest corner of section 32, T. 91 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; fine granular and very fine subangular blocky structure; friable; neutral clear boundary.

A12—9 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; very fine granular structure; friable; neutral; gradual boundary.

A3—16 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular and very fine subangular blocky structure; friable; some very dark gray (10YR 3/1) coatings on peds; medium acid; gradual boundary.

B21—21 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate very fine subangular blocky structure; very dark grayish brown (2.5Y 3/2) coatings on peds; strongly acid; gradual boundary.

B22t—25 to 35 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) light silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few thin discontinuous clay films; strongly acid; abrupt boundary.

IIB3—35 to 41 inches; light olive brown (2.5Y 5/6) heavy loam; weak medium prismatic structure parting to weak coarse subangular blocky; firm; slightly acid; clear boundary.

IIC1—41 to 50 inches; olive gray (5Y 5/2) heavy loam; many medium strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) mottles; weak coarse prismatic structure; firm; neutral; clear boundary.

IIC2—50 to 60 inches; gray (5Y 5/1) heavy loam; many medium and coarse strong brown (7.5YR 5/6) and

yellowish red (5YR 4/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is generally 42 to 48 inches in thickness, but ranges from 40 to 60 inches. The loess is generally 30 to 36 inches thick and ranges from 22 to 40 inches

The A3 horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). The part of the B horizon that formed in loess ranges from 27 to 35 percent clay and from dark grayish brown (10YR or 2.5Y 4/2) to light olive brown (2.5Y 5/4). The content of the sand in the A and B horizons ranges from 3 to 10 percent. The IIB horizon is generally loam, but the range includes sandy clay loam and light clay loam. In places there are thin, discontinuous lenses of sandy loam, loamy sand, or sand between the loess and the till.

Lawler series

The Lawler series consists of somewhat poorly drained soils on stream benches and outwash plains. These soils are moderately permeable in the solum and rapidly permeable in the substratum. They formed in 24 to 40 inches of loamy deposits over sandy material. Slope ranges from 0 to 2 percent.

Lawler soils are similar to Saude, Waukee, and Marshan soils and are commonly adjacent to Saude, Waukee, Marshan, and Turlin soils on the landscape. Saude and Waukee soils have a browner B horizon and better internal drainage than Lawler soils. Marshan soils have a grayer B horizon and poorer internal drainage. Turlin soils have a mollic epipedon more than 20 inches in depth.

Typical pedon of Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in cultivated field 1,590 feet north and 60 feet west of the southeast corner of section 11, T. 93 N., R. 20 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear boundary.

A12—9 to 14 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry, moderate fine and very fine granular structure; friable; slightly acid; gradual boundary.

A3—14 to 18 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine and very fine granular structure; friable; very dark brown (10YR 2/2) coatings on peds; a few dark grayish brown (2.5Y 4/2) peds; medium acid; gradual boundary.

B2—18 to 24 inches; dark grayish brown (10YR 4/2) loam; moderate fine subangular blocky structure; friable; discontinuous very dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.

B3—24 to 29 inches; mottled brown (10YR 4/3) and dark brown (7.5YR 4/4) light sandy clay loam; few fine dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; approximately 5 to 10 percent fine gravel; medium acid; abrupt boundary.

IIC1—29 to 36 inches; mottled brown (10YR 5/3) and yellowish brown (10YR 5/6) sand; massive; loose; approximately 5 to 10 percent fine gravel; few fine red (2.5YR 4/6) oxide concretions; medium acid; clear boundary.

IIC2—36 to 48 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) sand; massive; loose; approximately 5 to 10 percent fine pebbles; medium acid; gradual boundary.

IIC3—48 to 60 inches; grayish brown (2.5Y 5/2) sand; common medium strong brown (7.5YR 5/6) mottles; massive; loose; approximately 5 percent fine pebbles; neutral.

The solum is 24 to 40 inches in thickness. In some areas it extends into the upper part of the underlying sand and gravel.

The A horizon is generally loam but ranges to light silty clay loam that has a high content of sand. The B2 horizon generally ranges from loam to sandy clay loam and light clay loam. It is commonly underlain by a thin zone of sandy loam below a depth of 24 to 36 inches. The IIB3 horizon or the upper part of the IIC horizon generally ranges from loamy coarse sand to gravelly sand and has thin layers of sandy loam.

Lester series

The Lester series consists of well drained, moderately permeable soils on knobs, ridges, and side slopes in the uplands. They formed in glacial till. Slope ranges from 2 to 24 percent.

Lester soils are commonly adjacent to Clarion, Nicollet, Terril, and Coland soils on the landscape. Those soils all have a thicker and typically darker colored surface layer than Lester soils and lack an A2 horizon. Nicollet and Coland soils have a grayer B horizon and poorer internal drainage than Lester soils.

Typical pedon of Lester loam, 2 to 5 percent slopes, in pasture 490 feet north and 125 feet west of southeast corner of section 22, T. 91 N., R. 20 W.

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few dark brown (10YR 4/3) mixings in the lower part; black (10YR 2/1) and very dark brown (10YR 2/2) coatings on peds; slightly acid; clear boundary.

A2—8 to 11 inches; dark grayish brown (10YR 4/2) loam; few fine yellowish brown (10YR 5/6) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; light gray (10YR 7/1) grainy coatings on peds when dry; medium acid; clear boundary.

B1—11 to 14 inches; brown (10YR 4/3) loam; weak very fine subangular blocky structure; friable; discontinu-

ous very dark grayish brown (10YR 3/2) silt coatings on peds; light gray (10YR 7/1) when dry; few thin clay films; medium acid; clear boundary.

B21t—14 to 20 inches; brown (10YR 4/3) clay loam; moderate and strong very fine subangular blocky structure; friable; thin discontinuous clay films; few red (2.5YR 4/8) oxide concretions; discontinuous dark brown (10YR 3/3) silt coatings on peds; light gray (10YR 7/1) when dry; medium acid; gradual boundary.

B22t—20 to 28 inches; dark yellowish brown (10YR 4/4) light clay loam; weak fine prismatic structure parting to moderate and strong fine subangular blocky; friable; discontinuous brown (10YR 4/3) silt coatings on peds, light gray (10YR 7/2) thin coatings of fine sand and silt on peds; few shale fragments; thin clay films on prisms and peds; thick very dark grayish brown (10YR 3/2) clay flows in root channels; few fine red (2.5YR 4/8) oxide concretions; strongly acid; gradual boundary.

B31t—28 to 40 inches; yellowish brown (10YR 5/4) heavy loam; moderate fine prismatic structure parting to weak medium subangular blocky; friable; few thick very dark grayish brown (10YR 3/2) clay flows in root channels; few red (2.5YR 4/6) oxide concretions; thin brown (10YR 5/3) clay films and light gray (10YR 7/2) thin coatings of fine sand and silt on peds; strongly acid; gradual boundary.

B32t—40 to 50 inches; light olive brown (2.5Y 5/4) heavy loam; weak medium prismatic structure parting to weak medium and coarse subangular blocky; friable common dark brown (10YR 3/3) clay flows in root channels; few fine red (2.5YR 5/8) oxide and few fine dark oxide concretions; few shale fragments; medium acid; clear boundary.

C—50 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium strong brown (7.5YR 5/6) mottles; massive; friable; common thick very dark grayish brown (10YR 3/2) clay flows in root channels; few fine red (2.5YR 4/8) and few dark oxide concretions; few shale fragments; mildly alkaline.

The solum ranges from 36 to 50 inches in thickness. The A1 or Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark brown (10YR 3/3). It is 6 to 9 inches thick. The A1 or Ap horizon is loam or silt loam that has a high content of sand. The A2 horizon which is not in all pedons, ranges from very dark grayish brown (10YR 4/2) to brown (10YR 5/3) and is loam or silt loam that has a high content of sand. The upper part of the B horizon is 10YR in hue, 4 or 5 in value, and 3 or 5 to 6 in chroma. The lower part of the B horizon is 10YR or 2.5Y in hue, 4 or 5 in value and 3 or 4 to 6 in chroma. Texture of the B horizon ranges from heavy loam to clay loam. It is medium or strongly acid in the most acid part.

Map unit 236D2 has a surface layer that is lighter in color than is typical for the series. This difference does not alter the usefulness or behavior of this soil.

Marlean series

The Marlean series consists of well drained soils on long ridge crests and side slopes on uplands and terrace escarpments. These soils have moderate permeability in the upper part and moderately rapid permeability in the lower part. They formed in 4 to 15 inches of loamy materials and the underlying fractured bedrock that contains earthy material in the upper 3 to 5 feet. Slope ranges from 2 to 40 percent.

Marlean soils are commonly adjacent to Mottland, Rockton, and Ripon soils on the landscape. Mottland soils are underlain by soft earthy limestone. Rockton and Ripon are deeper to the hard limestone bedrock than Marlean soils.

Typical pedon of Marlean loam, 2 to 9 percent slopes, in a cultivated field 2,275 feet west and 50 feet south of the northeast corner of section 9, T. 92 N., R. 20 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; few limestone fragments; neutral; clear boundary.

A12—8 to 12 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/3) dry; weak fine granular structure; friable; neutral; abrupt boundary.

IIC1—12 to 24 inches; brown (10YR 4/3) very channery loam; massive; very friable; common roots between fragments; 70 percent limestone fragments 1/2 inch to 5 inches in length; moderately alkaline; gradual boundary.

IIC2—24 to 60 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) very flaggy sandy loam and very flaggy loamy sand; single grain; loose; few roots; 65 to 80 percent limestone fragments of 1/2 inch to 12 inches in length; moderately alkaline.

The solum is generally about 12 inches thick, but it ranges from 8 to 15 inches. It is generally loam. The shattered upper layer of limestone, 3 to 5 feet thick, contains 15 to 30 percent material ranging from heavy loam to loamy sand. As slope increases, the thickness of the shattered limestone generally decreases. In some areas the hard shattered bedrock is underlain by soft arenacous limestone.

The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The B2 horizon, if present, is generally very dark grayish brown (10YR 3/2).

Marshan series

The Marshan series consists of poorly drained soils and stream benches and outwash plains. These soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in 24 to 40 inches of loamy alluvial deposits over sandy materials. Slope ranges from 0 to 2 percent.

Marshan soils are similar to Talcot, Clyde, and Lawler soils and are commonly adjacent to Lawler and Saude

soils on the landscape. Talcot soils are calcareous and have free carbonates in the A horizon. Clyde soils lack a coarse textured substratum and are underlain with glacial till. Lawler and Saude soils have a browner B horizon and have better internal drainage than Marshan soils.

Typical pedon of Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field 2,240 feet north and 155 feet west of the southeast corner of section 11, T. 93 N., R. 20 W.

Ap—0 to 9 inches; black (N 2/0) light clay loam, dark gray (N 4/0) dry; cloddy parting to weak very fine subangular blocky structure; firm; neutral; clear boundary.

A12—9 to 14 inches; black (10YR 2/0) light clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; gradual boundary.

A3—14 to 20 inches; very dark gray (5Y 3/1) clay loam, gray (5Y 5/1) dry; moderate fine granular structure; friable; black (5Y 2/1) coatings on peds; neutral; clear boundary.

B2g—20 to 28 inches; olive gray (5Y 5/2) light clay loam; common fine faint olive yellow (2.5Y 5/6) mottles; weak medium prismatic structure; friable; common fine hard yellowish red (5YR 4/8) oxide concretions; slightly acid; abrupt boundary.

IIC1—28 to 40 inches; mottled gray (5Y 5/1) and brown (7.5YR 4/4) sand and coarse sand; single grain; loose; common very dark gray (N 3/0) manganese oxide concentrations; few fine pebbles; neutral; gradual boundary.

IIC2—40 to 60 inches; mottled gray (5Y 5/1) and brown (7.5YR 4/4) coarse sand; single grain; loose; common very dark gray (N 3/0) manganese oxide concentrations; 10 percent fine gravel; neutral.

The solum is 24 to 40 inches thick.

The A1 horizon is black (N 2/0 to 10YR 2/1). The A3 horizon, if present, is generally very dark gray (10YR 3/1 to 5Y 3/1) or very dark grayish brown (2.5Y 3/2). The A horizon is dominantly clay loam but ranges to silty clay loam. The upper part of the B horizon ranges from dark gray (10YR 4/1 or 5Y 4/1) to dark grayish brown (2.5Y 4/2) or olive gray (5Y 5/2) and is clay loam or silty clay loam that has a high content of sand. The IIB horizon when present, ranges from heavy sandy loam to sand. The IIC horizon ranges from gravelly loamy sand to sand that has some gravel.

Maxfield series

The Maxfield series consists of poorly drained, moderately permeable soils on upland flats and in shallow drainageways. They formed in 24 to 40 inches of loess and the underlying glacial till. Slope ranges from 0 to 2 percent.

Maxfield soils are similar to Garwin, Tripoli, and Klinger soils and are commonly adjacent to Klinger and Dinsdale soils on the landscape. Garwin soils formed in deeper deposits of loess over glacial till. Tripoli soils are shallower to the underlying glacial till and have more sand in the A horizon and upper part of the B horizon. Klinger and Dinsdale soils have a browner B horizon and better internal drainage than Maxfield soils.

Typical pedon of Maxfield silty clay loam, 0 to 2 percent slopes; in a cultivated field 2,795 feet north and 105 feet west of the southeast corner of section 6, T. 90 N., R. 19 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine granular structure; friable; neutral; clear boundary.

A12—8 to 14 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; fine granular structure; friable; neutral; gradual boundary.

A3—14 to 18 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; some mixing of olive gray (5Y 5/2); moderate fine granular structure; friable; neutral; gradual boundary.

B1—18 to 22 inches; olive gray (5Y 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine granular structure; friable; very dark gray (5Y 3/1) coatings on peds; slightly acid; clear boundary.

B21—22 to 27 inches; grayish brown (2.5Y 5/2) light silty clay loam; common medium faint gray (5Y 5/1) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate very fine subangular blocky structure; friable; neutral; clear boundary.

B22—27 to 35 inches; mottled grayish brown (5Y 5/2) and yellowish brown (10YR 5/6) light silty clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; grayish brown (2.5Y 5/2) coatings on prisms and peds; neutral; clear boundary.

IIB3—35 to 47 inches; mottled light olive gray (5Y 6/2) and strong brown (7.5YR 5/6) loam; moderate medium prismatic structure parting to weak coarse subangular blocky; firm; neutral; gradual boundary.

IIC—47 to 60 inches; mottled strong brown (7.5YR 5/6), olive gray (5Y 5/2), and yellowish brown (10YR 5/6) light loam; massive; firm; neutral.

The solum is generally 42 to 54 inches thick.

An A3 horizon is generally present and is very dark gray (10YR 3/1 or 5Y 3/1). The A horizon ranges from 16 to 22 inches in thickness. Clay content ranges from about 30 to 35 percent. The B1 horizon, if present, ranges from dark gray (10YR 4/1) to dark grayish brown (2.5Y 4/2) and olive gray (5Y 4/2 or 5/2) and may have mottles of high and low chroma. Clay content of the upper part of the B horizon ranges from about 30 to 35 percent. The B2 horizon ranges from olive gray (5Y 5/2) to dark grayish brown (2.5Y 4/2) and may have mottles of high and low chroma. The IIB2 horizon is loam but includes thin discontinuous strata of sandy loam in places.

Mottland series

The Mottland series consists of well drained soils on ridge crests and side slopes in the upland. They are moderately permeable in the upper part and moderately rapidly permeable in the lower part. They formed in loamy deposits over loamy residuum weathered from sandy limestone. Slope ranges from 5 to 18 percent.

Mottland soils are similar to Rossfield soils and are commonly adjacent to Rossfield, Judson, Jacwin, and Marlean soils on the landscape. Rossfield soils are deeper to the underlying soft earthy limestone than Mottland soils. Judson soils have a mollic epipedon more than 24 inches thick, do not have limestone in the upper 5 feet, and are downslope from Mottland soils. Jacwin soils have a B horizon developed partially in fine textured shale deposits. Marlean soils are shallow to hard, fractured limestone.

Typical pedon of Mottland loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field 1,285 feet north and 140 feet east of the southwest corner of section 6, T. 93 N., R. 20 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; violent effervescence; moderately alkaline; clear boundary.

IIC1—7 to 11 inches; yellowish brown (10YR 5/6) loam; massive; friable; soft limestone fragments make up 10 to 15 percent of volume; violent effervescence; moderately alkaline; clear boundary.

IIC2—11 to 60 inches; yellowish brown (10YR 5/6) channery sandy loam; massive; friable; few roots; estimate 20 percent soft limestone fragments by volume; moderately alkaline.

The solum is generally 7 to 12 inches thick but ranges to 20 inches.

The A1 or Ap horizon is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2) and is 7 to 12 inches thick. The A3 horizon, when present, is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) and 3 to 8 inches thick. The C horizon consists of soft earthy limestone that ranges in texture from sandy loam to light loam and silt loam high in content of sand. The C horizon is 7.5YR, 10YR, or 2.5Y in hue, 5 to 7 in value and 4 to 8 in chroma. It is mildly or moderately alkaline and is strongly or violently effervescent. Typically, soft rounded limestone pebbles and limestone fragments make up 10 to 30 percent of the C horizon, but they range from 5 to 40 percent.

Muscatine series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils occupy lower concave positions and convex ridges. They formed in loess deposits, 4 to 10 feet thick, over glacial till. Slope ranges from 1 to 3 percent.

Muscatine soils are similar to Klinger, Ely, Garwin, and Tama soils and commonly are adjacent to Dinsdale soils on the landscape. Klinger soils formed in loess deposits less than 40 inches thick and in the underlying glacial till. Ely soils have a mollic epipedon more than 20 inches thick. Garwin soils have a grayer B horizon and poorer internal drainage than Muscatine soils. Tama and Dinsdale soils have a browner B horizon and better internal drainage, and Dinsdale soils formed in loess deposits of less than 40 inches and the underlying glacial till.

Typical pedon of Muscatine silty clay loam, 1 to 3 percent slopes, in a cultivated field 1,810 feet east and 1,120 feet north of the southwest corner of section 35, T. 93 N., R. 20 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; clear boundary.

A12—7 to 19 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry, moderate very fine granular structure; friable; medium acid; gradual boundary.

B1—19 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate very fine subangular blocky structure; friable; very dark grayish brown (2.5Y 3/2) coatings on peds; medium acid; gradual boundary.

B21t—24 to 30 inches; grayish brown (10YR 5/2) silty clay loam; moderate fine subangular blocky structure; friable; few dark grayish brown (10YR 4/2) clay films in root channels and on peds; dark grayish brown (10YR 4/2) coatings on peds; medium acid; gradual boundary.

B22t—30 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; friable; few thin dark grayish brown (10YR 4/2) clay films on prisms and peds; medium acid; gradual boundary.

B3—36 to 45 inches; grayish brown (2.5Y 5/2) light silty clay loam; few fine strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak medium subangular blocky; friable; medium acid; gradual boundary.

C—45 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine strong brown (7.5YR 5/6) and yellowish red (5YR 5/8) mottles; weak medium prismatic structure; friable; medium acid.

The solum is generally about 4 feet thick, but it ranges from 40 to 60 inches.

Muscatine soils are medium acid to strongly acid in the A horizon and upper part of the B horizon and medium acid to neutral in the middle and lower parts of the B horizon. The upper part of the B horizon is 25 to 35 inches thick and centers on dark grayish brown (10YR to 2.5Y 4/2) and the lower part has values of 5 or 6 and chroma of 2 to 4. The B2t horizon is silty clay loam that ranges from 27 to 35 percent clay. In the B horizon the maximum amount of clay is in the upper part of the B2t

horizon, and below this the clay content decreases with depth.

Nicollet series

The Nicollet series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on low ridges and on slightly concave to flat side slopes. Nicollet soils formed in loamy glacial drift. Slope ranges from 1 to 3 percent.

Nicollet soils are similar to Clarion and Webster soils and are commonly adjacent to Clarion, Webster, Canisteo, and Harps soils on the landscape. Clarion soils have a browner B horizon and better internal drainage than Nicollet soils. Webster soils have a grayer B horizon and poorer internal drainage. Canisteo and Harps soils have a calcareous A horizon with free carbonates, have a grayer B horizon, and poorer internal drainage.

Typical pedon of Nicollet loam, 1 to 3 percent slopes, in a cultivated field 1,060 feet west and 195 feet south of the northeast corner of section 32, T. 93 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; clear boundary.

A12—8 to 15 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; medium acid; gradual boundary.

A3—15 to 20 inches; very dark gray (10YR 3/1) heavy loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; medium acid; gradual boundary.

B2—20 to 30 inches; dark grayish brown (2.5Y 4/2) heavy loam; moderate fine subangular blocky structure; friable; very dark grayish brown (2.5Y 3/2) coatings on peds and fills in root channels; medium acid; gradual boundary.

B3—30 to 42 inches; grayish brown (2.5Y 5/2) heavy loam; moderate medium subangular blocky structure; friable; few fine strong brown (7.5YR 5/6) oxide concretions; slightly acid; clear boundary.

C—42 to 60 inches; mottled light olive gray (5Y 5/2) and strong brown (7.5YR 5/6) loam; massive; friable; strong effervescence; moderately alkaline.

The solum is generally 3 to 4 feet thick.

The A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The A3 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 4 to 6 inches in thickness. The A1 and A3 horizons range from loam to light silty clay loam high in content of sands. The A horizon is 10 to 20 inches thick. The B2 horizon and the B1 horizon if there is one, are dark grayish brown (2.5Y 4/2 or 10YR 4/2) heavy loam or light clay loam. The B3 horizon is loam or light clay loam. Total thickness of the B horizon typically is 18 to 24 inches. The C horizon usually has a mottled color pattern. Texture ranges from heavy loam to light loam.

Okoboji series

The Okoboji series consists of moderately slowly permeable, very poorly drained soils in upland depressions. These soils formed in local alluvium washed from adjacent uplands. Slope ranges from 0 to 1 percent.

Okoboji soils are commonly adjacent to Harps, Canisteo, and Wacousta soils on the landscape. Those soils have a thinner mollic epipedon than Okoboji soils. Canisteo and Harps soils occur as rims above the Okoboji soils on the landscape, are calcareous, and have free carbonates in the A horizon.

Typical pedon of Okoboji silty clay loam, 0 to 1 percent slopes, in a cultivated field 560 feet south and 120 feet east of the northwest corner of section 25, T. 93 N., R. 22 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak very fine granular structure; firm; neutral; clear boundary.

A12—9 to 14 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate, very fine granular structure; friable; neutral; clear boundary.

A13—14 to 26 inches; black (N 2/0) heavy silty clay loam, dark gray (N 4/0) dry; few fine strong brown (7.5YR 5/6) mottles; weak very fine subangular blocky structure, friable; neutral; clear boundary.

A14—26 to 31 inches; black (10YR 2/1) heavy silty clay loam, dark gray (10YR 4/1) dry; few fine yellowish red (5YR 4/6) and strong brown (7.5YR 5/6); mottles; weak very fine subangular blocky structure; friable; yellowish red (5YR 4/6) fills in root channels; neutral; clear boundary.

B1g—31 to 36 inches; black (5Y 2/1) and very dark gray (5Y 3/1) heavy silty clay loam, dark gray (5Y 4/1) and gray (5Y 5/1) dry; very weak very fine prismatic structure parting to weak fine subangular blocky; friable; neutral; clear boundary.

B21g—36 to 43 inches; very dark gray (5Y 3/1) and dark olive gray (5Y 3/2) heavy silty clay loam, gray (5Y 5/1) and olive gray (5Y 5/2) dry; very weak very fine prismatic structure parting to weak fine subangular blocky; friable; gray (5Y 5/1) krotovinas; neutral; clear boundary

B22g—43 to 55 inches; olive gray (5Y 5/2) heavy silty clay loam; common fine light olive brown (2.5Y 5/4) mottles; weak fine prismatic structure parting to weak medium subangular blocky; friable; a few very fine yellowish red (5YR 4/6) oxide connections; common very dark gray (5Y 3/1) fills in root channels and krotovinas; mildly alkaline; clear boundary.

Cg—55 to 60 inches; olive gray (5Y 5/2) light and medium silty clay loam; massive; friable; common fine and medium yellowish red (5YR 4/6) oxide connections; slight effervescence; mildly alkaline.

The solum is generally 40 to 60 inches thick.

The A1 horizon ranges from about 24 to 36 inches in thickness. The texture of the upper 12 to 18 inches

ranges from silty clay loam to mucky silt loam. The clay content of the lower part of the A1 horizon ranges from 35 to 40 percent. The Bg horizon ranges from black (10YR 2/1, 5Y 2/1, or N 2/0) to very dark gray (N 3/0 or 5Y 3/1) in the upper part to dark gray (5Y 4/1) to olive gray (5Y 5/2) in the lower part. The clay content of the Bg horizon ranges from 35 to 40 percent. The Cg horizon has thin layers in which the texture is coarser than silty clay loam in some pedons.

Palms series

The Palms series consists of very poorly drained soils in depressions that formerly were ponds. Permeability is moderately rapid to moderately slow. These soils formed in 16 to 50 inches of organic materials underlain by loamy, mineral soil material. Slope is 0 to 1 percent.

Palms soils are similar to Houghton soils and are commonly adjacent to Okoboji mucky silt loam and Harps soils on the landscape. Houghton soils have organic layers from 51 inches to many feet thick. Okoboji mucky silt loam soil has an organic surface layer only 8 to 16 inches thick that is somewhat lower in organic content than the surface tier of Palms soils. Harps soils formed in glacial drift, occur as rims above the Palms soils on the landscape, are calcareous, and have free carbonates in the A horizon.

Typical pedon of Palms muck, 0 to 1 percent slopes, in a blue grass pasture 530 feet north and 130 feet west of the southeast corner of section 35, T. 92 N., R. 22 W.

Oa1—0 to 9 inches; black (N 2/0 broken face, 10YR 2/1 rubbed) sapric material; weak very fine granular structure; neutral; clear boundary.

Oa2—9 to 28 inches; black (N 2/0 broken face, 10YR 2/1 rubbed) sapric material; weak very fine granular structure; few fine sand grains on peds; neutral; clear boundary.

Oa3—28 to 34 inches; black (N 2/0 broken face, 10YR 2/1 rubbed) sapric material; weak fine subangular blocky structure; few fine sand grains on peds; few fine snail shells; mildly alkaline; clear boundary.

IIC1g—34 to 38 inches; dark gray (5Y 4/1) loam; massive; friable; common fine yellowish red (5YR 4/6) iron seams; few fine snail shells; mildly alkaline; clear boundary.

IIC2g—38 to 50 inches; dark gray (5Y 4/1) silt loam high in content of sand; massive; friable; common fine yellowish red (5YR 4/6) iron seams; few fine snail shells; mildly alkaline; clear boundary.

IIC3g—50 to 60 inches; dark gray (5Y 4/1) loam; massive friable; common fine yellowish red (5YR 4/6) iron seams; few fine snail shells; mildly alkaline.

The organic layer is typically 20 to 40 inches thick but ranges from 16 to 50 inches. It has hue of 10YR or 7.5YR, value of 2, and chroma of 0 or 1. Broken face and rubbed and pressed colors are quite similar. The organic material is dominantly sapric, and relatively few pedons contain thin layers of fibric material. In some pedons the organic material in the layer above the IICg horizon contains about 50 percent by volume of mineral material. Reaction of the organic layer is slightly acid to mildly alkaline. In some pedons a sedimentary peat layer, 1 to 2 inches thick, is above the IICg horizon. The IICg horizon has a hue of 10YR, 2.5Y, or 5Y; value of 4 to 7; and chroma of 1 or 2. It ranges from loam to silty clay loam and averages less than 35 percent clay. It is mildly or moderately alkaline.

Port Byron series

The Port Byron series consists of well drained, moderately permeable soils on uplands. These soils occupy ridges and side slopes. They formed in deep loess. Slope ranges from 5 to 20 percent.

Port Byron soils are similar to Tama, Dinsdale, and Tallula soils and are commonly adjacent to Tama, Tallula, and Judson soils on the landscape. Tama soils are higher in clay and lower in silt content than Port Byron soils. Dinsdale soils formed in 24 to 40 inches of loess and the underlying glacial till. Tallula soils are lower in clay, higher in fine sand content throughout, and are leached to shallower depths. Judson soils have a mollic epipedon more than 24 inches thick and are lower than Port Byron soils on the landscape.

Typical pedon of Port Byron silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field 2,330 feet north and 145 feet east of the southwest corner of section 14, T. 92 N., R. 19 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) with some mixing of dark brown (10YR 3/3) heavy silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; slightly acid; clear boundary.

B1—8 to 13 inches; dark brown (10YR 3/3) with mixings of brown (10YR 4/3) heavy silt loam, brown (10YR 5/3) dry; dark brown (10YR 3/3) rubbed; weak very fine and fine subangular blocky structure; discontinuous very dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.

B21—13 to 17 inches; brown (10YR 4/3) silt loam; weak very fine and fine subangular blocky structure; discontinuous very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) coatings on peds and in root channels; friable; medium acid; gradual boundary.

B22—17 to 24 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; slightly acid; gradual boundary.

B3—24 to 42 inches; yellowish brown (10YR 5/4) silt loam; few fine gray (5Y 5/1) mottles; weak fine and medium prismatic structure parting to weak medium subangular blocky; friable; slightly acid; gradual boundary.

C1—42 to 47 inches; yellowish brown (10YR 5/4 and 10YR 5/6) silt loam; common medium gray (5Y 5/1) mottles; massive; very friable; neutral; clear boundary.
C2—47 to 60 inches; yellowish brown (10YR 5/6) light loam; massive; very friable; sand size is dominantly very fine; strong effervescence; moderately alkaline.

The solum is generally 3 to 4 feet thick. It is medium acid in the most acid part.

Sand content of the A horizon and upper part of the B horizon ranges from 5 to 10 percent. Sand content ranges from 10 to 20 percent in the lower part of the B horizon and from 15 to 35 percent in the C horizon. Sand size in the A and B horizons is dominantly very fine but it increases in size in the C horizon. The finest part of the B horizon averages between 20 and 25 percent clay. A few fine mottles of high and low chroma are in the lower part of the B horizon in some places.

Readlyn series

The Readlyn series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils are on broad ridges and on slightly convex side slopes. They formed in 14 to 24 inches of loamy materials and the underlying glacial till. Slope ranges from 1 to 3 percent.

Readlyn soils are similar to Kenyon, Floyd, and Tripoli soils and are commonly adjacent to Kenyon, Clyde, and Tripoli soils on the landscape. Kenyon soils have a browner B horizon and better internal drainage than Readlyn soils. Floyd soils are more stratified and less acid. Clyde and Tripoli soils have a grayer B horizon, poorer internal drainage, and are less acid.

Typical pedon of Readlyn loam, 1 to 3 percent slopes, in a cultivated field 1,670 feet north and 55 feet west of the southeast corner of section 25, T. 93 N., R. 19 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; clear boundary.
A12—8 to 14 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate very fine and fine granular structure; friable; medium acid; gradual boundary.
A3—14 to 19 inches; very dark grayish brown (10YR 3/2) heavy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; very dark gray (10YR 3/1) coatings on peds; medium acid; gradual boundary.
IIB21—19 to 27 inches; grayish brown and light olive brown (2.5Y 5/3) heavy loam; few fine grayish brown (2.5Y 5/2) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; firm; medium acid; gradual boundary.
IIB22—27 to 36 inches; light olive brown (2.5Y 5/4) heavy loam; common fine light olive brown (2.5Y 5/2) mottles; weak fine prismatic structure parting to weak fine and medium subangular blocky; firm; medium acid; clear boundary.
IIB3—36 to 49 inches; light olive brown (2.5Y 5/4) loam; common medium grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; neutral; abrupt boundary.
IIC—49 to 60 inches; light olive gray (5Y 6/2) loam; many medium strong brown (7.5YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is generally 3 1/2 to 5 feet thick.

The A1 horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2), from loam to silty clay loam, and from 10 to 15 inches in thickness. The B1 horizon, if present, is generally dark grayish brown (10YR to 2.5Y 4/2) or light olive brown (2.5Y 5/3). The IIB horizon ranges from loam to light clay loam or sandy clay loam.

Ripon series

The Ripon series consists of well drained, moderately permeable soils on upland ridge crests and side slopes. These soils formed in 20 to 40 inches of loess and a thin remnant of till or till-derived sediments over shattered limestone bedrock. Slope ranges from 2 to 9 percent.

The Ripon soils in Franklin County differ from the Ripon soils in other places in that they typically lack the increase in clay necessary for an argillic horizon. This difference does not alter the use or behavior of these soils.

Ripon soils are similar to Rockton soils and are commonly adjacent to Marlean soils on the landscape. Rockton soils have more sand than Ripon soils and less silt. Marlean soils are shallow to fractured limestone bedrock.

Typical pedon of Ripon silt loam, 30 to 40 inches of limestone, 2 to 5 percent slopes, in a cultivated field 960 feet north and 130 feet east of the southwest corner of section 13, T. 92 N., R. 19 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) heavy silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; clear boundary.
A12—7 to 10 inches; very dark brown (10YR 2/2) heavy silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; slightly acid; clear boundary.
A3—10 to 14 inches; dark brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) dry; few brown (10YR 4/3) mixings; moderate very fine granular structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; slightly acid; gradual boundary.
B21t—14 to 20 inches; brown (10YR 4/3) light silty clay loam; moderate fine subangular blocky structure; friable; grayish brown (10YR 3/2) fills in root channels;

dark brown (10YR 3/3) coatings on peds; few thin clay films on peds; slightly acid; gradual boundary.

B22t—20 to 31 inches; yellowish brown (10YR 5/4) light silty clay loam; moderate fine and medium subangular blocky structure; friable; few thin clay films on peds; discontinuous brown (10YR 4/3) coatings on peds; slightly acid; clear boundary.

IIB23t—31 to 36 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) clay loam; moderate very fine subangular blocky structure; firm; clay films line root channels; common yellowish red (5YR 5/8) oxide concretions; few small pebbles up to 3/4 inch in diameter; slightly acid; abrupt boundary.

R—36 inches; very pale brown (10YR 7/4) hard fractured bedrock.

The solum ranges from 20 to 40 inches in thickness. The loess ranges from 20 to 36 inches in thickness. The shattered upper part of the bedrock ranges from 2 to 5 feet in thickness. It generally consists of 15 to 30 percent loamy materials in crevices and thin layers of clayey material on the slabs of bedrock.

The A1 or Ap horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2). The A3 horizon ranges from very dark brown (10YR 2/2) to dark brown (10YR 3/3). The IIB horizon formed in glacial materials and ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). It ranges from loam to sandy loam and heavy sandy loam. A IIIB horizon is in some pedons just above the shattered bedrock. It is clay or silty clay limestone residuum that is 0 to 2 inches thick.

Rockton series

The Rockton series consists of well drained, moderately permeable soils on upland ridge crests and side slopes. These soils formed in about 20 to 40 inches of loamy material and in residuum from limestone. Slope ranges from 2 to 9 percent.

These Rockton soils in Franklin County differ from the Rockton soils in other places in that they typically lack the clay increase necessary for an argillic horizon. This difference does not alter the use or behavior of these soils.

Rockton soils are similar to Ripon and Marlean soils and are commonly adjacent to Marlean, Rossfield, and Mottland soils on the landscape. Ripon soils have lower sand and higher silt content in the A horizon and upper part of the B horizon than Rockton soils. Marlean soils are shallow to fractured limestone bedrock. Rossfield and Mottland soils are underlain by soft earthy limestone.

Typical pedon of Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes, in a bluegrass pasture 1,280 feet north and 65 feet west of the southeast corner of section 15, T. 92 N., R. 20 W.

A11—0 to 11 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate very fine and fine granular structure grading to moderate very fine subangular in the lower part; friable; neutral; gradual boundary.

A12—11 to 16 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; strongly acid; gradual boundary.

A3—16 to 20 inches; very dark grayish brown (10YR 3/2) heavy loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; very dark brown (10YR 2/2) coatings on peds; strongly acid; gradual boundary.

B21t—20 to 24 inches; brown (10YR 4/3) light clay loam; moderate fine prismatic structure parting to moderate fine subangular blocky; friable; few thin very dark grayish brown (10YR 3/2) clay films in root channels and on peds; nearly continuous dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) coatings on peds; medium acid; gradual boundary.

IIB22t—24 to 28 inches; brown (10YR 4/3) heavy clay loam; moderate very fine and fine subangular blocky structure; firm; common dark brown (7.5YR 3/2) clay films on peds; few small pebbles; dark brown (10YR 3/3) coatings on peds; neutral; abrupt boundary.

IIR1—28 to 55 inches; about 15 percent yellowish brown (10YR 5/4) fine sandy loam; strong effervescence; shattered limestone fragments dominantly ranging from 1/2 inch to 8 inches; moderately alkaline.

IIR2—55 to 60 inches; hard level-bedded, fractured limestone bedrock.

The thickness of the solum, which is the same as the depth to limestone, ranges from 20 to 40 inches.

The shattered upper part of the limestone ranges from 2 to 5 feet in thickness. This part consists of 5 to 15 percent, by volume, loamy material in crevices and a thin layer of clay residuum on the slabs of limestone. The flags of limestone are typically 6 to 10 inches in length and 1 to 3 inches thick. The thickness of the shattered bedrock decreases with increasing slope.

The A1 or Ap horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2). The A3 horizon ranges from very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2). The upper part of the B horizon ranges from dark brown (10YR 3/3) to brown (10YR 4/3), and from loam to clay loam. If present, the clayey material just above the shattered bedrock is clay loam to silty clay and is 1 inch to 4 inches thick.

Rossfield series

The Rossfield series consists of well drained soils on uplands. They are moderately permeable in the solum and moderately rapidly permeable in the substratum. These soils occupy flats, ridges, and side slopes. They

formed in silty and loamy deposits over residuum from sandy limestone. Slope ranges from 0 to 14 percent.

Rossfield soils are similar to Mottland soils and are commonly adjacent to Dinsdale, Judson, and Marlean soils on the landscape. Mottland soils are shallow to the underlying soft earthy limestone. Dinsdale soils are underlain by glacial till. Judson soils have a mollic epipedon more than 20 inches thick, do not have limestone within the upper 5 feet, and are downslope from Rossfield soils. Marlean soils are shallow to hard fractured limestone.

Typical pedon of Rossfield silt loam, 0 to 2 percent slopes, in a cultivated field 525 feet east and 70 feet south of the northwest corner of section 16, T. 93 N., R. 20 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; slightly acid; clear boundary.

A12—7 to 11 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; slightly acid; clear boundary.

A3—11 to 15 inches; mixed very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; moderate very fine subangular blocky structure; friable; very dark brown (10YR 2/2) coatings on peds; slightly acid; gradual boundary.

B2—15 to 26 inches; brown (10YR 4/3) silty clay loam high in content of sand; weak medium subangular blocky structure; friable; very dark brown (10YR 3/3) coatings on peds; slightly acid; clear boundary.

B3—26 to 32 inches; yellowish brown (10YR 5/6) clay loam; weak medium subangular blocky structure; friable; brown (10YR 4/3) coatings on peds; neutral; clear boundary.

IIC—32 to 60 inches; olive yellow (2.5Y 6/6) channery sandy loam; massive; friable; few roots; about 20 percent soft limestone fragments; violent effervescence; moderately alkaline.

The solum is generally 24 to 40 inches thick, but in places it is as shallow as 20 inches. It is slightly acid in the most acid part.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon and upper part of the B horizon range from silty clay loam high in content of sand to loam with as much as 25 percent sand that is dominantly very fine. A B1 horizon is in some pedons. It is 4 to 8 inches thick and has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. The B2 horizon has hue of 10YR, value of 4 or 5 and chroma of 3 to 6. The texture of the B2 horizon is typically silty clay loam or heavy silt loam that is high in content of sand where there is a B3 horizon. In pedons without a B3 horizon, the B2 horizon is clay loam or heavy loam. The B3 horizon typically is light clay loam, but ranges to sandy loam and sandy clay loam. The IIC horizon consists of soft earthy limestone that ranges from channery sandy loam to light loam and silt loam high in content of sand. It has a hue of 7.5YR, 2.5Y, or 10YR, value of 5 to 7, and chroma of 6 to 8. It is moderately or mildly alkaline and strongly to violently effervescent. Typically 10 to 30 percent of the volume of the IIC horizon consists of pebbles or fragments of limestone. The extreme range is 5 to 40 percent.

Salida series

The Salida series consists of excessively drained, very rapidly permeable soils on uplands and benches. These soils formed in calcareous, sandy and loamy glacial outwash. Slope ranges from 2 to 9 percent.

These soils have less gravel than is defined as the range for the Salida series. This difference does not alter the agricultural use or behavior of the soils; however, they are less suitable as a source of gravel.

Salida soils are commonly adjacent to Clarion, Zenor, and Storden soils on the landscape. Zenor and Clarion soils are finer textured, more acid, and leached to a greater depth than Salida soils. Storden soils are finer textured.

Typical pedon of Salida gravelly sandy loam, 2 to 9 percent slopes, in a cultivated field 1,140 feet east and 500 feet north of the center of section 19, T. 91 N., R. 22 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) gravelly light sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; weak effervescence; moderately alkaline; clear boundary.

C1—7 to 14 inches; brown (7.5YR 5/4) gravelly coarse sand; single grain; loose; violent effervescence; moderately alkaline; gradual boundary.

C2—14 to 36 inches; yellowish brown (10YR 5/6) coarse sand; single grain; loose; few fine pebbles; strong effervescence; moderately alkaline; gradual boundary.

C3—36 to 60 inches; light brownish gray (10YR 6/2) sand and fine sand; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 7 to 15 inches. Thickness of the mollic epipedon ranges from 7 to 10 inches.

The A horizon has a color value of 2 or 3 and chroma of 2 or 3. It ranges from 7 to 10 inches in depth. Texture ranges from gravelly sandy loam to gravelly loamy sand. Reaction is usually mildly or moderately alkaline but ranges to neutral. Some pedons have a B horizon. The C horizon has value of 4 to 6 and chroma of 2 to 6. It is commonly stratified gravelly sand to sand. Gravel content decreases with depth. Reaction is mildly or moderately alkaline.

Saude series

The Saude series consists of well drained soils on stream benches and uplands. These soils are moderately or moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They formed in 20 to 36 inches of loamy and sandy materials over sand and gravel. Slope ranges from 0 to 9 percent.

Saude soils are similar to Waukee, Bolan, and Lawler soils and are commonly adjacent to Waukee, Lawler, and Marshan soils on the landscape. Waukee soils have a higher clay content in the A horizon and upper part of the B horizon than Saude soils and are usually deeper to the underlying sand and gravel. Bolan soils have loamy fine or fine sand in the substratum which is free of gravel. Lawler and Marshan soils have a grayer B horizon and poorer internal drainage.

Typical pedon of Saude loam, 0 to 2 percent slopes, in a cultivated field 1,230 feet north and 60 feet east of the southwest corner of section 12, T. 93, N., R. 20 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; abrupt boundary.

A12—8 to 15 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; medium acid; gradual boundary.

B1—15 to 23 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure parting to medium fine granular; friable; medium acid; gradual boundary.

B2—23 to 27 inches; brown (7/5YR 4/4) light loam; weak medium and coarse subangular blocky structure; very friable; medium acid; clear boundary.

IIB3—27 to 36 inches; brown (7.5YR 4/4) loamy sand; very weak coarse subangular blocky structure; very friable; 5 percent fine gravel; medium acid; gradual boundary.

IIC1—36 to 46 inches; yellowish brown (10YR 5/6) sand; single grain; loose; 5 percent fine gravel; medium acid; clear boundary.

IIC2—46 to 55 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) sand; single grain; loose; neutral; clear boundary.

IIC3—55 to 60 inches; light gray (10YR 7/2) sand; single grain; loose; neutral.

The solum is generally 2 1/2 to 3 1/2 feet thick. Depth of loamy materials over the gravelly sand and loamy sand ranges from 20 to 36 inches.

The A horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) and from 10 to 18 inches in thickness. The B horizon ranges from loam to heavy sandy loam in the upper part to loamy sand or gravelly sand in the lower part. The C horizon ranges from dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/6) light brownish gray (10YR 6/2), and light gray (10YR 7/2) and from loamy sand to gravelly sand.

Sawmill series

The Sawmill series consists of poorly drained, moderately slowly permeable or moderately permeable soils on flood plains of small streams and on low benches near the larger streams. They formed in silty alluvial deposits. Slope ranges from 0 to 2 percent.

Sawmill soils are similar to Colo and Ely soils and are commonly adjacent to Colo, Ely, Klinger, and Muscatine soils on the landscape. Colo soils have a thicker mollic epipedon than Sawmill soils. Ely soils have a browner B horizon, and better internal drainage.

Typical pedon of Sawmill silty clay loam, 0 to 2 percent slopes, in a bluegrass pasture 385 feet east and 2,900 feet south of the northwest corner of section 3, T. 92 N., R. 20 W.

Ap—0 to 7 inches; black (N 2/0) light silty clay loam, dark gray (N 4/0) dry; moderate fine granular structure; friable; neutral; clear boundary.

A12—7 to 13 inches; black (N 2/0) light silty clay loam grading to silty clay loam with depth, dark gray (N 4/0) dry; moderate fine granular structure; friable; slightly acid; gradual boundary.

A13—13 to 18 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A14—18 to 24 inches; black (N 2/0) heavy silty clay loam, dark gray (N 4/0) dry; moderate medium prismatic structure parting to weak fine and medium subangular blocky; friable; neutral; clear boundary.

A3g—24 to 28 inches; black (10YR 2/1) and very dark gray (5Y 3/1) silty clay loam, dark gray (10YR 4/1) and gray (5Y 3/1) dry; moderate medium prismatic structure; friable; neutral; clear boundary.

B2g—28 to 36 inches; olive gray (5Y 4/2) light silty clay loam; weak medium prismatic structure; friable; dark gray (5Y 4/1) coatings on prisms; neutral; clear boundary.

B3g—36 to 54 inches; light olive gray (5Y 6/2) silt loam; common fine olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure; friable; few fine strong brown (7.5YR 5/6) oxide concretions; neutral; gradual boundary.

Cg—54 to 60 inches; light olive gray (5Y 6/2) silt loam; massive; friable; few fine strong brown (7.5YR 5/6) oxide concretions; neutral.

The solum is generally 40 to 60 inches thick. Reaction is slightly acid or neutral, and depth to carbonates is generally more than 60 inches.

The A horizon is black (N 2/0, 10YR 2/1, or 5Y 2/1) or very dark gray (10YR 3/1) and 24 to 36 inches in depth. It ranges from light silty clay loam to heavy silty clay loam. Clay content of the A horizon and upper part of the B horizon to a depth of 40 inches averages 27 to 35 percent. The C1 horizon ranges from light olive gray (5Y 6/2) to gray (5Y 5/1) and from silt loam to light silty

clay loam. The C horizon below a depth of about 45 inches in some areas contains considerably more sand and has a loam texture.

Schley series

The Schley series consists of somewhat poorly drained, moderately permeable soils on uplands. These soils occupy slightly convex to concave lower positions on slopes and in coves. The soils formed in 30 to 50 inches of loamy material that is stratified in the lower part of the solum and in the underlying glacial till. Slope ranges from 1 to 4 percent.

Schley soils are commonly adjacent to Donnan, Floyd, and Clyde soils on the landscape. Donnan soils have a substratum that is higher in clay content and firmer than that of Schley soils. Floyd and Clyde soils have a thicker A horizon. Clyde soils have a grayer B horizon and poorer internal drainage.

Typical pedon of Schley silt loam, 1 to 4 percent slopes, in a cultivated field 1,000 feet south and 480 feet east of the northwest corner of section 7, T. 92 N., R. 20 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy silt loam that is moderate in sand, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear boundary.

B1—8 to 16 inches; very dark grayish brown (10YR 4/2) heavy silt loam moderate in sand; common fine grayish brown (2.5Y 5/2) and olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; strongly acid; clear boundary.

B21t—16 to 20 inches; 50 percent dark grayish brown (2.5Y 4/2) and 50 percent yellowish brown (10YR 5/6) light silty clay loam moderate in sand; moderate fine subangular blocky structure; friable; few thin clay films on peds; strongly acid; clear boundary.

IIB22t—20 to 25 inches; grayish brown (2.5Y 5/2) loam; common fine, yellowish brown (10YR 5/6) and a few fine strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few dark gray (10YR 4/1) clay films on peds; strongly acid; clear boundary.

IIB23t—25 to 33 inches; light olive gray (5Y 6/2) heavy sandy loam grading to light sandy loam with depth; weak fine prismatic structure parting to weak medium subangular blocky; friable; few dark gray (10YR 4/1) clay films on peds; common fine yellowish red (5YR 5/6) oxide concretions; medium acid; clear boundary.

IIB31—33 to 40 inches; light olive gray (5Y 6/2) heavy loam; weak medium prismatic structure parting to weak medium and coarse subangular blocky; firm; common light gray dry (10YR 7/1) silt coatings on ped faces; many fine and medium strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) oxide concretions; medium acid; clear boundary.

IIB32—40 to 60 inches; strong brown (7.5YR 5/6) heavy loam; common medium gray (5Y 6/1) mottles; weak coarse prismatic structure; firm; few thin clay films; common dark oxide concretions; 1/2 inch krotovinas filled with dark gray (N 4/0) clay; slightly acid grading to neutral with depth.

The solum is generally 4 to 6 feet thick. Depth to carbonates is more than 50 inches.

The A1 or Ap horizon is generally black (10YR 2/1) or very dark brown (10YR 2/2). The A2 horizon, where not incorporated in the Ap horizon, ranges from dark grayish brown (10YR to 10YR 4/2) to light brownish gray (10YR 6/2) and has mottles of higher chroma and that commonly have redder hues. The A1 or Ap and A2 horizons are silt loam or loam. The B1 horizon, if present, ranges from dark grayish brown (10YR or 2.5Y 4/2) to grayish brown (10YR 5/2) and brown (10YR 5/3) and has mottles of higher chroma in hues of 7.5YR to 2.5Y. It is silt loam that has a high content of sand or loam. The IIB horizon is generally mottled with a hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 8. The IIB2 horizon is generally heavy sandy loam, sandy clay loam, or loam. Depth to the IIB horizon ranges from 30 to 50 inches.

Shandep series

The Shandep series consists of very poorly drained soils in depressions on stream benches and outwash areas. These soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in 40 to 55 inches of loamy alluvial deposits over underlying layers of sandy materials. Slope ranges from 0 to 1 percent.

Shandep soils are similar to Coland soils and are commonly adjacent to Marshan, Talcot, Harcot, and Lawler soils on the landscape. None of these soils commonly occur in depressions. Coland soils have a thicker mollic epipedon than Shandep soils and occur along streams. Marshan soils have a mollic epipedon of less than 24 inches and have coarse textures nearer the surface than Shandep soils. Talcot and Harcot soils have a mollic epipedon of less than 24 inches that is calcareous and contains free carbonates. Lawler soils have a browner B horizon and are not so poorly drained.

Typical pedon of Shandep loam, 0 to 1 percent slopes, in native prairie 1,600 feet south and 75 feet east of the northwest corner of section 36, T. 92 N., R. 19 W.

A11—0 to 5 inches; black (N 2/0) heavy loam, dark gray (N 2/0) dry; moderate fine granular structure; friable; few fine pebbles; slightly acid; gradual boundary.

A12—5 to 25 inches; black (N 2/0) light clay loam, dark gray (N 2/0) dry; moderate fine granular structure; friable; few fine pebbles; slightly acid; gradual boundary.

A3—25 to 29 inches; black (5Y 2/1) and very dark gray (5Y 3/1) light clay loam, dark gray (5Y 4/1) and gray

(5Y 5/1) dry; weak medium granular structure; friable; few fine pebbles; slightly acid; gradual boundary.

B2g—29 to 45 inches; dark gray (5Y 4/1) light clay loam grading to gray (5Y 5/1) loam with depth; weak fine and medium subangular blocky structure; friable; slightly acid; clear boundary.

IIC—45 to 60 inches; dark gray (5Y 4/1) loamy sand; single grain; loose; few fine pebbles; slightly acid.

The thickness of the solum, or the depth to the IIC horizon, is generally 44 to 48 inches, but ranges from 40 to 55 inches.

The A horizon typically is 26 to 32 inches thick but ranges from 24 to 36 inches. Texture of the A horizon is usually loam or clay loam but ranges to silty clay loam high in content of sand. The B horizon typically has hue of 5Y or neutral, value of 4 or 5, and chroma of 1 or less. Distinct or prominent mottles may be present. The B horizon is typically clay loam, heavy loam, or silty clay loam high in content of sand. The B3 horizon, where present, ranges from loam to sandy loam. The IIC horizon ranges from loamy sand to gravelly loamy sand.

Sparta series

The Sparta series consists of excessively drained, rapidly permeable soils on uplands. They formed in 25 to 40 inches of loamy fine sand over fine sand or light loamy sand. Slope ranges from 2 to 6 percent.

Sparta soils are similar to Dickinson soils and are commonly adjacent to Dickinson, Bolan, and the Hoopeston Variant soils on the landscape. Dickinson soils have slightly higher clay and lower sand content than Sparta soils. Bolan soils have considerably more clay and less sand in the A and B horizons. The Hoopeston Variant has a grayer B horizon, is more poorly drained, and has more clay and less sand throughout the solum.

Typical pedon of Sparta loamy fine sand, 2 to 6 percent slopes, in a farm windbreak 2,390 feet west and 60 feet south of the northeast corner of section 24, T. 93 N., R. 19 W.

A1—0 to 12 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; very weak very fine subangular blocky structure; very friable; strongly acid; gradual boundary.

A3—12 to 17 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; very weak fine subangular blocky structure; very friable; strongly acid; gradual boundary.

B2—17 to 29 inches; brown (10YR 4/3) loamy fine sand; very weak medium subangular blocky structure; very friable; strongly acid; gradual boundary.

C1—29 to 39 inches; yellowish brown (10YR 5/4) loamy fine sand; very weak coarse subangular blocky structure; very friable; strongly acid; gradual boundary.

C2—39 to 60 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; medium acid.

The solum is generally about 30 inches thick, but ranges from 24 to 40 inches.

The Ap or A1 horizon is generally very dark brown (10YR 2/2) but ranges to very dark grayish brown (10YR 3/2). The A horizon is 10 to 20 inches thick. The B horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/6). It is about 10 to 16 inches thick. The C horizon ranges from yellowish brown (10YR 5/4) to light yellowish brown (10YR 6/4) or strong brown (7.5YR 5/6). It ranges from sand to light loamy fine sand.

Storden series

The Storden series consists of well drained, moderately permeable soils on uplands. These soils occupy knobs, ridges, and side slopes. They formed in calcareous glacial drift. Slope ranges from 5 to 18 percent.

Storden soils are commonly adjacent to Clarion, Lester, Terril, and Nicollet soils on the landscape. These soils all have a darker colored surface layer that is not calcareous and does not have free carbonates. Terril and Nicollet soils have poorer internal drainage than Storden soils. Terril soils are below the Storden soils on the landscape. Nicollet soils occupy positions upslope and downslope from Storden soils.

Typical pedon of Storden loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field 2,185 feet south and 85 feet west of the center of section 27, T. 90 N., R. 21 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; strong effervescence; mildly alkaline; gradual boundary.

C1—8 to 16 inches; brown (10YR 5/3) light loam; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline; gradual boundary.

C2—16 to 21 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) light loam; weak medium subangular blocky structure; friable; violent effervescence; moderately alkaline; clear boundary.

C3—21 to 60 inches; light yellowish brown (2.5Y 6/4) loam; massive; friable; violent effervescence; moderately alkaline.

The solum is commonly as thick as the A or Ap horizon, which ranges from 7 to 12 inches thick.

The color of the A horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). There is mixing of very dark grayish brown (10YR 3/2) in some pedons. The C horizon below the C1 horizon typically is 2.5Y in hue with value of 5 or 6 and chroma of 2 to 6. Consistence is friable or very friable.

Talcot series

The Talcot series consists of poorly drained, calcareous soils on stream benches and outwash areas. These soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in 24 to 40 inches of loamy alluvial deposits over sandy materials. Slope ranges from 0 to 2 percent.

Talcot soils are similar to Harcot and Canisteo soils and are commonly adjacent to Harcot, Marshan, and Lawler soils on the landscape. Harcot soils have greater amounts of free carbonates in the A horizon than Talcot soils. Canisteo soils lack stratified coarse textured layers in the substratum. Marshan and Lawler soils are not calcareous in the A horizon.

Typical pedon of Talcot clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, in a cultivated field 925 feet north and 60 feet west of the southeast corner of section 19, T. 92 N., R. 20 W.

Ap—0 to 7 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine and very fine granular structure; firm; strong effervescence; moderately alkaline; clear boundary.

A12—7 to 13 inches; black (N 2/0) clay loam; dark gray (N 4/0) dry; weak fine and very fine granular structure; friable; slight effervescence; moderately alkaline; gradual boundary.

A3—13 to 19 inches; very dark gray (5Y 3/1) gray loam; gray (5Y 5/1) dry; weak fine and very fine granular structure; friable; slight effervescence; black (5Y 2/1) coatings on peds; moderately alkaline; gradual boundary.

B1—19 to 26 inches; dark gray (5Y 4/1) and gray (5Y 5/1) silty clay loam high in sand content; weak very fine subangular blocky structure; friable; few very dark gray (5Y 3/1) mixings; slight effervescence; moderately alkaline; gradual boundary.

B2—26 to 33 inches; olive gray (5Y 5/2) light clay loam grading to loam with depth; weak medium subangular blocky structure; friable; few dark gray (5Y 4/1) mixings and very dark gray (5Y 3/1) fills in root channels; slight effervescence; moderately alkaline; clear boundary.

IIB3—33 to 38 inches; light olive gray (5Y 6/2) light sandy loam; few fine light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure; very friable; slight effervescence; moderately alkaline; clear boundary.

IIC1—38 to 49 inches; olive gray (5Y 5/2) gravelly loamy sand; single grain; loose; common fine and medium black (10YR 2/1) manganese and oxide concretions; few small calcium concretions; strong effervescence; moderately alkaline; clear boundary.

IIC2—49 to 60 inches; mottled yellowish red (5YR 4/6) to grayish brown (2.5Y 5/2) gravelly sand; single grain; loose; few small shale fragments and pebbles; strong effervescence; moderately alkaline.

The solum is generally 30 to 40 inches thick.

The A1 horizon is black (N 2/0 to 10YR 2/1). The A3 horizon is generally very dark gray (10YR 3/1 to 5Y 3/1) or very dark grayish brown (2.5Y 3/2) and has olive gray (5Y 5/2) mottles. The A horizon is dominantly clay loam but ranges from heavy loam to silty clay loam. The upper part of the B horizon ranges from dark gray (5Y 4/1) to dark grayish brown (2.5Y 4/2) or olive gray (5Y 5/2) and from clay loam to silty clay loam that has a high content of sand. The IIB horizon, where present, ranges from heavy sandy loam to sand. The IIC horizon ranges from gravelly loamy sand to sand that has some gravel.

Tallula series

The Tallula series consists of well drained, moderately permeable soils on uplands. These soils occupy knobs, ridges, and side slopes. They formed in loess. Slope ranges from 5 to 14 percent.

Tallula soils are similar to Port Byron and Tama soils and are commonly adjacent to Port Byron, Tama, and Judson soils on the landscape. Tama and Port Byron soils are higher in clay and lower in sand content than Tallula soils and are leached to a greater depth. Judson soils have a mollic epipedon more than 20 inches deep and are below Tallula soils on the landscape.

Typical pedon of Tallula silt loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field 900 feet east and 985 feet north of the center of section 34, T. 93 N., R. 20 W.

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; friable; neutral; clear boundary.

B2—7 to 12 inches; brown (10YR 4/3) silt loam; moderate very fine granular structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; neutral; gradual boundary.

B3—12 to 20 inches; yellowish brown (10YR 5/4) silt loam; weak very fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on peds; mildly alkaline; abrupt boundary.

C1—20 to 24 inches; yellowish brown (10YR 5/4) light silt loam; very weak vertical cleavage; very friable; strong effervescence; mildly alkaline; clear boundary.

C2—24 to 60 inches; yellowish brown (10YR 5/4) light silt loam; few fine gray (10YR 6/1) mottles; massive; very friable; a few fine strong brown (7.5YR 5/6) oxide concretions; violent effervescence; moderately alkaline.

The solum ranges from 18 to 30 inches thick. It is neutral or mildly alkaline.

The sand content ranges from 15 to 25 percent in the A and B horizon and from 20 to 35 percent in the C horizon. Sand size is dominantly very fine to a depth of 60 inches.

Tama series

The Tama series consists of well drained, moderately permeable soils on ridges and side slopes on uplands. These soils formed in loess deposits that range from 3 1/2 to many feet thick over glacial till. Slope ranges from 2 to 5 percent.

The Tama soils in Franklin County differ from the Tama soils in other places in that they typically lack the increase in clay necessary for an argillic horizon. These differences do not alter the use or behavior of the soils.

Tama soils are similar to Port Byron, Dinsdale, and Muscatine soils and are commonly adjacent to Port Byron and Tallula soils on the landscape. Port Byron soils have a lower clay and higher silt content than Tama soils. Dinsdale soils formed partly in loess and partly in glacial till. Muscatine soils have a grayer B horizon and poorer internal drainage. Tallula soils have a thinner mollic epipedon, lower clay and higher sand content, and are not leached to as great a depth as Tama soils.

Typical pedon of Tama silty clay loam, 2 to 5 percent slopes, in a cultivated field 140 feet east and 10 feet north of the southwest corner of section 9, T. 92 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; abrupt boundary.

A12—9 to 16 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; friable; medium acid; gradual boundary.

A3—16 to 22 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and very fine granular structure; friable; medium acid; gradual boundary.

B21t—22 to 31 inches; brown (10YR 4/3) light silty clay loam; weak fine prismatic structure parting to moderate very fine subangular blocky; friable; few thin clay films; discontinuous dark grayish brown (10YR 3/2) and dark brown (10YR 2/2) coatings on peds; medium acid; gradual boundary.

B22t—31 to 38 inches; dark yellowish brown (10YR 4/4) light silty clay loam grading to yellowish brown (10YR 5/4) with depth; weak medium prismatic structure parting to weak fine subangular blocky; friable; few thin clay films; medium acid; gradual boundary.

B3—38 to 50 inches; yellowish brown (10YR 5/4) heavy silt loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; medium acid; gradual boundary.

C—50 to 60 inches; mottled yellowish brown (10YR 5/6), brown (10YR 5/3), and light gray (2.5Y 7/2) silt loam; few fine reddish brown (5YR 4/4) oxide concretions; massive; friable; medium acid.

The solum is generally 4 to 5 feet thick, but it ranges from 3 1/2 to 5 feet. It is medium acid in the most acid part. It contains less than 10 percent sand to a depth of 40 inches.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is silt loam or light silty clay loam. The finest part of the B horizon averages between 27 and 32 percent clay. A few fine mottles of high and low chroma are in the lower part of the B horizon in places.

Terril series

The Terril series consists of moderately well drained, moderately permeable soils. These soils are in waterways and narrow valleys in the uplands and on foot slopes adjacent to steep areas. They formed in loamy alluvial sediment. Slope ranges from 1 to 5 percent.

Terril soils are commonly adjacent to Clarion, Storden, and Coland soils on the landscape. Clarion soils have a mollic epipedon less than 24 inches in thickness and are above the Terril soils on the landscape. Storden soils are light colored, calcareous, and are above the Terril soils on the landscape. Coland soils have poorer internal drainage than Terril soils and are below the Terril soils on the landscape.

Typical pedon of Terril loam, 2 to 5 percent slopes, in a cultivated field 90 feet south and 325 feet east of the center of section 26, T. 91 N., R. 20 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; neutral; clear boundary.

A12—7 to 20 inches; very dark brown (10YR 2/2) heavy loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A13—20 to 28 inches; very dark grayish brown (10YR 3/2) heavy loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; very dark brown (10YR 2/2) coatings on peds; slightly acid; gradual boundary.

B1—28 to 36 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; friable; neutral; gradual boundary.

B2—36 to 56 inches; dark yellowish brown (10YR 4/4) heavy loam grading to yellowish brown (10YR 5/4) with depth; few fine light olive brown (2.5Y 5/3) and red (2.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral; gradual boundary.

C—56 to 60 inches; light olive brown (2.5Y 5/4) heavy loam; few fine light olive brown (2.5Y 5/3) and red (2.5YR) mottles; massive; friable; neutral.

The solum ranges from 42 to 60 inches in thickness. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is 24 to 36 inches

thick. The A horizon ranges from loam to silt loam that has a high content of sand. The upper part of the A horizon is usually slightly acid but ranges from neutral to slightly acid. The lower part of the A horizon and the B horizon range from neutral to slightly acid.

Tripoli series

The Tripoli series consists of poorly drained, moderately permeable soils on uplands. These soils are on flats and at the heads and along the upper parts of some of the shallow drainageways. They formed in 18 to 28 inches of loamy material and the underlying glacial till. Slope ranges from 0 to 2 percent.

Tripoli soils are similar to Readlyn, Clyde, and Maxfield soils and are adjacent to Readlyn and Clyde soils on the landscape. Readlyn soils have a browner B horizon and better internal drainage than Tripoli soils. Clyde soils have a B horizon that is more stratified and friable. In Maxfield soils the A horizon and upper part of the B horizon developed in loess with lower sand and higher silt content.

Typical pedon of Tripoli silty clay loam, 0 to 2 percent slopes, in a cultivated field 1,330 feet north and 70 feet west of the southeast corner of section 25, T. 93 N., R. 19 W.

Ap—0 to 7 inches; black (N 2/0) light silty clay loam high in content of sand, dark gray (N 4/0) dry; moderate very fine granular structure; friable; slightly acid; clear boundary.

A12—7 to 13 inches; black (N 2/0) light silty clay loam high in content of sand, dark gray (N 4/0) dry; moderate very fine granular structure; friable; neutral; gradual boundary.

A3—13 to 18 inches; very dark gray (10YR 3/1) light clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; gradual boundary.

B1—18 to 22 inches; olive gray (5Y 4/2) light clay loam; common fine dark gray (5Y 4/1) and light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; friable; neutral; clear boundary.

IIB2—22 to 32 inches; olive (5Y 5/3) loam; common fine dark gray (5Y 4/1) and light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral; gradual boundary.

IIB3—32 to 43 inches; olive gray (5Y 5/2) loam; common fine yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; mildly alkaline; abrupt boundary.

IIC—43 to 60 inches; gray (5Y 6/1) loam; common medium strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; strong effervescence; moderately alkaline.

The thickness of the solum, which is the same as the depth to carbonates, is generally 3 to 4 feet.

The A3 horizon is generally present and ranges from dark gray (10YR 3/1) to dark olive gray (5Y 3/1). The A horizon ranges from 15 to 22 inches in thickness and is typically silty clay loam that has a high content of sand, but it ranges to clay loam. The B1 horizon ranges from dark gray (10YR 4/1) to dark grayish brown (2.5Y 4/2) and olive gray (5Y 4/2). The B1 horizon has mottles of high and low chroma. It is clay loam that ranges from 27 to 34 percent clay. The IIB2 horizon ranges from dark grayish brown (2.5Y 4/2) to olive brown (2.5Y 4/4) and olive (5Y 5/3) and has mottles in hue of 7.5YR, 10YR, and 2.5Y, values of 4 or 5 and chroma of 2 to 8. The IIB2, IIB3, and IIC horizons are generally loam, but the range includes sandy clay loam and light clay loam.

Turlin series

The Turlin series consists of somewhat poorly drained, moderately permeable soils on flood plains of rivers, narrow intermittent streams, and low terraces. These soils formed in loamy alluvial sediment. Slope ranges from 0 to 2 percent.

Turlin soils are similar to Terril and Coland soils and are commonly adjacent to Terril, Coland, and Lawler soils on the landscape. Terril soils have a browner B horizon and better internal drainage than Turlin soils. Coland soils have poorer internal drainage. Lawler soils have a mollic epipedon of less than 24 inches and are underlain with coarse textured sediments nearer the surface than Turlin soils.

Typical pedon of Turlin loam, 0 to 2 percent slopes, in a cultivated field 2,450 feet north and 95 feet east of the southwest corner of section 13, T. 93 N., R. 20 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear boundary.

A12—8 to 16 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A13—16 to 28 inches; very dark gray (10YR 3/1) heavy loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; slightly acid; gradual boundary.

A3—28 to 35 inches; very dark grayish brown (10YR 3/2) heavy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; discontinuous very dark gray (10YR 3/1) coatings on peds; slightly acid.

B2—35 to 44 inches; dark grayish brown (2.5Y 4/2) light sandy clay loam; common medium olive brown (2.5Y 4/4) mottles; moderate very fine subangular blocky structure; friable; slightly acid.

B3—44 to 52 inches; grayish brown (2.5Y 5/2) sandy loam; common medium light olive brown (2.5Y 5/4) mottles; weak medium and coarse subangular blocky structure; friable; slightly acid.

C—52 to 60 inches; mottled grayish brown (2.5Y 5/2) and light olive yellow (2.5Y 5/6) loamy sand; single grain; loose; neutral.

The solum is generally 3 1/2 to 5 feet thick.

The A horizon ranges from black (10YR 2/1) or very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) and from 24 to 36 inches in thickness. The B horizon above a depth of 40 inches ranges from sandy loam to light clay loam. Depth to textures coarser than sandy loam is 48 inches or more. The B horizon is generally slightly acid but ranges from neutral to medium acid.

Wacousta series

The Wacousta series consists of very poorly drained, moderately permeable soils in upland depressions. These soils formed in local alluvium washed from adjacent uplands. Slope ranges from 0 to 1 percent.

Wacousta soils are similar to Okoboji soils and are commonly adjacent to Harps and Canisteo soils on the landscape. Okoboji soils have a thicker mollic epipedon than Wacousta soils. Harps and Canisteo soils have a calcareous A horizon. They occur as rims around and above the Wacousta soils.

Typical pedon of Wacousta silt loam, 0 to 1 percent slopes, in a cultivated field 1,370 feet east and 75 feet north of the southwest corner of section 17, T. 93 N., R. 22 W.

Ap—0 to 9 inches; black (N 2/0) silt loam; dark gray (N 4/0) dry; weak very fine granular structure; friable; neutral; clear boundary.

A12—9 to 14 inches; black (N 2/0) silty clay loam; dark gray (N 4/0) dry; moderate very fine subangular blocky structure; firm; neutral; clear boundary.

Bg—14 to 23 inches; olive gray (5Y 5/2) silty clay loam; moderate fine and medium subangular blocky structure; firm; few very dark gray (10YR 3/1) fills in root channels; few fine yellowish red (5YR 5/6) oxide concretions; strong effervescence; mildly alkaline; gradual boundary.

C1g—23 to 40 inches; olive gray (5Y 5/2) light silty clay loam; weak medium prismatic structure parting to weak coarse subangular blocky; firm; few very dark gray (10YR 3/1) fills in root channels; common fine; yellowish red (5YR 4/6) and red (2.5YR 4/8) oxide concretions; strong effervescence; mildly alkaline; gradual boundary.

C2g—40 to 50 inches; olive gray (5Y 5/2) light silty clay loam; common yellowish red (5YR 4/6) mottles; massive; firm; common very dark gray (10YR 3/1) fills in root channels; strong effervescence; mildly alkaline; gradual boundary.

C2—50 to 70 inches; olive gray (5Y 5/2) stratified light silty clay loam and silt loam; massive; firm; common dark grayish brown (10YR 4/2) clay fills in root channels; strong effervescence; mildly alkaline.

The solum is generally 14 to 24 inches thick.

The A horizon is black (N 2/0 to 10YR 2/1) and ranges from about 10 to 16 inches in thickness. The texture ranges from silty clay loam to mucky silt loam. The Bg horizon ranges from dark gray (5Y 4/1) to olive gray (5Y 5/2). Texture of the Bg horizon ranges from heavy to light silty clay loam. The Cg horizon ranges from silty clay loam to silt loam.

Waubeek series

The Waubeek series consists of well drained and moderately well drained, moderately permeable soils on uplands. These soils are on ridge crests and side slopes. They formed in 20 to 40 inches of loess and the underlying glacial till. Slope ranges from 2 to 9 percent.

Waubeek soils are similar to Franklin soils and are commonly adjacent to Franklin, Ansgar, and Dinsdale soils on the landscape. Franklin and Ansgar soils have grayer A2 and B horizons and poorer internal drainage than Waubeek soils. Dinsdale soils lack an A2 horizon and have a thicker A horizon.

Typical pedon of Waubeek silt loam, 2 to 5 percent slopes, in a cultivated field 510 feet east and 605 feet south of the center of section 4, T. 90 N., R. 19 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) heavy silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular and subangular blocky structure; friable; slightly acid; abrupt boundary.

A2—8 to 14 inches; brown (10YR 4/3) silt loam; weak thick platy structure parting to weak very fine subangular blocky; friable; slightly acid; clear boundary.

B21t—14 to 27 inches; yellowish brown (10YR 5/4) light silty clay loam; moderate very fine subangular blocky structure; friable; few thin very dark grayish brown (10YR 3/2) clay films on peds and lining root channels; dark yellowish brown (10YR 4/4) coatings on peds; strongly acid; clear boundary.

B22t—27 to 32 inches; mottled olive gray (5Y 5/2) and strong brown (7.5YR 5/6) light silty clay loam; weak fine subangular blocky structure; friable; strongly acid; clear boundary.

IIB31t—32 to 37 inches; strong brown (7.5YR 5/6) light loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; light gray (10YR 7/1) coatings of fine sand on prisms observable when dry; strongly acid; clear boundary.

IIB32t—37 to 60 inches; mottled strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) heavy loam; moderate medium prismatic structure; firm; thin discontinuous brown (10YR 4/3) clay films on prisms; common fine hard dark oxide concretions; thin light gray (10YR 7/1) grainy coatings on prisms observable when dry; medium acid.

The solum is generally 4 to 6 feet thick. The depth of loess ranges from 20 to 40 inches, but it is generally 26

to 34 inches. Discontinuous lenses of sandy loam to sand, 1 to 8 inches thick, occur between the loess and the till in places.

The A1 or Ap horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and from 6 to 9 inches in thickness. The content of sand in the A and B horizon, which formed in the loess, ranges from 3 to 10 percent, but it is higher near the till contact. The IIB horizon is generally loam, but it ranges to sandy clay loam and, in some places, to light clay loam.

Waukee series

The Waukee series consists of well drained soils on stream benches or, less commonly, on uplands. These soils are moderately permeable in the upper part and very rapidly permeable in the lower part. They formed in 30 to 40 inches of loamy materials over sand and gravel. Slope ranges from 0 to 5 percent.

Waukee soils are similar to Saude and Lawler soils and are commonly adjacent to Saude, Lawler, and Marshan soils on the landscape. Saude soils are lower in clay and higher in sand content than Waukee soils. Lawler and Marshan soils have a grayer B horizon and poorer internal drainage.

Typical pedon of Waukee loam, 0 to 2 percent slopes in a cultivated field 2,630 feet east and 75 feet north of the southwest corner of section 11, T. 93 N., R. 21 W.

Ap—0 to 9 inches; black (10YR 2/1) heavy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; neutral; clear boundary.

A12—9 to 13 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; slightly acid; gradual boundary.

A3—13 to 20 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; moderate very fine granular structure; friable; medium acid; gradual boundary.

B2—20 to 31 inches; brown (10YR 4/3) loam; weak very fine subangular blocky structure; friable; few fine pebbles in lower parts; dark brown (10YR 3/3) coatings on peds; medium acid; clear boundary.

B3—31 to 36 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; few fine pebbles; brown (10YR 4/3) coatings on peds; neutral; clear boundary.

IIB32—36 to 39 inches; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine and medium pebbles; neutral; clear boundary.

IIC—39 to 60 inches; yellowish brown (10YR 5/4) sand, grading to light yellowish brown (10YR 6/4) with depth; single grain; loose; few fine and medium pebbles; neutral.

The solum is generally 3 to 4 feet thick.

The A1 or Ap horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A horizon ranges from loam to silt loam high in content of sand. The B1 horizon ranges from loam to silt loam that has a high content of sand. The contrasting textures of gravelly loamy sand or sand are at a depth of 35 to 40 inches.

Webster series

The Webster series consists of poorly drained, moderately permeable soils on uplands. These soils are on flats, in irregularly shaped swales, and along the upper parts of some of the drainageways. They formed in loamy glacial drift. Slope ranges from 0 to 3 percent.

Webster soils are similar to Canisteo and Nicollet soils and are commonly adjacent to Canisteo, Nicollet, and Clarion soils on the landscape. Canisteo soils are calcareous and have free carbonates. Nicollet and Clarion soils have a browner B horizon, better internal drainage, and occur above the Webster soils on the landscape.

Typical pedon of Webster silty clay loam, 0 to 2 percent slopes, in a cultivated field 895 feet west and 90 feet north of the southeast corner of section 15, T. 95 N., R. 21 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam high in sand, dark gray (N 4/0) dry; weak very fine subangular blocky structure; firm; neutral; clear boundary.

A12—8 to 17 inches; black (N 2/0) silty clay loam high in sand, dark gray (N 4/0) dry; moderate very fine granular structure; friable; neutral; gradual boundary.

A13—17 to 22 inches; black (5Y 2/1) silty clay loam high in sand, grading to very dark gray (5Y 3/1) with depth, dark gray (5Y 2/1) and gray (5Y 5/1) dry, moderate very fine granular and weak very fine subangular blocky structure; friable; neutral; gradual boundary.

B1g—22 to 27 inches; dark gray (5Y 4/1) light silty clay loam high in sand; common medium olive gray (5Y 4/2) mottles; moderate very fine subangular blocky structure; friable; very dark gray (5Y 3/1) coatings on peds and in root channels; neutral; clear boundary.

B2g—27 to 34 inches; olive gray (5Y 5/2) light clay loam; weak fine prismatic structure parting to weak medium subangular blocky; friable; discontinuous dark gray (5Y 4/1) and gray (5Y 5/1) coatings on peds; mildly alkaline; gradual boundary.

B3g—34 to 46 inches; olive gray (5Y 5/2) loam; few fine strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; few small pebbles; mildly alkaline; clear boundary.

C1g—46 to 55 inches; olive gray (5Y 5/2) light loam; few fine strong brown (7.5YR 5/6) mottles; massive; very friable; few small pebbles; very dark gray (5Y 3/1) krotovinas 1 inch in diameter; strong effervescence; moderately alkaline; gradual boundary.

C2g—55 to 60 inches; light olive gray (5Y 6/2) light loam and heavy sandy loam; common fine and medium yellowish red (5YR 5/6) mottles; massive; very friable; few dark gray (5Y 4/1) fills in root channels; strong effervescence; moderately alkaline.

The solum is generally 3 to 4 feet thick.

The A1 horizon is black (N 2/0 to 10YR 2/1). The A horizon ranges from 16 to 24 inches in thickness and is silty clay loam, high in content of sand or clay loam. The B1g horizon ranges from dark gray (5Y 4/1) to dark grayish brown (2.5Y 4/2) and ranges from silty clay loam, high in content of sand to clay loam. The B2g horizon ranges from olive gray (5Y 5/2) to dark gray (10YR 4/1) and ranges from clay loam to silty clay loam high in content of sand. The B3g horizon ranges from olive gray (5Y 5/2) to gray (10YR 5/1) and from loam to light clay loam. The C horizon ranges from olive gray (5Y 5/2) to light olive gray (5Y 6/2) and from loam to sandy loam.

Zenor series

The Zenor series consists of somewhat excessively drained soils on uplands and, less commonly, on stream benches. These soils are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. They formed in glacial outwash. Slope ranges from 2 to 14 percent.

Zenor soils are similar to Flagler soils and are commonly adjacent to Clarion, Salida, and Storden soils on the landscape. Flagler soils are more acid and leached to a greater depth than Zenor soils. Clarion and Storden soils are medium textured. Salida soils are coarse textured.

Typical pedon of Zenor sandy loam, 2 to 5 percent slopes, in a cultivated field 2,140 feet north and 700 feet west of the southeast corner of section 24, T. 93 N., R. 22 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular and very fine subangular blocky structure; very friable; slightly acid; clear boundary.

A12—8 to 15 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular and very fine subangular blocky structure; very friable; black (10YR 2/1) coatings on peds; slightly acid; gradual boundary.

A3—15 to 20 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) sandy loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak very fine subangular blocky structure; very friable; very dark brown (10YR 2/2) coatings on peds; slightly acid; gradual boundary.

B2—20 to 30 inches; brown (10YR 4/3) light sandy loam; weak very fine subangular blocky structure; very friable; dark brown (10YR 3/3) coatings on peds; neutral; clear boundary.

IIC1—30 to 37 inches; mottled light brownish gray (2.5Y 6/2) to strong brown (7.5YR 5/6) loamy sand; single grain; loose; common fine yellowish red (5YR 4/6) and dark reddish brown (2.5YR 3/4) oxide concretions; strong effervescence; mildy alkaline; gradual boundary.

IIC2—37 to 50 inches; mottled light brownish gray (2.5Y 6/2) to strong brown (7.5YR 5/6) sand; single grain; loose; common fine yellowish red (5YR 4/6) and dark reddish brown (2.5YR 3/4) oxide concretions; few fine pebbles; violent effervescence; moderately alkaline; gradual boundary.

IIC3—50 to 56 inches; mottled light brownish gray (2.5Y 6/2) to strong brown (7.5YR 5/6) gravelly sand; single grain; loose; violent effervescence; moderately alkaline; clear boundary.

IIC4—56 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand; single grain; loose; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 30 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches.

The A1 horizon has a color value of 2 or 3 and chroma of 1 or 2. The B2 horizon has a color value of 4 and chroma of 3 or 4 with the darkest colors in the upper part. Reaction is neutral to medium acid. The C horizon commonly has variegated colors with color value of 5 or 6 and chroma of 2 to 6. It is loamy sand or sand in the upper part with a few pebbles. Below 30 inches, gravel content ranges from 5 to 20 percent. The C horizon is mildly alkaline or moderately alkaline.

Factors of soil formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil materials.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. A long time generally is required 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 other four. Many of the processes of soil development are unknown.

Parent material

The accumulation of parent material is the first step in the development of a soil. A few soils in the county formed in arenaceous (sandy) limestone and shale weathered in place. Most of the soils, however, formed in material that was transported from other locations and redeposited through the action of glacial ice, water, wind, and gravity.

The principle parent materials in Franklin County are loess, glacial drift, and alluvium. Less extensive parent materials are eolian (wind deposited) sand, organic deposits, and shale and limestone bedrock.

Loess, a silty material deposited by wind, covers about 25 percent of Franklin County. It ranges in thickness from about 2 feet to 25 feet. In places it overlies glacial till, and in other places it overlies bedrock. Loess consists of about 70 percent silt and about 20 to 25 percent clay. It contains no coarse sand or gravel because these materials were too large to be moved by wind, but it does contain small amounts of very fine sand, generally less than 5 percent.

In Franklin County, the Ansgar, Dinsdale, Franklin, Klinger, Maxfield, and Waubeek soils formed in 2 to 3 feet of loess underlain by glacial till. The Garwin, Harpster, and Muscatine soils formed in loess 3 1/3 feet to about 8 feet thick. The Port Byron, Tallula, and Tama soils formed in loess deposits that are generally 8 to 25 feet thick. The Ripon soils formed in loess and the underlying glacial materials which are underlain by bedrock at a depth of about 20 to 40 inches. The Rossfield soils formed in a layer of loess or loess-like material and in weathered arenaceous limestone.

Glacial drift is all rock material transported and deposited by glacial ice, including materials sorted by melt water. It also includes glacial till. Glacial till is unsorted sediment in which particles range in size from boulders to clay (*5*). Glacial till is the most extensive parent material in the county.

At least two continental glaciers moved over all of Franklin County. A third covered the western part. The oldest ice sheet, known as the Nebraskan, occurred some 750,000 years ago. The Kansan Glaciation is thought to have occurred about 500,000 years ago. The Cary substage of the Wisconsin Glaciation covered part of the county about 13,000 to 14,000 years ago.

The Canisteo, Clarion, Harps, Lester, Nicollet, Okoboji, Salida, Storden, Wacousta, Webster, and Zenor soils formed in glacial sediment of the Cary Drift. The Canisteo, Harps, and Webster soils are lower on the landscape. They formed in glacial till and in glacial sediments or reworked glacial till. The Clarion, Lester, and Storden soils are on higher ridges and knobs. The Nicollet soils are on low ridges and lower slopes. The Okoboji and Wacousta soils formed in alluvial sediments derived from till that in many places washed from nearby slopes. The Salida and Zenor soils formed in coarser textured sediments of the Cary Drift.

The Iowan surface soils that developed mostly in till are in northeast Franklin County and in other small areas throughout the eastern part. The Iowan surface is multilevel and is arranged in a series of steps from major drainageways toward bounding divides. It is marked by a stone line. The stone line is on all levels of the stepped surface, and it passes under the alluvium along the drainageways. Much of the Iowan surface in Franklin County is covered by loess and is in the Dinsdale-Klinger-Maxfield association of the general soil map.

Studies by Leighton (*3*) and others indicated that an earlier substage of the Wisconsin glacier (the Iowan) covered parts of the county. However, later studies (*7*) led to the conclusion that the surface is a result of an erosional cycle rather than deposited by glacial drift. The underlying Kansan and Nebraskan glacial till is covered by loess or by a loamy surficial mantle. This mantle uniformly covers the Kansan or Nebraskan glacial till to a depth of 1 to 3 feet. It is deepest in the lower, concave, sloping areas and in the waterways. A stone line or pebble band commonly separates the friable, loamy overburden from the more dense, firm, loam glacial till. Pockets of coarse-textured material are within the glacial till in places.

Aredale, Clyde, Floyd, Kenyon, Readlyn, Schley, and Tripoli soils formed in the loamy mantle and the underlying glacial till on the Iowan surface. Clyde, Floyd, and Schley soils are downslope and in drainageways where the loamy overburden is usually thicker. Aredale soils formed on ridges and flats where the loamy mantle is thicker than on the ridges where the Kenyon soils formed. The Readlyn and Tripoli soils are on level to nearly level upland flats. Donnan soils are on ridges that are usually somewhat higher than adjacent till soils. They formed in a loamy surficial mantle over a truncated ancient soil called a paleosol that developed on the Kansan or Nebraskan glacial till in ages past. The remnant of this ancient soil is high in content of clay.

Alluvium is material that was deposited by water on the flood plains. The soils that formed in alluvium are mainly along the West Fork of the Cedar River, Hartgrave Creek, Maynes Creek, the Iowa River, and tributaries of these streams. Soils derived from alluvium are generally stratified. Much of the alluvium in Franklin County washed from adjoining loamy glacial soils and has a texture of loam, clay loam, sandy loam, or silty clay loam high in content of sand. Loamy soils of the bottom land are Coland and Turlin soils. Other areas of bottom land received sediment from loess-covered uplands low in sand. The Colo, Sawmill, and Calco soils formed in the silty alluvium that washed from these areas. All of these soils are on first bottoms or very low terraces and are subject to flooding.

Differences in texture are accompanied by some differences in chemical and mineralogical composition of the alluvium. Most of the soils are free of carbonates and are neutral to slightly acid, but the Calco soils are alkaline.

The soils on terraces or second bottoms also consist of alluvium and vary in texture. Most are underlain by coarser textured material within a depth of 2 to 3 feet. These soils are above the present flood plain and generally do not flood. They are the Flagler, Harcot, Lawler, Marshan, Saude, Talcot, and Waukee soils. The Shandep soils are in shallow depressions on the terraces. They frequently impound runoff from the adjacent higher soils. Most of the soils are free of carbonates and are neutral to slightly acid, but the Harcot and Talcot soils are alkaline.

Eolian sand is *wind deposited*. It is not extensive, but is important in the northeast part of Franklin County and occurs to some extent throughout the county. Many areas occur as low mounds or dunes within the glacial till plain and are underlain by till at a depth of 5 to 10 feet. Wind-deposited sand consists largely of very fine and fine quartz that is highly resistant to weathering. It has not been altered appreciably since it was deposited. Depending on the amount of silt and clay mixed in the eolian deposit, the upper 3 feet ranges in texture from loam to sand. The Bolan, Dickinson, Hoopston Variant, and Sparta soils in Franklin County formed mainly in wind-deposited material with a high sand content.

Organic material deposits are the parent material of organic soils (peat or muck). Muck is a more complete stage of decomposition of the original organic plant remains than peat. In Franklin County muck soils occur in wet areas where poor drainage has retarded the decay of the plant remains that accumulated over a period of time. Most of these organic soils are in the western half of the county where plant material accumulated in old pond and lake beds. They also occur in a few hillside seep areas and drainageways throughout the county. In Franklin County the thickness of the organic material ranges from as little as 8 inches in the Okoboji mucky silt loam to more than 10 feet in some of the deeper deposits of Houghton muck. Palms muck is intermediate in depth.

Limestone, dolomite, and shale are the oldest parent materials in the county. They occur as a series of beds deposited during the Mississippian period.

The Calamine and Jacwin soils were derived from shale. They formed partly in material weathered from Sheffield shale and partly in the overlying loamy material. The Sheffield shale is one of the formations within the Mississippian system. Aplington dolomite, which occurs just above the shale, is a relatively earthy, arenaceous limestone that has a high magnesium content. Mottland and Rossfield soils formed in silty sediment and the underlying Aplington dolomite.

Deposition of glacial till and loess resulted in some of the soils in Franklin County having multiple parent materials of quite different origin. An example is Ripon soils, which formed in loess over glacial materials underlain by limestone bedrock. All of these materials occur within a depth of less than 40 inches. The Rockton and Marlean soils were also influenced by limestone. Rockton soils have a loamy overburden over a thin layer of residuum over limestone. Marlean soils have a thin loamy overburden over limestone.

Climate

The soils of Franklin County formed under the influence of a midcontinental, subhumid climate over a period of at least 5,000 years. Between 5,000 and 16,000 years ago the climate was conducive to the growth of forest vegetation (*4, 11*). The morphology of most of the soils in the county indicates that the climate under which the soils formed is similar to the present one. At present, the climate is fairly uniform throughout the county but is marked by wide seasonal extremes in temperature. Precipitation is evenly distributed throughout the year.

Climate is a major factor in determining what soils develop from the various plant materials. The rate and intensity of hydrolysis, carbonation, and other important chemical reactions in the soil are influenced by the climate. Temperature, rainfall, relative humidity, and length of the frost-free period are important in determining the vegetation.

The influence of the general climate of the region is somewhat modified by the local conditions in or near the forming soil. For example, south-facing dry, sandy slopes have a local climate or microclimate that is warmer and less humid than the average climate of nearby areas. Low-lying, poorly drained areas are wetter and colder than most areas around them. These contrasts account for some of the differences in soils within the same general climatic regions.

Relief

Relief is an important cause of differences among soils. Indirectly, it influences soil development through its effect on drainage. In Franklin County the relief ranges from level to steep. Many level or nearly level areas are frequently flooded and have a high or periodically high water table. Much of the rainfall runs off the more strongly sloping areas.

The Marshan, Maxfield, and Webster soils, for example, formed in areas where there was normally or periodically a high water table and generally have a dominantly olive gray subsoil. Soils that formed in areas where the water table was below the subsoil have a yellowish brown or brown subsoil. Examples are the Aredale, Clarion, Dinsdale, Lester, Ripon, and Waukee soils. The Floyd, Franklin, Klinger, Lawler, Muscatine, and Nicollet soils, which formed where natural drainage was intermediate, have a mottled grayish brown subsoil. Of the soils that formed under prairie, those that have a high water

table generally have more organic matter in the surface layer than those that have good natural drainage.

Aspect, as well as gradient, has significant influence on soil formation. Because south-facing slopes generally are warmer and drier than north-facing slopes, they support a different kind and amount of vegetation.

The influence of a porous, rapidly permeable parent material may override the influence of topography. Dickinson soils, for example, are somewhat excessively drained, even though they are no more than gently sloping, because they have moderately rapid to rapid permeability. Also, some nearly level Dinsdale soils that have porous, fractured limestone bedrock relatively close to the surface are well drained and moderately well drained.

The Dinsdale, Klinger, and Maxfield soils are examples of soils that formed in the same kind of parent material and under similar vegetation but that differ because of differences in topographic positions. The Maxfield soils are on broad, level upland flats and in waterways. The Klinger soils are on nearly level ridges and long, gentle side slopes. Dinsdale soils typically are on long convex ridges and gently or moderately sloping convex side slopes. Topography influences the drainage of these soils.

The Judson and Terril soils are on foot slopes and in some narrow upland waterways. They have properties related to the soils upslope from which they receive sediment.

Many of the Marlean and Mottland soils are steep and have very little soil development. Much of the water that falls on the surface runs off rather than into the soil.

Plant and animal life

Plant and animal life are important factors in soil formation. Plant life is especially significant. Soil formation really begins with the coming of vegetation. As plants grow and die they add organic matter to the upper layers of soil material. The 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. Trees commonly feed on plant nutrients deep in the subsoil; consequently, they add little organic matter to the surface layer other than that gained from falling leaves and dead trees. Much of the organic matter from dead leaves and trees remains on the surface where it decomposes.

All living organisms are important to soil formation. These include vegetation, animals, bacteria, and fungi. The vegetation chiefly determines the color of the surface layer and the amount of organic matter and nutrients in the soil. Earthworms and burrowing animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food.

Most of the soils of Franklin County formed under prairie grasses or a mixture of prairie grasses and water-tolerant plants. Webster, Clarion, Dinsdale, and Marshan soils are typical of those that formed under prairie. Webster and Marshan soils are representative of soils that formed under prairie grasses and water-tolerant plants. Lester and Waubeek soils have properties intermediate between those of the soils that formed entirely under prairie and soils that formed entirely under forest. Franklin County has no soils that formed entirely under forest. Soils that formed under trees have a thin, dark surface layer generally less than 5 inches thick and, just beneath it, a lighter colored A2 horizon. If these layers are mixed by plowing, the new surface layer is lighter in color than that of prairie soils. Lester, Waubeek, and similar soils have the properties of the true forest soil with the exception of the somewhat deeper surface layer. In contrast to forest soils, soils that formed under prairie vegetation contain a large amount of organic matter derived from roots, and they have a thick, dark surface layer.

Man's influence on the soil

Important changes take place in the soil when it is drained and cultivated. Some of these changes have little effect on soil productivity; others have drastic effects. Changes caused by erosion generally are more apparent. On some of the cultivated soils in the county, particularly those that have steeper slopes, much of the original surface layer has been lost through sheet erosion.

Man has done much to increase productivity of the soil and to reclaim areas not suitable for crops. For example, subsurface drainage has been installed in many places in the county and has lowered the water table sufficiently so that these areas can be used for crops. Through the use of commercial fertilizers, man has been able to counteract deficiencies in plant nutrients and make many soils more productive. To date, many of the soils in Franklin County have not been seriously affected by soil erosion. This is mainly because many areas have low relief.

Man can improve the soil for crop production by good management or he can reduce soil fertility and production through improper land use. For general information about the soils, refer to the section "General soil map for broad land use planning," which describes broad patterns of soils in the county.

Time

Time is necessary for the various processes of soil formation to take place. The amount of time necessary ranges from a few days for the formation of soils in fresh alluvial deposits along the streams to thousands of years for the paleosols that today make up the subsoil of the Donnan soils. If other factors are favorable, the texture of the subsoil generally becomes finer and a greater amount of soluble materials is leached out as the soils continue to weather. Exceptions are soils that formed in quartz sand, such as the Dickinson soils, or soils that

formed in other materials that are resistant to weathering. Such soils do not change much over a long period of time. Other exceptions are steep soils that have a small amount of water infiltration and a large amount of runoff. Such soils weather more slowly than stable, less sloping soils.

Where organic materials, such as trees, have been buried by material deposited by ice, water, or wind, the age of a landscape can be determined by radiocarbon dating (*6*). The loess that covers the eastern parts of Franklin County in which Tama and Port Byron and other soils formed is probably 14,000 to 20,000 years old, and the Iowa erosion surface formed during the time of loess deposition (*7*). The Iowan surface beneath the loess could, therefore, be as young as 14,000 years. Where it is covered by loam sediments, the Iowan surface is younger than 14,000 years. The Kenyon, Readlyn, and Tripoli soils formed in this loamy sediment. The Clyde, Floyd, and Schley soils are still younger, because they are cut in and below these higher lying soils. Radiocarbon dates for some of the surface in Franklin County are as recent as 2,000 to 6,000 years ago. This perhaps accounts for the weakly developed profile in the Clyde, Floyd, and Schley soils. Dates for the base of the Cary glacial drift in the southern part of its extension into Iowa indicate that the drift was deposited about 14,000 years ago (*5*); thus, all the soils that formed from it, such as the Clarion, Webster, and Nicollet soils, are only 14,000 years old or younger.

Time is needed for soil formation, but the age of the parent material does not necessarily reflect the true age of the soil that formed in it.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Leighton, M. M. 1933. The naming of the subdivisions of the Wisconsin glacial age. Sci. (New ser.) 77: 168.

(4) Ruhe, Robert V. 1956. Geomorphic surfaces and the nature of soils. Soil Sci. 82: 441-445, illus.

(5) Ruhe, Robert V. 1969. Quaternary landscapes in Iowa. Iowa State Univ. Press, 255 pp., illus.

(6) Ruhe, R. V., Meyer Rubin, and W. H. Scholtes. 1957. Late pleistocene radiocarbon chronology in Iowa. Am. J. Sci. 255: 671-689.

(7) Ruhe, R. V., W. P. Dietz, T. E. Fenton, and G. F. Hall. 1968. Iowan drift problem of northeastern Iowa. Iowa Geol. Surv. Rep. Invest. 7, pp. 1-40, illus.

(8) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(9) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(10) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(11) Walker, P. H. 1966. Post-glacial erosion and environment changes in central Iowa. Soil and Water Conserv. 21: 21-23.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. Method of preparing a seedbed with a minimum of soil disturbance, leaving enough crop residue on the surface to protect the soil.

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 (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Depth to rock. Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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 the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

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*.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial 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 melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 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 (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

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, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A 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) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B 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, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters

(about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated orgainc and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

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 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater 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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate

types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

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.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

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.

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.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 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 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
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 and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or " very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION[1]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[2]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January	23.9	5.5	14.8	47	-25	0	0.83	0.33	1.22	2	7.0
February	29.9	11.6	20.8	51	-20	0	1.07	.25	1.71	3	7.0
March	39.6	21.3	30.5	73	-8	23	2.19	1.19	3.01	6	10.4
April	57.9	35.7	46.8	86	16	60	3.09	1.62	4.28	7	1.4
May	70.7	47.3	59.0	91	27	293	4.40	2.87	5.78	9	.0
June	80.1	57.5	68.8	95	40	564	5.02	2.53	7.04	8	.0
July	82.7	61.2	72.0	95	45	682	5.12	3.32	6.74	7	.0
August	81.8	59.0	70.4	95	41	632	3.71	1.75	5.30	6	.0
September	73.5	49.6	61.6	92	30	348	3.77	1.27	5.75	7	.0
October	63.4	39.7	51.6	86	18	155	2.47	.72	3.87	5	.0
November	44.9	25.9	35.4	70	-1	8	1.36	.44	2.08	4	2.6
December	29.6	13.0	21.3	57	-22	0	1.05	.47	1.52	4	8.0
Year	56.5	35.6	46.1	97	-26	2,765	34.08	27.73	40.07	68	36.4

[1]Recorded in the period 1951-73 at Hampton, Iowa.

[2]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° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 24	May 11	May 17
2 years in 10 later than--	April 20	May 5	May 12
5 years in 10 later than--	April 11	April 24	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	October 9	September 26	September 16
2 years in 10 earlier than--	October 14	October 2	September 21
5 years in 10 earlier than--	October 23	October 13	September 30

[1]Recorded in the period 1951-73 at Hampton, Iowa.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	173	149	128
8 years in 10	180	157	135
5 years in 10	194	171	149
2 years in 10	209	184	162
1 year in 10	216	192	169

[1]Recorded in the period 1951-73 at Hampton, Iowa.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
6	Okoboji silty clay loam, 0 to 1 percent slopes	6,960	1.9
8B	Judson silty clay loam, 2 to 5 percent slopes	3,725	1.0
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes	5,045	1.3
27B	Terril loam, 2 to 5 percent slopes	1,400	0.4
41B	Sparta loamy fine sand, 2 to 6 percent slopes	360	0.1
55	Nicollet loam, 1 to 3 percent slopes	24,855	6.6
62C2	Storden loam, 5 to 9 percent slopes, moderately eroded	520	0.1
62D2	Storden loam, 9 to 14 percent slopes, moderately eroded	1,250	0.3
62E2	Storden loam, 14 to 18 percent slopes, moderately eroded	370	0.1
73C	Salida gravelly sandy loam, 2 to 9 percent slopes	210	0.1
83B	Kenyon loam, 2 to 5 percent slopes	2,750	0.7
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded	3,325	0.9
83D	Kenyon loam, 9 to 14 percent slopes	335	0.1
83F	Kenyon loam, 14 to 24 percent slopes	150	*
84	Clyde silty clay loam, 0 to 2 percent slopes	2,225	0.6
90	Okoboji mucky silt loam, 0 to 1 percent slopes	1,130	0.3
95	Harps loam, 1 to 3 percent slopes	18,515	4.9
96	Turlin loam, 0 to 2 percent slopes	630	0.2
107	Webster silty clay loam, 0 to 2 percent slopes	15,235	4.1
118	Garwin silty clay loam, 0 to 2 percent slopes	1,125	0.3
119	Muscatine silty clay loam, 1 to 3 percent slopes	2,950	0.8
120B	Tama silty clay loam, 2 to 5 percent slopes	760	0.2
133	Colo silty clay loam, 0 to 2 percent slopes	2,150	0.6
135	Coland clay loam, 0 to 2 percent slopes	10,475	2.8
138B	Clarion loam, 2 to 5 percent slopes	52,025	13.8
138C2	Clarion loam, 5 to 9 percent slopes, moderately eroded	14,280	3.8
138D2	Clarion loam, 9 to 14 percent slopes, moderately eroded	725	0.2
151	Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	4,375	1.2
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	7,740	2.1
153	Shandep loam, 0 to 1 percent slopes	405	0.1
174B	Bolan loam, 2 to 5 percent slopes	2,875	0.8
174C2	Bolan loam, 5 to 9 percent slopes, moderately eroded	835	0.2
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	1,550	0.4
175C	Dickinson fine sandy loam, 5 to 9 percent slopes	440	0.1
177	Saude loam, 0 to 2 percent slopes	4,225	1.1
177B	Saude loam, 2 to 5 percent slopes	1,175	0.3
177C	Saude loam, 5 to 9 percent slopes	230	0.1
178	Waukee loam, 0 to 2 percent slopes	2,025	0.5
178B	Waukee loam, 2 to 5 percent slopes	645	0.2
184	Klinger silty clay loam, 1 to 3 percent slopes	15,460	4.1
198B	Floyd loam, 1 to 4 percent slopes	4,275	1.1
201B	Coland-Terril complex, 1 to 5 percent slopes	3,075	0.8
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	195	0.1
214B	Rockton loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	500	0.1
214C2	Rockton loam, 20 to 30 inches to limestone, 5 to 9 percent slopes, moderately eroded	850	0.2
216C2	Ripon silt loam, 20 to 30 inches to limestone, 5 to 9 percent slopes, moderately eroded	500	0.1
217B	Ripon silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	475	0.1
221	Palms muck, 0 to 1 percent slopes	1,525	0.4
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	5,410	1.4
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	4,450	1.2
236B	Lester loam, 2 to 5 percent slopes	440	0.1
236C	Lester loam, 5 to 9 percent slopes	490	0.1
236D2	Lester loam, 9 to 14 percent slopes, moderately eroded	335	0.1
236F	Lester loam, 14 to 24 percent slopes	465	0.1
284B	Flagler sandy loam, 1 to 5 percent slopes	865	0.2
284C	Flagler sandy loam, 5 to 9 percent slopes	400	0.1
329	Webster-Nicollet complex, 1 to 3 percent slopes	20,085	5.4
335	Harcot loam, 0 to 2 percent slopes	2,325	0.6
373C2	Tallula silt loam, 5 to 9 percent slopes, moderately eroded	240	0.1
373D2	Tallula silt loam, 9 to 14 percent slopes, moderately eroded	570	0.2
377	Dinsdale silty clay loam, 0 to 2 percent slopes	4,175	1.1
377B	Dinsdale silty clay loam, 2 to 5 percent slopes	34,520	9.1
377C	Dinsdale silty clay loam, 5 to 9 percent slopes	790	0.2
377C2	Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded	3,125	0.8
382	Maxfield silty clay loam, 0 to 2 percent slopes	5,945	1.6
391B	Clyde-Floyd complex, 1 to 4 percent slopes	935	0.2
398	Tripoli silty clay loam, 0 to 2 percent slopes	270	0.1
399	Readlyn loam, 1 to 3 percent slopes	1,150	0.3

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
407B	Schley silt loam, 1 to 4 percent slopes	530	0.1
426	Aredale loam, 0 to 2 percent slopes	440	0.1
426B	Aredale loam, 2 to 5 percent slopes	3,000	0.8
426C	Aredale loam, 5 to 9 percent slopes	370	0.1
426C2	Aredale loam, 5 to 9 percent slopes, moderately eroded	700	0.2
428B	Ely silty clay loam, 2 to 5 percent slopes	1,650	0.4
444B	Jacwin loam, 1 to 5 percent slopes	1,120	0.3
444C2	Jacwin loam, 5 to 9 percent slopes, moderately eroded	240	0.1
506	Wacousta silt loam, 0 to 1 percent slopes	335	0.1
507	Canisteo silty clay loam, 0 to 2 percent slopes	16,155	4.3
512C	Marlean loam, 2 to 9 percent slopes	305	0.1
512E	Marlean loam, 9 to 18 percent slopes	575	0.2
512G	Marlean loam, 18 to 40 percent slopes	575	0.2
551	Calamine silty clay loam, 1 to 3 percent slopes	480	0.1
559	Talcot clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	1,975	0.5
595	Harpster silty clay loam, 0 to 2 percent slopes	465	0.1
612C2	Mottland loam, 5 to 9 percent slopes, moderately eroded	415	0.1
612E2	Mottland loam, 9 to 18 percent slopes, moderately eroded	605	0.2
613	Rossfield silt loam, 0 to 2 percent slopes	395	0.1
613B	Rossfield silt loam, 2 to 5 percent slopes	1,350	0.4
613C	Rossfield silt loam, 5 to 9 percent slopes	205	0.1
613C2	Rossfield silt loam, 5 to 9 percent slopes, moderately eroded	300	0.1
613D2	Rossfield silt loam, 9 to 14 percent slopes, moderately eroded	200	0.1
620C	Port Byron silt loam, 5 to 9 percent slopes	270	0.1
620C2	Port Byron silt loam, 5 to 9 percent slopes, moderately eroded	1,750	0.5
620D2	Port Byron silt loam, 9 to 14 percent slopes, moderately eroded	1,750	0.5
620E2	Port Byron silt loam, 14 to 20 percent slopes, moderately eroded	380	0.1
621	Houghton muck, 0 to 1 percent slopes	545	0.1
638C2	Clarion-Storden loams, 5 to 9 percent slopes, moderately eroded	3,725	1.0
638D2	Clarion-Storden loams, 9 to 14 percent slopes, moderately eroded	455	0.1
733	Calco silty clay loam, 0 to 2 percent slopes	1,450	0.4
760	Ansgar silt loam, 0 to 2 percent slopes	230	0.1
761	Franklin silt loam, 1 to 3 percent slopes	680	0.2
771B	Waubeek silt loam, 2 to 5 percent slopes	1,265	0.3
771C	Waubeek silt loam, 5 to 9 percent slopes	235	0.1
782B	Donnan silt loam, 2 to 5 percent slopes	585	0.2
782C2	Donnan silt loam, 5 to 9 percent slopes, moderately eroded	225	0.1
828B	Zenor sandy loam, 2 to 5 percent slopes	510	0.1
828C	Zenor sandy loam, 5 to 14 percent slopes	700	0.2
933	Sawmill silty clay loam, 0 to 2 percent slopes	4,050	1.1
956	Okoboji-Harps complex, 0 to 2 percent slopes	4,625	1.2
1135	Coland clay loam, channeled, 0 to 2 percent slopes	3,650	1.0
1173	Hoopeston Variant sandy loam, 1 to 3 percent slopes	385	0.1
5010	Pits, gravel	225	0.1
5030	Pits, quarries	180	*
5550	Orthents, loamy	670	0.2
	Water	275	0.1
	Total	375,040	100.0

* Less than 0.1 percent.

TABLE 5.--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	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
6---------- Okoboji	82	32	67	3.4	4.3	3.3
8B---------- Judson	124	47	99	5.2	7.3	4.2
11B---------- Colo-Ely	100	38	80	4.0	5.3	3.8
27B---------- Terril	118	45	94	4.9	7.0	4.2
41B---------- Sparta	61	---	49	2.2	3.7	2.3
55---------- Nicollet	117	44	94	4.9	7.0	4.2
62C2---------- Storden	91	35	73	3.8	5.5	3.7
62D2---------- Storden	82	31	66	3.4	4.9	3.3
62E2---------- Storden	67	25	54	2.8	4.0	2.2
73C---------- Salida	35	14	28	1.2	2.1	1.7
83B---------- Kenyon	113	43	90	4.7	6.8	4.2
83C2---------- Kenyon	105	40	84	4.4	6.3	3.8
83D---------- Kenyon	99	38	80	4.2	5.8	3.7
83F---------- Kenyon	---	---	---	---	---	3.3
84---------- Clyde	102	39	82	4.0	5.5	3.8
90---------- Okoboji	84	32	67	3.4	4.3	3.3
95---------- Harps	95	36	76	3.8	5.0	3.7
96---------- Turlin	120	46	96	5.0	7.1	4.1
107---------- Webster	110	42	88	4.4	5.8	3.8
118---------- Garwin	125	47	100	5.0	6.4	4.2
119---------- Muscatine	139	50	105	5.5	7.9	4.2
120B---------- Tama	125	48	100	5.2	7.5	4.2

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
133--- Colo	104	40	83	4.2	5.5	3.8
135--- Coland	100	38	80	4.0	5.3	3.8
138B--- Clarion	110	42	88	4.6	6.7	3.8
138C2--- Clarion	102	39	82	4.3	6.2	3.8
138D2--- Clarion	93	35	74	3.9	5.5	3.7
151--- Marshan	91	35	73	3.6	4.8	3.7
152--- Marshan	101	38	81	4.0	5.4	3.8
153--- Shandep	87	33	70	3.5	4.5	3.3
174B--- Bolan	96	36	77	4.0	5.8	3.6
174C2--- Bolan	88	33	70	3.7	5.3	3.3
175B--- Dickinson	81	31	65	3.0	4.8	3.3
175C--- Dickinson	76	29	61	2.8	4.5	2.7
177--- Saude	83	32	66	3.5	5.0	3.3
177B--- Saude	81	31	65	3.4	4.9	3.3
177C--- Saude	76	29	61	3.2	4.6	2.7
178--- Waukee	98	37	78	4.1	5.9	3.7
178B--- Waukee	96	36	77	4.0	5.8	3.7
184--- Klinger	125	47	100	5.1	7.5	4.2
198B--- Floyd	100	42	88	4.5	6.6	4.1
201B--- Coland-Terril	98	37	78	3.9	5.2	3.7
213B--- Rockton	96	36	77	4.0	5.8	3.6
214B--- Rockton	76	29	60	3.2	4.6	2.6
214C2--- Rockton	68	26	54	2.8	4.1	2.3
216C2--- Ripon	105	40	84	4.4	6.3	3.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
217B--Ripon	83	32	66	3.5	5.0	3.3
221--Palms	89	34	71	3.6	4.6	3.3
225--Lawler	85	32	68	3.6	5.0	3.3
226--Lawler	100	38	80	4.2	6.0	3.8
236B--Lester	105	40	83	4.5	6.2	3.8
236C--Lester	95	36	76	4.0	5.7	3.7
236D2--Lester	83	32	66	3.5	5.0	3.3
236F--Lester	---	---	---	3.0	4.1	2.7
284B--Flagler	66	25	53	2.4	4.0	2.3
284C--Flagler	61	23	49	2.2	3.7	2.3
329--Webster-Nicollet	115	43	91	4.5	6.1	4.2
335--Harcot	95	36	76	3.8	5.1	3.7
373C2--Tallula	105	40	84	4.4	6.3	3.8
373D2--Tallula	96	36	77	4.0	5.8	3.7
377--Dinsdale	121	46	97	5.1	7.3	4.2
377B--Dinsdale	119	45	95	5.0	7.1	4.2
377C--Dinsdale	114	43	91	4.8	6.8	4.2
377C2--Dinsdale	111	42	89	4.6	6.6	4.2
382--Maxfield	119	45	95	4.8	6.4	4.2
391B--Clyde-Floyd	103	40	84	4.2	5.6	3.8
398--Tripoli	111	42	89	4.5	6.0	4.1
399--Readlyn	115	44	92	4.7	6.9	4.1
407B--Schley	100	38	80	4.2	6.0	3.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
426---------- Aredale	115	44	92	4.8	6.9	4.2
426B---------- Aredale	113	43	90	4.7	6.8	4.2
426C---------- Aredale	108	41	86	4.5	6.5	3.8
426C2---------- Aredale	105	40	84	4.4	6.3	3.8
428B---------- Ely	124	47	99	5.3	7.5	4.2
444B---------- Jacwin	90	34	72	3.8	5.4	3.7
444C2---------- Jacwin	55	21	44	2.3	3.3	1.7
506---------- Wacousta	100	38	80	4.0	5.3	3.8
507---------- Canisteo	104	40	83	4.2	5.5	3.8
512C---------- Marlean	53	20	42	2.3	3.2	1.7
512E---------- Marlean	---	---	36	2.0	2.7	1.5
512G---------- Marlean	---	---	20	1.2	1.5	1.0
551---------- Calamine	75	28	60	3.0	3.8	2.7
559---------- Talcot	90	34	72	3.6	4.7	3.6
595---------- Harpster	110	42	89	4.4	5.9	4.2
612C2---------- Mottland	80	30	64	3.4	4.8	3.3
612E2---------- Mottland	50	19	40	2.1	3.0	1.7
613---------- Rossfield	105	40	84	4.4	6.3	3.8
613B---------- Rossfield	103	39	82	4.3	6.2	3.8
613C---------- Rossfield	98	37	78	4.1	5.9	3.7
613C2---------- Rossfield	95	36	76	4.0	5.7	3.6
613D2---------- Rossfield	85	32	68	3.6	5.1	3.3
620C---------- Port Byron	120	45	96	5.0	7.2	4.2
620C2---------- Port Byron	117	44	94	4.9	7.0	4.2
620D2---------- Port Byron	108	41	86	4.5	6.5	3.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*
620E2--- Port Byron	93	35	74	3.9	5.6	3.7
621--- Houghton	70	26	56	2.8	3.5	2.7
638C2--- Clarion-Storden	96	36	77	4.0	5.8	3.7
638D2--- Clarion-Storden	87	33	70	3.7	5.2	3.3
733--- Calco	99	38	79	4.0	5.2	3.7
760--- Ansgar	100	38	80	4.0	5.3	3.8
761--- Franklin	115	44	92	4.8	7.0	4.2
771B--- Waubeek	111	42	89	4.7	6.8	4.2
771C--- Waubeek	106	40	85	4.5	6.5	3.8
782B--- Donnan	70	27	56	2.8	4.2	2.7
782C2--- Donnan	60	23	48	2.4	3.6	2.3
828B--- Zenor	79	30	63	2.8	4.8	2.7
828C--- Zenor	74	28	59	2.7	4.5	2.7
933--- Sawmill	104	40	83	4.2	5.5	3.8
956--- Okoboji-Harps	90	34	72	3.7	4.7	3.3
1135--- Coland	---	---	---	---	---	3.3
1173--- Hoopeston Variant	90	34	72	3.8	5.4	3.7
5010, 5030. Pits						
5550. Orthents						

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	52,160	---	---	---
II	253,575	109,335	130,155	14,085
III	59,680	43,675	16,005	---
IV	2,835	1,595	---	1,240
V	3,650	---	3,650	---
VI	615	615	---	---
VII	575	---	---	575
VIII	---	---	---	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
6---- Okoboji	Silky dogwood, redosier dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash----------	Silver maple, eastern cottonwood.
8B---- Judson	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
11B*:					
Colo----	Redosier dogwood, silky dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash----------	Silver maple, eastern cottonwood.
Ely----	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
27B---- Terril	Redosier dogwood, gray dogwood.	Siberian dogwood, Tatarian honeysuckle, bloodtwig dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
41B---- Sparta	European privet---	Forsythia, autumn-olive.	Austrian pine, tall purple willow.	Eastern white pine, red pine, jack pine.	---
55---- Nicollet	Arrowwood, redosier dogwood.	Gray dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple, eastern redcedar.	Red pine, eastern white pine, green ash, common hackberry.	---
62C2, 62D2-------- Storden	Redosier dogwood, gray dogwood.	Tall purple willow, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	Eastern redcedar, white spruce.	Green ash, Russian-olive, golden willow.	Eastern cottonwood, Siberian elm.
62E2. Storden					
73C---- Salida	Siberian peashrub	Eastern redcedar, northern white-cedar, Russian-olive, Tatarian honeysuckle.	Common hackberry, bur oak, red pine.	---	---
83B, 83C2, 83D, 83F---- Kenyon	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
84---------- Clyde	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
90---------- Okoboji	Silky dogwood, redosier dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
95---------- Harps	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
96---------- Turlin	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
107---------- Webster	Silky dogwood, redosier dogwood.	Zabel honeysuckle, bloodtwig dogwood, Siberian dogwood, Tatarian honeysuckle.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Silver maple, eastern cottonwood.
118---------- Garwin	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
119---------- Muscatine	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
120B---------- Tama	Redosier dogwood, gray dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
133---------- Colo	Redosier dogwood, silky dogwood.	Siberian dogwood, bloodtwig dogwood, Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
135---------- Coland	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
138B, 138C2, 138D2---------- Clarion	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
151, 152---------- Marshan	Arrowwood---------	Eastern redcedar, northern white-cedar.	Black spruce, Amur maple, blue spruce.	Common hackberry, black ash.	Siberian elm.
153---------- Shandep	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Northern white-cedar, laurel willow, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
174B, 174C2------- Bolan	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
175B, 175C-------- Dickinson	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
177, 177B, 177C--- Saude	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
178, 178B--------- Waukee	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
184---------- Klinger	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
198B---------- Floyd	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
201B*: Coland.					
Terril----------	Redosier dogwood, gray dogwood.	Siberian dogwood, Tatarian honeysuckle, bloodtwig dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
213B, 214B, 214C2 Rockton	Siberian peashrub	Siberian crabapple, gray dogwood, Tatarian honeysuckle, lilac.	Eastern redcedar, northern white-cedar, blue spruce, eastern white pine, common hackberry.	Green ash, American elm.	Eastern cottonwood.
216C2, 217B------- Ripon	Siberian peashrub	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	Eastern cottonwood.
221---------- Palms	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
225, 226---------- Lawler	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
236B, 236C, 236D2 Lester	Redosier dogwood--	Gray dogwood, Tatarian honeysuckle, lilac.	Siberian crabapple, Amur maple.	Eastern white pine, green ash, common hackberry.	Eastern cottonwood, American elm.
236F. Lester					
284B, 284C-------- Flagler	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, Siberian dogwood, bloodtwig dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
329*: Webster----------	Silky dogwood, redosier dogwood.	Zabel honeysuckle, bloodtwig dogwood, Siberian dogwood, Tatarian honeysuckle.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Silver maple, eastern cottonwood.
Nicollet---------	Arrowwood, redosier dogwood.	Gray dogwood, Tatarian honeysuckle, lilac.	Northern white-cedar, white spruce, Siberian crabapple, Amur maple, eastern redcedar.	Red pine, eastern white pine, green ash, common hackberry.	---
335---------- Harcot	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
373C2, 373D2------ Tallula	Gray dogwood------	Forsythia---------	Amur maple, autumn-olive.	Douglas-fir, Norway spruce, eastern white pine.	Red pine.
377, 377B, 377C, 377C2---------- Dinsdale	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
382---------- Maxfield	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
391B*: Clyde----------	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
Floyd----------	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
398---------- Tripoli	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
399---------- Readlyn	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
407B---------- Schley	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
426, 426B, 426C, 426C2---------- Aredale	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
428B---------- Ely	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
444B, 444C2------- Jacwin	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
506---------- Wacousta	Silky dogwood, redosier dogwood.	Zabel honeysuckle, Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	---	Eastern cottonwood, silver maple.
507---------- Canisteo	---	Medium purple willow, redosier dogwood, Tatarian honeysuckle.	Russian-olive-----	Green ash---------	Eastern cottonwood, golden willow, Siberian elm.
512C, 512E-------- Marlean 512G. Marlean 551. Calamine	Russian peashrub	Eastern redcedar	Siberian peashrub	---	---
559---------- Talcot	Arrowwood---------	Tatarian honeysuckle, medium purple willow, redosier dogwood.	Russian-olive-----	Green ash---------	Eastern cottonwood, Siberian elm, golden willow.
595---------- Harpster	Vanhoutte spirea	Silky dogwood, Amur maple, American cranberrybush, forsythia.	Russian-olive-----	Green ash, black spruce, pin oak, European larch.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
612C2, 612E2----- Mottland	Gray dogwood------	Tatarian honeysuckle.	Russian-olive, northern white-cedar, Austrian pine, eastern redcedar.	Ponderosa pine, common hackberry.	Green ash.
613, 613B, 613C, 613C2, 613D2----- Rossfield	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
620C, 620C2, 620D2, 620E2----- Port Byron	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, lilac, silky dogwood, Peking cotoneaster.	White spruce, northern white-cedar, Amur maple, Siberian crabapple.	Eastern white pine, silver maple, green ash, common hackberry.	---
621---------- Houghton	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
638C2*, 638D2*: Clarion----------	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
Storden----------	Redosier dogwood--	Tall purple willow, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	Eastern redcedar, white spruce.	Green ash, Russian-olive, golden willow.	Eastern cottonwood, Siberian elm.
733---------- Calco	Redosier dogwood, silky dogwood.	Siberian dogwood, Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
760---------- Ansgar	Redosier dogwood, silky dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
761---------- Franklin	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
771B, 771C-------- Waubeek	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
782B, 782C2------- Donnan	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
828B, 828C-------- Zenor	Redosier dogwood, gray dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
933. Sawmill					
956*: Okoboji----------	Silky dogwood, redosier dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Siberian dogwood.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash---------	Silver maple, eastern cottonwood.
Harps----------	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
1135---------- Coland	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, bloodtwig dogwood, Zabel honeysuckle, Siberian dogwood.	Laurel willow, northern white-cedar, Amur maple.	Green ash---------	Eastern cottonwood, silver maple.
1173---------- Hoopeston Variant	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
5010*, 5030*. Pits					
5550*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
6 Okoboji	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
8B Judson	Slight	Slight	Moderate: slope.	Slight	Slight.
11B*: Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
27B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
41B Sparta	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Moderate: too sandy.
55 Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
62C2 Storden	Slight	Slight	Severe: slope.	Slight	Slight.
62D2 Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
62E2 Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
73C Salida	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.	Severe: small stones.
83B Kenyon	Slight	Slight	Moderate: slope.	Slight	Slight.
83C2 Kenyon	Slight	Slight	Severe: slope.	Slight	Slight.
83D Kenyon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
83F Kenyon	Severe: slope.	Severe: slope.	Severe: slope.	Slight	Severe: slope.
84 Clyde	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: floods.
90 Okoboji	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
95 Harps	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
96--- Turlin	Severe: floods.	Slight---	Moderate: floods.	Slight---	Moderate: floods.
107--- Webster	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.
118--- Garwin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
119--- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight---	Slight.
120B--- Tama	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
133--- Colo	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness.	Moderate: wetness, floods.
135--- Coland	Severe: floods, wetness.	Moderate: wetness, too clayey, floods.	Severe: wetness, floods.	Moderate: wetness, too clayey, floods.	Severe: wetness, floods.
138B--- Clarion	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
138C2--- Clarion	Slight---	Slight---	Severe: slope.	Slight---	Slight.
138D2--- Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight---	Moderate: slope.
151, 152--- Marshan	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness, too clayey.
153--- Shandep	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: floods, wetness.
174B--- Bolan	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
174C2--- Bolan	Slight---	Slight---	Severe: slope.	Slight---	Slight.
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.
177C--- Saude	Slight---	Slight---	Severe: slope.	Slight---	Slight.
178--- Waukee	Slight---	Slight---	Slight---	Slight---	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
178B---------- Waukee	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
184---------- Klinger	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Moderate: wetness.
198B---------- Floyd	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
201B*: Coland----------	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: floods.
Terril----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
213B, 214B---------- Rockton	Slight----------	Slight----------	Moderate: depth to rock, slope.	Slight----------	Moderate: thin layer.
214C2---------- Rockton	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: thin layer.
216C2---------- Ripon	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: thin layer.
217B---------- Ripon	Slight----------	Slight----------	Moderate: depth to rock, slope.	Slight----------	Moderate: thin layer.
221---------- Palms	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.
225, 226---------- Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
236B---------- Lester	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
236C---------- Lester	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
236D2---------- Lester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
236F---------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
284B---------- Flagler	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
284C---------- Flagler	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
329*: Webster----------	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
329*: Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
335 Harcot	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
373C2 Tallula	Slight	Slight	Severe: slope.	Slight	Slight.
373D2 Tallula	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
377 Dinsdale	Slight	Slight	Slight	Moderate: too clayey.	Slight.
377B Dinsdale	Slight	Slight	Moderate: slope.	Moderate: too clayey.	Slight.
377C, 377C2 Dinsdale	Slight	Slight	Severe: slope.	Moderate: too clayey.	Slight.
382 Maxfield	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
391B*: Clyde	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: floods.
Floyd	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
398 Tripoli	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
399 Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
407B Schley	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
426 Aredale	Slight	Slight	Slight	Slight	Slight.
426B Aredale	Slight	Slight	Moderate: slope.	Slight	Slight.
426C, 426C2 Aredale	Slight	Slight	Severe: slope.	Slight	Slight.
428B Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
444B Jacwin	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Slight	Moderate: wetness.
444C2 Jacwin	Severe: percs slowly.	Moderate: wetness.	Severe: slope, percs slowly.	Slight	Moderate: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
506--Wacousta	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
507--Canisteo	Severe: wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness.
512C--Marlean	Severe: depth to rock.	Slight	Severe: depth to rock.	Slight	Moderate: thin layer.
512E--Marlean	Severe: depth to rock.	Moderate: slope.	Severe: slope, depth to rock.	Slight	Moderate: slope, thin layer.
512G--Marlean	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
551--Calamine	Severe: wetness, floods, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
559--Talcot	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
595--Harpster	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
612C2--Mottland	Slight	Slight	Severe: slope.	Slight	Moderate: large stones, droughty.
612E2--Mottland	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
613, 613B--Rossfield	Slight	Slight	Slight	Slight	Slight.
613C, 613C2--Rossfield	Slight	Slight	Severe: slope.	Slight	Slight.
613D2--Rossfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
620C, 620C2--Port Byron	Slight	Slight	Severe: slope.	Slight	Slight.
620D2, 620E2--Port Byron	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
621--Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
638C2*: Clarion	Slight	Slight	Severe: slope.	Slight	Slight.
Storden	Slight	Slight	Severe: slope.	Slight	Slight.
638D2*: Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
733 Calco	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
760 Ansgar	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
761 Franklin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
771B Waubeek	Slight	Slight	Moderate: slope.	Slight	Slight.
771C Waubeek	Slight	Slight	Severe: slope.	Slight	Slight.
782B Donnan	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Slight	Slight.
782C2 Donnan	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly, slope.	Slight	Slight.
828B Zenor	Slight	Slight	Moderate: slope.	Slight	Slight.
828C Zenor	Slight	Slight	Severe: slope.	Slight	Slight.
933 Sawmill	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
956*: Okoboji	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, floods.
Harps	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1135 Coland	Severe: floods, wetness.	Moderate: floods, wetness, too clayey.	Severe: wetness, floods.	Moderate: wetness, too clayey, floods.	Severe: floods.
1173 Hoopeston Variant	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
5010*, 5030*. Pits					
5550*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[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
6---- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
8B---- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
11B*:										
Colo----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Ely----	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
27B---- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
41B---- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
55---- Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
62C2, 62D2, 62E2--- Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
73C---- Salida	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
83B---- Kenyon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
83C2, 83D, 83F----- Kenyon	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
84---- Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
90---- Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
95---- Harps	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
96---- Turlin	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
107---- Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
118---- Garwin	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
119---- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
120B---- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
133---- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
135---- Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
138B---------- Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
138C2, 138D2------- Clarion	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
151, 152---------- Marshan	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
153---------- Shandep	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
174B---------- Bolan	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
174C2---------- Bolan	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very 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.
177C---------- Saude	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
178, 178B---------- Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
184---------- Klinger	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
198B---------- Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
201B*:										
Coland----------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Terril----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
213B, 214B, 214C2-- Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
216C2---------- Ripon	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
217B---------- Ripon	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
221---------- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
225, 226---------- Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
236B---------- Lester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
236C, 236D2-------- Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
236F---------- Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
284B---------- Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
284C---------- Flagler	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
329*:										
Webster----------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Nicollet----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
335. Harcot										
373C2, 373D2------- Tallula	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
377, 377B---------- Dinsdale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
377C, 377C2-------- Dinsdale	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
382---------- Maxfield	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
391B*:										
Clyde----------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Floyd----------	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
398---------- Tripoli	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
399---------- Readlyn	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
407B---------- Schley	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
426---------- Aredale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
426B---------- Aredale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
426C, 426C2-------- Aredale	Fair	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Poor.
428B---------- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
444B---------- Jacwin	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
444C2---------- Jacwin	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
506---------- Wacousta	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
507---------- Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
512C, 512E, 512G---Marlean	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Very poor.	Poor	Very poor.
551----------Calamine	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
559----------Talcot	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
595----------Harpster	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
612C2, 612E2-------Mottland	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Very poor.	Very poor.
613, 613B----------Rossfield	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
613C, 613C2, 613D2 Rossfield	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
620C, 620C2, 620D2, 620E2----------Port Byron	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
621----------Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
638C2*, 638D2*: Clarion-----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Storden-----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
733----------Calco	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Poor	Fair.
760----------Ansgar	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
761----------Franklin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
771B----------Waubeek	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
771C----------Waubeek	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very 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.
828B----------Zenor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
828C----------Zenor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
933----------Sawmill	Good	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
956*: Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good.
Harps	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1135 Coland	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
1173 Hoopeston Variant	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
5010*, 5030*. Pits										
5550*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
6 Okoboji	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
8B Judson	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
11B*: Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Severe: floods.
Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
27B Terril	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.	Slight.
41B Sparta	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: too sandy.
55 Nicollet	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
62C2 Storden	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.	Slight.
62D2 Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
62E2 Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
73C Salida	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: small stones.
83B Kenyon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.	Slight.
83C2 Kenyon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Severe: low strength.	Slight.
83D Kenyon	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
83F Kenyon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength.	Severe: slope.
84 Clyde	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
90--Okoboji	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
95--Harps	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength, frost action.	Moderate: wetness.
96--Turlin	Severe: floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods.	Moderate: floods.
107--Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.
118--Garwin	Severe: wetness.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: frost action, low strength.	Moderate: wetness.
119--Muscatine	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
120B--Tama	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
133--Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Severe: floods.
135--Coland	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.	Severe: floods.
138B--Clarion	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
138C2--Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
138D2--Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength, frost action.	Moderate: slope.
151, 152--Marshan	Severe: wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, frost action, low strength.	Moderate: wetness, too clayey.
153--Shandep	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, wetness, floods.	Severe: floods, wetness.
174B--Bolan	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
174C2--- Bolan	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Slight.
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---	Moderate: low strength.	Slight.
177C--- Saude	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Moderate: low strength.	Slight.
178, 178B--- Waukee	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Moderate: low strength.	Slight.
184--- Klinger	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Moderate: wetness.
198B--- Floyd	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: frost action, low strength.	Good.
201B*:						
Coland---	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Severe: floods.
Terril---	Slight---	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.	Slight.
213B, 214B--- Rockton	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.	Moderate: thin layer.
214C2--- Rockton	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Moderate: thin layer.
216C2--- Ripon	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: depth to rock, slope, shrink-swell.	Severe: frost action, low strength.	Moderate: thin layer.
217B--- Ripon	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: frost action, low strength.	Moderate: thin layer.
221--- Palms	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, excess humus.
225, 226--- Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness, low strength.	Severe: wetness.	Moderate: wetness, low strength.	Severe: frost action, low strength.	Slight.
236B--- Lester	Slight---	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
236C---------- Lester	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.
236D2---------- Lester	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
236F---------- Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
284B---------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
284C---------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength.	Slight.
329*: Webster----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.
Nicollet---------	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
335---------- Harcot	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.	Moderate: wetness.
373C2---------- Tallula	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
373D2---------- Tallula	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
377---------- Dinsdale	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
377B---------- Dinsdale	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
377C, 377C2------- Dinsdale	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
382---------- Maxfield	Severe: wetness.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, frost action, low strength.	Moderate: wetness.
391B*: Clyde----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods, frost action.	Severe: floods.
Floyd----------	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: wetness.	Moderate: wetness, low strength, shrink-swell.	Severe: frost action, low strength.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
398---------- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
399---------- Readlyn	Severe: wetness.	Moderate: wetness, low strength.	Severe: wetness.	Moderate: wetness, low strength.	Severe: frost action, low strength.	Slight.
407B---------- Schley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
426---------- Aredale	Slight---------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.	Slight.
426B---------- Aredale	Slight---------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.	Slight.
426C, 426C2------- Aredale	Slight---------	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Severe: low strength.	Slight.
428B---------- Ely	Severe: wetness.	Moderate: low strength.	Severe: wetness.	Moderate: low strength.	Severe: frost action, low strength.	Slight.
444B, 444C2------- Jacwin	Moderate: wetness, too clayey.	Severe: low strength.	Severe: wetness, low strength.	Severe: low strength.	Severe: frost action, low strength.	Moderate: wetness.
506---------- Wacousta	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: low strength, wetness, floods.	Severe: wetness, floods.
507---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: too clayey, wetness.
512C---------- Marlean	Severe: depth to rock.	Moderate: depth to rock, large stones.	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Moderate: depth to rock, large stones.	Moderate: thin layer.
512E---------- Marlean	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, large stones.	Moderate: slope, thin layer.
512G---------- Marlean	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.	Severe: slope.
551---------- Calamine	Severe: wetness, too clayey.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness.
559---------- Talcot	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength.	Severe: wetness.
595---------- Harpster	Severe: wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: wetness, frost action, low strength.	Severe: wetness.
612C2---------- Mottland	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: large stones, droughty.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
612E2--Mottland	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty.
613, 613B--Rossfield	Slight	Slight	Slight	Slight	Severe: low strength.	Slight.
613C, 613C2--Rossfield	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
613D2--Rossfield	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
620C, 620C2--Port Byron	Slight	Slight	Slight	Moderate: slope.	Severe: frost action, low strength.	Slight.
620D2--Port Byron	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
620E2--Port Byron	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength.	Severe: slope.
621--Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: excess humus, wetness, floods.
638C2*:						
Clarion	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Storden	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.	Slight.
638D2*:						
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength, frost action.	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: slope.
733--Calco	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength, wetness.	Severe: floods.
760--Ansgar	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, frost action, low strength.	Moderate: wetness.
761--Franklin	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
771B--Waubeek	Slight	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
771C---------- Waubeek	Slight---------	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.	Slight.
782B, 782C2------- Donnan	Moderate: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell, frost action.	Slight.
828B---------- Zenor	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
828C---------- Zenor	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
933---------- Sawmill	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods.
956*: Okoboji----------	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
Harps----------	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength, frost action.	Moderate: wetness.
1135---------- Coland	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.	Severe: floods.
1173---------- Hoopeston Variant	Severe: cutbanks cave.	Moderate: wetness.	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
5010*, 5030*. Pits						
5550*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
6 Okoboji	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
8B Judson	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
11B*: Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
27B Terril	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Good.
41B Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
55 Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
62C2 Storden	Slight	Severe: slope.	Slight	Slight	Good.
62D2 Storden	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
62E2 Storden	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
73C Salida	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
83B Kenyon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
83C2 Kenyon	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
83D Kenyon	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
83F Kenyon	Severe: slope.	Severe: slope.	Slight	Severe: slope.	Poor: slope.
84 Clyde	Severe: floods, wetness, percs slowly.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
90---------- Okoboji	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
95---------- Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
96---------- Turlin	Severe: wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness.	Fair: wetness.
107---------- Webster	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
118---------- Garwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
119---------- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
120B---------- Tama	Slight----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
133---------- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
135---------- Coland	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
138B---------- Clarion	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
138C2---------- Clarion	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
138D2---------- Clarion	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
151, 152---------- Marshan	Severe: wetness.	Severe: wetness, floods, seepage.	Severe: wetness, seepage, too sandy.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
153---------- Shandep	Severe: floods, wetness.	Severe: wetness, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness.
174B---------- Bolan	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Good.
174C2---------- Bolan	Severe: poor filter.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Good.
175B---------- Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage, too sandy.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
175C---------- Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, too sandy.	Poor: seepage, too sandy.
177, 177B---------- Saude	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
177C---------- Saude	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
178, 178B---------- Waukee	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
184---------- Klinger	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
198B---------- Floyd	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
201B*:					
Coland----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Terril----------	Slight----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Good.
213B, 214B---------- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
214C2---------- Rockton	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
216C2---------- Ripon	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
217B---------- Ripon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
221---------- Palms	Severe: wetness, floods, subsides.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, hard to pack.
225, 226---------- Lawler	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Good.
236B---------- Lester	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
236C---------- Lester	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
236D2---------- Lester	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
236F Lester	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
284B Flagler	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
284C Flagler	Severe: poor filter.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
329*: Webster	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
335 Harcot	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
373C2 Tallula	Slight	Severe: slope.	Slight	Slight	Good.
373D2 Tallula	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
377 Dinsdale	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
377B Dinsdale	Moderate: percs slowly.	Moderate: slope.	Slight	Slight	Good.
377C, 377C2 Dinsdale	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
382 Maxfield	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
391B*: Clyde	Severe: floods, wetness, percs slowly.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Floyd	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
398 Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
399 Readlyn	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
407B Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
426 Aredale	Slight	Severe: seepage.	Slight	Severe: seepage.	Good.
426B Aredale	Slight	Severe: seepage.	Slight	Severe: seepage.	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
426C, 426C2--------- Aredale	Slight----------	Severe: slope, seepage.	Slight----------	Severe: seepage.	Good.
428B---------- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
444B---------- Jacwin	Severe: wetness, percs slowly, depth to rock.	Moderate: slope, depth to rock, seepage.	Severe: too clayey, depth to rock.	Moderate: wetness, depth to rock.	Poor: area reclaim, too clayey.
444C2---------- Jacwin	Severe: wetness, percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: wetness, depth to rock.	Poor: area reclaim, too clayey.
506---------- Wacousta	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
507---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
512C---------- Marlean	Severe: large stones.	Severe: seepage, depth to rock.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: thin layer, small stones.
512E---------- Marlean	Severe: large stones.	Severe: slope, seepage, depth to rock.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: thin layer, small stones.
512G---------- Marlean	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: seepage, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, depth to rock.
551---------- Calamine	Severe: wetness, percs slowly.	Severe: wetness, depth to rock, floods.	Severe: wetness, depth to rock.	Severe: wetness.	Poor: wetness.
559---------- Talcot	Severe: wetness.	Severe: wetness, seepage, floods.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
595---------- Harpster	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Poor: wetness.
612C2, 612E2-------- Mottland	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage.	Severe: seepage, depth to rock.	Poor: area reclaim.
613, 613B---------- Rossfield	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
613C, 613C2--------- Rossfield	Slight----------	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
613D2---------- Rossfield	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
620C, 620C2--------- Port Byron	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
620D2--------- Port Byron	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
620E2--------- Port Byron	Severe: slope.	Severe: slope.	Slight----------	Severe: slope.	Poor. slope.
621--------- Houghton	Severe: wetness, floods, percs slowly.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
638C2*: Clarion----------	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
Storden----------	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
638D2*: Clarion----------	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
Storden----------	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
733--------- Calco	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
760--------- Ansgar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
761--------- Franklin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
771B--------- Waubeek	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
771C--------- Waubeek	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
782B--------- Donnan	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
782C2--------- Donnan	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
828B--------- Zenor	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
828C--------- Zenor	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
933--------- Sawmill	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
956*: Okoboji	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1135 Coland	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
1173 Hoopeston Variant	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Good.
5010*, 5030*. Pits					
5550*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
6 Okoboji	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
8B Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
11B*: Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ely	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
27B Terril	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
41B Sparta	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
55 Nicollet	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
62C2 Storden	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: small stones.
62D2 Storden	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, small stones.
62E2 Storden	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
73C Salida	Good	Good	Poor: too sandy.	Poor: small stones, area reclaim.
83B, 83C2 Kenyon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
83D Kenyon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
83F Kenyon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	
84 Clyde	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
90 Okoboji	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
95 Harps	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
96--- Turlin	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
107--- Webster	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
118--- Garwin	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
119--- Muscatine	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
120B--- Tama	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
133--- Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
135--- Coland	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
138B, 138C2--- Clarion	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
138D2--- Clarion	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
151, 152--- Marshan	Poor: wetness.	Good	Good	Fair: too clayey.
153--- Shandep	Poor: low strength, wetness.	Good	Unsuited: excess fines.	Poor: wetness.
174B, 174C2--- Bolan	Good	Fair: excess fines.	Unsuited: excess fines.	Good.
175B, 175C--- Dickinson	Good	Fair: excess fines.	Unsuited: excess fines.	Good.
177, 177B, 177C--- Saude	Good	Good	Good	Good.
178, 178B--- Waukee	Good	Good	Unsuited: excess fines.	Good.
184--- Klinger	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
198B--- Floyd	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
201B*: Coland---	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Terril---	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
213B, 214B, 214C2----- Rockton	Poor: low strength, thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, thin layer.
216C2, 217B----------- Ripon	Poor: area reclaim, thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, thin layer.
221------------------- Palms	Poor: wetness, low strength.	Unsuited: excess humus, excess fines.	Unsuited: excess humus, excess fines.	Poor: wetness, excess humus.
225, 226-------------- Lawler	Good----------	Good----------	Good----------	Good.
236B, 236C------------ Lester	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
236D2----------------- Lester	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
236F------------------ Lester	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
284B, 284C------------ Flagler	Good----------	Good----------	Unsuited: excess fines.	Good.
329*: Webster---------------	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Nicollet--------------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
335------------------- Harcot	Poor: wetness.	Good----------	Unsuited: excess fines.	Good.
373C2----------------- Tallula	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
373D2----------------- Tallula	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
377------------------- Dinsdale	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
377B, 377C, 377C2----- Dinsdale	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
382------------------- Maxfield	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
391B*: Clyde----------------	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Floyd----------------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
398--Tripoli	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
399--Readlyn	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
407B--Schley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
426--Aredale	Fair: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
426B, 426C, 426C2--Aredale	Fair: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
428B--Ely	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
444B, 444C2--Jacwin	Poor: area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
506--Wacousta	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
507--Canisteo	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
512C, 512E--Marlean	Poor: area reclaim.	Poor: excess fines.	Poor: excess fines.	Poor: area reclaim, large stones.
512G--Marlean	Poor: area reclaim.	Poor: excess fines.	Poor: excess fines.	Poor: slope, area reclaim, large stones.
551--Calamine	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
559--Talcot	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
595--Harpster	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
612C2, 612E2--Mottland	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: area reclaim, small stones.
613, 613B, 613C, 613C2--Rossfield	Good	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
613D2--Rossfield	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
620C, 620C2--Port Byron	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
620D2---------- Port Byron	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
620E2---------- Port Byron	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
621---------- Houghton	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
638C2*: Clarion----------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Storden----------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: small stones.
638D2*: Clarion----------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Storden----------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, small stones.
733---------- Calco	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
760---------- Ansgar	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
761---------- Franklin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
771B, 771C---------- Waubeek	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
782B, 782C2---------- Donnan	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
828B, 828C---------- Zenor	Good----------	Good----------	Unsuited: excess fines.	Good.
933---------- Sawmill	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
956*: Okoboji----------	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Harps----------	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1135---------- Coland	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1173---------- Hoopeston Variant	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
5010*, 5030*. Pits				
5550*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
6--Okoboji	Favorable	Wetness, hard to pack.	Slow refill	Frost action, floods.	Not needed	Wetness, erodes easily.
8B--Judson	Seepage	Favorable	No water	Not needed	Erodes easily	Erodes easily.
11B*:						
Colo	Seepage	Hard to pack, wetness.	Slow refill	Floods, frost action.	Wetness	Wetness.
Ely	Seepage	Hard to pack, wetness.	Deep to water, slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
27B--Terril	Seepage	Favorable	No water	Not needed	Favorable	Favorable.
41B--Sparta	Seepage	Piping, seepage.	No water	Not needed	Too sandy, soil blowing.	Droughty.
55--Nicollet	Seepage	Wetness	Slow refill, deep to water.	Frost action	Wetness	Favorable.
62C2--Storden	Slope, seepage.	Favorable	No water	Not needed	Favorable	Erodes easily.
62D2--Storden	Slope, seepage.	Favorable	No water	Not needed	Favorable	Slope, erodes easily.
62E2--Storden	Slope, seepage.	Favorable	No water	Not needed	Slope	Slope, erodes easily.
73C--Salida	Seepage	Seepage	No water	Not needed	Too sandy	Droughty.
83B--Kenyon	Seepage	Favorable	No water	Not needed	Favorable	Favorable.
83C2--Kenyon	Slope, seepage.	Favorable	No water	Not needed	Favorable	Favorable.
83D--Kenyon	Slope, seepage.	Favorable	No water	Not needed	Favorable	Slope.
83F--Kenyon	Slope, seepage.	Favorable	No water	Not needed	Slope	Slope.
84--Clyde	Seepage	Wetness	Slow refill	Frost action, floods.	Wetness	Wetness, erodes easily.
90--Okoboji	Favorable	Wetness, hard to pack.	Slow refill	Frost action, floods.	Not needed	Wetness, erodes easily.
95--Harps	Favorable	Hard to pack, wetness.	Slow refill	Frost action	Not needed	Wetness.
96--Turlin	Seepage	Hard to pack	Deep to water, slow refill.	Not needed	Favorable	Favorable.
107--Webster	Seepage	Wetness	Slow refill	Frost action	Not needed	Wetness.
118--Garwin	Seepage	Wetness, hard to pack.	Slow refill	Frost action	Not needed	Wetness.
119--Muscatine	Seepage	Wetness	Deep to water, slow refill.	Frost action	Wetness, erodes easily.	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
120B---------- Tama	Seepage--------	Favorable------	No water-------	Not needed-----	Erodes easily	Erodes easily.
133---------- Colo	Seepage--------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Wetness--------	Wetness.
135---------- Coland	Seepage--------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Wetness--------	Wetness.
138B---------- Clarion	Seepage--------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
138C2---------- Clarion	Seepage, slope.	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
138D2---------- Clarion	Seepage, slope.	Favorable------	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
151, 152---------- Marshan	Seepage--------	Wetness, seepage.	Slow refill----	Frost action---	Not needed-----	Wetness.
153---------- Shandep	Seepage--------	Wetness--------	Slow refill----	Frost action, floods.	Not needed-----	Wetness.
174B---------- Bolan	Seepage--------	Seepage, piping.	No water-------	Not needed-----	Too sandy------	Favorable.
174C2---------- Bolan	Seepage, slope.	Seepage, piping.	No water-------	Not needed-----	Too sandy------	Favorable.
175B---------- Dickinson	Seepage--------	Seepage--------	No water-------	Not needed-----	Soil blowing, too sandy.	Favorable.
175C---------- Dickinson	Slope, seepage.	Seepage--------	No water-------	Not needed-----	Soil blowing, too sandy.	Favorable.
177, 177B---------- Saude	Seepage--------	Seepage--------	No water-------	Not needed-----	Too sandy------	Favorable.
177C---------- Saude	Slope, seepage.	Seepage--------	No water-------	Not needed-----	Too sandy------	Favorable.
178, 178B---------- Waukee	Seepage--------	Seepage--------	No water-------	Not needed-----	Too sandy------	Favorable.
184---------- Klinger	Seepage--------	Wetness--------	Deep to water, slow refill.	Frost action---	Wetness, erodes easily.	Erodes easily.
198B---------- Floyd	Seepage--------	Wetness--------	Deep to water, slow refill.	Frost action---	Wetness--------	Favorable.
201B*: Coland----------	Seepage--------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Wetness--------	Wetness.
Terril----------	Seepage--------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
213B, 214B-------- Rockton	Depth to rock, seepage.	Thin layer-----	No water-------	Not needed-----	Depth to rock	Depth to rock.
214C2---------- Rockton	Slope, seepage, depth to rock.	Thin layer-----	No water-------	Not needed-----	Depth to rock	Depth to rock.
216C2---------- Ripon	Slope, depth to rock, seepage.	Thin layer, piping.	No water-------	Not needed-----	Depth to rock	Depth to rock.
217B---------- Ripon	Depth to rock, seepage.	Thin layer, piping.	No water-------	Not needed-----	Depth to rock	Depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
221---------- Palms	Seepage---------	Excess humus, wetness.	Slow refill----	Floods, frost action, excess humus.	Not needed-----	Wetness.
225, 226---------- Lawler	Seepage---------	Seepage---------	Deep to water, slow refill.	Frost action---	Wetness, too sandy.	Favorable.
236B---------- Lester	Seepage---------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
236C---------- Lester	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
236D2---------- Lester	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
236F---------- Lester	Slope, seepage.	Favorable------	No water-------	Not needed-----	Slope----------	Slope, erodes easily.
284B---------- Flagler	Seepage---------	Seepage---------	No water-------	Not needed-----	Too sandy, soil blowing.	Droughty.
284C---------- Flagler	Slope, seepage.	Seepage---------	No water-------	Not needed-----	Too sandy, soil blowing.	Droughty.
329*:						
Webster----------	Seepage---------	Wetness---------	Slow refill----	Frost action---	Not needed-----	Wetness.
Nicollet---------	Seepage---------	Wetness---------	Slow refill, deep to water.	Frost action---	Wetness---------	Favorable.
335---------- Harcot	Seepage---------	Piping, seepage, wetness.	Slow refill----	Frost action---	Not needed-----	Wetness.
373C2---------- Tallula	Slope, seepage.	Piping---------	No water-------	Not needed-----	Erodes easily	Erodes easily.
373D2---------- Tallula	Slope, seepage.	Piping---------	No water-------	Not needed-----	Erodes easily	Slope, erodes easily.
377---------- Dinsdale	Seepage---------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
377B---------- Dinsdale	Seepage---------	Favorable------	No water-------	Not needed-----	Favorable------	Erodes easily.
377C, 377C2------- Dinsdale	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Erodes easily.
382---------- Maxfield	Seepage---------	Wetness, hard to pack.	Slow refill----	Frost action---	Not needed-----	Wetness.
391B*:						
Clyde----------	Seepage---------	Wetness---------	Slow refill----	Frost action, floods.	Wetness---------	Wetness, erodes easily.
Floyd----------	Seepage---------	Wetness---------	Deep to water, slow refill.	Frost action---	Wetness---------	Favorable.
398---------- Tripoli	Favorable------	Wetness---------	Slow refill----	Frost action---	Not needed-----	Wetness.
399---------- Readlyn	Favorable------	Wetness---------	Deep to water, slow refill.	Frost action---	Wetness---------	Favorable.
407B---------- Schley	Seepage---------	Wetness---------	Deep to water, slow refill.	Frost action---	Wetness---------	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
426---------- Aredale	Seepage---------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
426B---------- Aredale	Seepage---------	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
426C, 426C2------- Aredale	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
428B---------- Ely	Seepage---------	Hard to pack, wetness.	Deep to water, slow refill.	Frost action---	Erodes easily, wetness.	Erodes easily.
444B---------- Jacwin	Depth to rock	Thin layer, wetness, hard to pack.	Deep to water, slow refill.	Depth to rock, percs slowly, frost action.	Wetness, percs slowly.	Wetness, depth to rock.
444C2---------- Jacwin	Slope, depth to rock.	Thin layer, wetness, hard to pack.	Deep to water, slow refill.	Depth to rock, percs slowly, frost action.	Wetness, percs slowly.	Wetness, depth to rock.
506---------- Wacousta	Seepage---------	Wetness---------	Slow refill----	Floods, frost action.	Not needed-----	Wetness, erodes easily.
507---------- Canisteo	Seepage---------	Wetness---------	Slow refill, deep to water.	Frost action---	Not needed-----	Wetness.
512C---------- Marlean	Seepage, depth to rock.	Seepage, large stones.	No water-------	Not needed-----	Depth to rock, large stones, slope.	Droughty, large stones.
512E, 512G-------- Marlean	Slope, seepage, depth to rock.	Seepage, large stones.	No water-------	Not needed-----	Depth to rock, large stones, slope.	Slope, droughty, large stones.
551---------- Calamine	Depth to rock	Wetness, thin layer.	Slow intake----	Depth to rock, percs slowly.	Wetness, depth to rock.	Wetness.
559---------- Talcot	Seepage---------	Seepage, wetness.	Favorable------	Frost action---	Not needed-----	Wetness.
595---------- Harpster	Seepage---------	Hard to pack, wetness.	Slow refill----	Frost action---	Not needed-----	Wetness.
612C2---------- Mottland	Seepage, slope.	Thin layer-----	No water-------	Not needed-----	Rooting depth	Rooting depth.
612E2---------- Mottland	Seepage, slope.	Thin layer-----	No water-------	Not needed-----	Slope, rooting depth.	Slope, rooting depth.
613, 613B--------- Rossfield	Seepage---------	Seepage---------	No water-------	Not needed-----	Small stones---	Favorable.
613C, 613C2------- Rossfield	Seepage, slope.	Seepage---------	No water-------	Not needed-----	Small stones---	Favorable.
613D2---------- Rossfield	Seepage, slope.	Seepage---------	No water-------	Not needed-----	Small stones---	Slope.
620C, 620C2------- Port Byron	Seepage, slope.	Favorable------	No water-------	Not needed-----	Erodes easily	Erodes easily.
620D2---------- Port Byron	Seepage, slope.	Favorable------	No water-------	Not needed-----	Erodes easily	Slope, erodes easily.
620E2---------- Port Byron	Seepage, slope.	Favorable------	No water-------	Not needed-----	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
621---------- Houghton	Seepage--------	Excess humus, wetness.	Slow refill----	Frost action, excess humus, floods.	Not needed-----	Wetness.
638C2*:						
Clarion----------	Seepage, slope.	Favorable------	No water-------	Not needed-----	Favorable------	Favorable.
Storden----------	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Erodes easily.
638D2*:						
Clarion----------	Seepage, slope.	Favorable------	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
Storden----------	Slope, seepage.	Favorable------	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
733---------- Calco	Seepage--------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
760---------- Ansgar	Favorable------	Wetness--------	Slow refill----	Frost action---	Not needed-----	Wetness, erodes easily.
761---------- Franklin	Seepage--------	Wetness--------	Deep to water, slow refill.	Frost action---	Erodes easily, wetness.	Erodes easily.
771B---------- Waubeek	Seepage--------	Favorable------	No water-------	Not needed-----	Erodes easily	Erodes easily.
771C---------- Waubeek	Slope, seepage.	Favorable------	No water-------	Not needed-----	Erodes easily	Erodes easily.
782B---------- Donnan	Favorable------	Hard to pack, wetness.	Slow refill, deep to water.	Percs slowly, frost action.	Wetness, percs slowly.	Percs slowly.
782C2---------- Donnan	Slope----------	Hard to pack, wetness.	Slow refill, deep to water.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Percs slowly.
828B---------- Zenor	Seepage--------	Seepage--------	No water-------	Not needed-----	Too sandy, soil blowing.	Favorable.
828C---------- Zenor	Slope, seepage.	Seepage--------	No water-------	Not needed-----	Too sandy, soil blowing.	Favorable.
933---------- Sawmill	Favorable------	Wetness--------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
956*:						
Okoboji----------	Favorable------	Wetness, hard to pack.	Slow refill----	Frost action, floods.	Not needed-----	Wetness, erodes easily.
Harps----------	Favorable------	Hard to pack, wetness.	Slow refill----	Frost action---	Not needed-----	Wetness.
1135---------- Coland	Seepage--------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Wetness--------	Wetness.
1173---------- Hoopeston Variant	Seepage--------	Seepage, piping.	Deep to water	Not needed-----	Soil blowing---	Favorable.
5010*, 5030*. Pits						
5550*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
6	0-36	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
Okoboji	36-60	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
8B	0-31	Silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
Judson	31-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
11B*:											
Colo	0-40	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	40-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
Ely	0-30	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	30-60	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
27B	0-36	Loam	CL	A-6	0-5	100	95-100	70-90	60-80	30-40	10-20
Terril	36-60	Clay loam, loam	CL	A-6	0-5	100	100	85-95	65-85	25-40	10-20
41B	0-39	Loamy fine sand	SM, ML	A-2, A-4	0	100	100	60-95	20-55	---	NP
Sparta	39-60	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	100	100	60-95	5-50	---	NP
55	0-20	Loam	OL, ML, CL	A-6, A-7	0	95-100	95-100	85-98	55-85	35-50	10-25
Nicollet	20-42	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	55-80	35-50	15-25
	42-60	Loam	CL, ML	A-6, A-4	0-5	95-100	90-100	75-90	50-75	30-40	5-15
62C2, 62D2, 62E2	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
Storden	8-60	Loam	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
73C	0-7	Gravelly sandy loam.	SM	A-2, A-1	0-5	85-95	60-75	30-60	12-20	---	NP
Salida	7-14	Gravelly loamy sand, gravelly coarse sand, gravelly loamy coarse sand.	SP, SW	A-1	0-5	50-90	40-60	10-30	0-5	---	NP
	14-60	Coarse sand, sand, fine sand.	SP, SW, GP	A-1	0-5	20-70	10-60	5-30	0-5	---	NP
83B, 83C2, 83D, 83F	0-18	Loam	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
Kenyon	18-22	Loam, clay loam	CL	A-6	0-5	90-95	85-95	80-90	55-75	30-40	10-20
	22-60	Loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
84	0-14	Silty clay loam, clay loam.	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
Clyde	14-31	Clay loam, loam	CL, ML	A-6, A-7	0	95-100	90-95	75-90	50-75	30-50	10-20
	31-37	Sandy loam	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	37-60	Loam	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
90	0-14	Mucky silt loam	OH, MH	A-7	0	100	100	95-100	90-95	60-95	10-30
Okoboji	14-36	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	36-60	Silty clay loam	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
95	0-19	Loam	CL, CH	A-6, A-7	0-5	100	95-100	80-90	65-80	30-55	15-35
Harps	19-42	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	42-61	Loam	CL	A-6	0-5	95-100	90-100	70-80	50-75	25-40	10-25

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
96---------- Turlin	0-35	Loam----------	OL, ML, CL	A-4, A-6	0	100	100	95-100	60-70	30-40	5-15
	35-60	Sandy loam, sandy clay loam, loamy sand.	SC, SM-SC, CL-ML, SM	A-4, A-6	0	100	80-95	80-95	35-40	25-35	5-15
107---------- Webster	0-22	Silty clay loam	CL, CH	A-7, A-6	0-5	100	95-100	85-95	70-90	35-60	15-30
	22-46	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	46-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
118---------- Garwin	0-22	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	22-34	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	34-60	Silt loam-------	CL	A-6	0	100	100	100	95-100	30-40	15-20
119---------- Muscatine	0-19	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	19-45	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	45-60	Silt loam-------	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
120B---------- Tama	0-22	Silty clay loam	ML, OL	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	22-38	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	38-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
133---------- Colo	0-40	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	40-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
135---------- Coland	0-48	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	70-90	45-55	20-30
	48-55	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	95-100	60-70	40-60	20-40	5-15
	55-70	Sand and gravel	GP, GW, SM, SP	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
138B, 138C2, 138D2 Clarion	0-18	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	18-36	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	36-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
151---------- Marshan	0-20	Clay loam-------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
	20-28	Loam, sandy loam, clay loam.	CL, CL-ML, SC, SM-SC	A-7, A-6	0	95-100	75-100	70-90	45-75	25-40	5-15
	28-60	Coarse sand, gravelly coarse sand, sand.	SP, SW, GP, GW	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
152---------- Marshan	0-20	Clay loam-------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
	20-37	Loam, sandy loam, clay loam.	CL, CL-ML, SC, SM-SC	A-7, A-6	0	95-100	75-100	70-90	45-75	25-40	5-15
	37-60	Coarse sand, gravelly coarse sand, sand.	SP, SW, GP, GW	A-1	0-3	65-95	45-95	20-45	2-5	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
153---------- Shandep	0-29	Loam, clay loam	CL, CH	A-7	0	95-100	95-100	90-100	85-95	40-55	20-30
	29-45	Silty clay loam, clay loam, loam.	CL	A-7	0	95-100	95-100	90-100	85-95	40-50	20-30
	45-60	Loamy sand, gravelly loamy coarse sand, gravelly coarse sand.	SW, SP, SP-SM	A-1	0-5	65-90	60-80	20-45	2-5	---	NP
174B, 174C2-------- Bolan	0-14	Loam----------	CL, ML	A-4, A-6	0	100	100	85-95	50-70	30-40	5-15
	14-26	Loam----------	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	100	80-90	40-55	25-35	5-15
	26-33	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	80-90	35-50	15-25	2-8
	33-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2	0	100	100	70-85	10-30	---	NP
175B, 175C--------- Dickinson	0-20	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	20-31	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	31-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
177, 177B, 177C---- Saude	0-15	Loam----------	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	15-27	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	36-60	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
178, 178B---------- Waukee	0-20	Loam----------	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
	20-36	Loam, sandy clay loam, sandy loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	36-60	Gravelly sand, loamy coarse sand, sand.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP
184---------- Klinger	0-21	Silty clay loam	CL, ML	A-7	0	100	100	100	95-100	40-50	15-25
	21-35	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	35-60	Loam, clay loam	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
198B---------- Floyd	0-19	Loam----------	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	19-36	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	36-60	Loam----------	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
201B*:											
Coland----------	0-50	Clay loam-------	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	50-60	Sandy clay loam, loam, sandy loam.	CL, SC, CL-ML	A-7	0	100	100	90-100	90-100	40-55	20-30
	60-70	Sand and gravel	SM, SP, GP, GM	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
Terril----------	0-36	Loam----------	CL	A-6	0-5	100	95-100	70-90	60-80	30-40	10-20
	36-60	Clay loam, loam	CL	A-6	0-5	100	100	85-95	65-85	25-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
213B---------- Rockton	0-20	Loam----------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	20-32	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
	32-36	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
214B, 214C2-------- Rockton	0-20	Loam----------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	20-24	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
	24-28	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
216C2---------- Ripon	0-20	Silt loam, silty clay loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	20-30	3-10
	20-26	Clay loam, sandy clay loam, loam.	SC, CL	A-6	0-5	90-100	90-100	80-95	40-75	25-40	10-20
	26-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
217B---------- Ripon	0-14	Silt loam-------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	20-30	3-10
	14-31	Silty clay loam, silt loam.	CL	A-6	0	100	100	90-100	70-95	25-40	10-20
	31-36	Clay loam, sandy clay loam, loam.	SC, CL	A-6	0-5	90-100	90-100	80-95	40-75	25-40	10-20
	36-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
221---------- Palms	0-34	Sapric material	PT	---	---	---	---	---	---	---	---
	34-60	Clay loam, loam, silt loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
225---------- Lawler	0-18	Loam----------	OL, CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	18-29	Loam, sandy clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	29-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
226---------- Lawler	0-18	Loam----------	OL, CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	18-37	Loam, sandy clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	37-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
236B, 236C, 236D2, 236F---------- Lester	0-11	Loam----------	ML	A-6, A-4, A-7	0	95-100	90-100	80-95	50-70	30-45	5-15
	11-50	Clay loam, loam	CL	A-7, A-6	0-5	95-100	90-100	80-95	55-75	35-45	15-25
	50-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	75-90	50-70	20-40	5-20
284B, 284C---------- Flagler	0-18	Sandy loam------	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	18-30	Sandy loam------	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	30-60	Loamy sand, gravelly sand, sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
329*: Webster----------	0-22	Silty clay loam	CL, CH	A-7, A-6	0-5	100	95-100	85-95	70-90	35-60	15-30
	22-46	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	46-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20
Nicollet----------	0-20	Loam----------	OL, ML, CL	A-6, A-7	0	95-100	95-100	85-98	55-85	35-50	10-25
	20-42	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	55-80	35-50	15-25
	42-60	Loam----------	CL, ML	A-6, A-4	0-5	95-100	90-100	75-90	50-75	30-40	5-15
335---------- Harcot	0-20	Loam----------	CH, CL, OH, OL	A-7	0	95-100	90-95	80-90	55-75	40-55	15-25
	20-37	Loam, clay loam, sandy clay loam.	CL	A-6	0	95-100	90-95	75-85	55-75	30-40	10-20
	37-60	Fine sand, loamy sand, gravelly sand.	SP, SM, SP-SM	A-1	0	80-95	75-95	40-50	3-25	---	NP
373C2, 373D2------- Tallula	0-7	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-35	5-15
	7-20	Silt loam-------	CL	A-6	0	100	100	100	90-100	25-40	10-20
	20-60	Silt loam, silt	CL, CL-ML	A-4, A-6	0	100	100	100	85-100	20-35	5-15
377, 377B, 377C, 377C2---------- Dinsdale	0-14	Silty clay loam	ML, CL, OL	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	14-32	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	32-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
382---------- Maxfield	0-18	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	18-35	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	35-60	Loam----------	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
391B*: Clyde----------	0-14	Silty clay loam	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	14-31	Clay loam, loam	CL, ML	A-6, A-7	0	95-100	90-95	75-90	50-75	30-50	10-20
	31-37	Sandy loam------	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	37-60	Loam----------	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
Floyd----------	0-19	Loam----------	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	19-36	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	36-60	Loam----------	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
398---------- Tripoli	0-22	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	85-95	55-75	35-45	15-25
	22-60	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---------- Readlyn	0-19	Loam----------	CL	A-6	0	100	100	85-95	55-75	30-40	15-25
	19-36	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	10-20
	36-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	25-35	10-20
407B---------- Schley	0-20	Silty clay loam, silt loam, loam.	CL, CL-ML	A-4, A-6	0	100	95-100	80-90	55-75	25-40	5-15
	20-33	Loam, sandy loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-2, A-4	2-8	90-95	70-80	50-70	20-60	20-30	5-10
	33-60	Loam, sandy clay loam, clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-40	10-20
426, 426B, 426C, 426C2---------- Aredale	0-17	Loam----------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	55-75	25-35	5-15
	17-24	Loam, clay loam	CL, SC	A-6	2-5	90-95	85-95	80-90	40-60	30-40	10-20
	24-56	Sandy loam, loam, loamy sand.	SC, SM, SM-SC	A-2, A-4	2-5	90-95	85-95	70-90	20-50	<25	NP-10
	56-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-95	80-90	45-65	25-35	11-20
428B---------- Ely	0-36	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	36-60	Silt loam, silty clay loam.	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
444B, 444C2-------- Jacwin	0-8	Loam----------	OL, ML	A-7	0	100	100	90-95	50-65	40-50	10-20
	8-28	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	95-100	90-95	85-95	45-65	25-35	10-20
	28-60	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	80-95	40-55	20-30
506---------- Wacousta	0-14	Silt loam, silty clay loam, mucky silt loam.	CH, CL OL	A-7	0	100	100	95-100	95-100	40-65	20-40
	14-23	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-60	20-40
	23-70	Silt loam, silty clay loam.	CL, ML	A-6, A-4	0-5	95-100	95-100	85-100	80-90	30-40	5-15
507---------- Canisteo	0-20	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	85-100	35-50	15-25
	20-36	Clay loam, loam	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	36-60	Clay loam, loam, sandy loam.	CL, ML, SM, SC	A-6, A-4	0-5	90-100	80-95	60-90	40-80	30-40	5-15
512C, 512E, 512G--- Marlean	0-12	Loam----------	CL, CL-ML	A-4, A-6	5-15	75-85	70-80	60-70	50-85	20-30	5-15
	12-60	Very channery loam, very flaggy sandy loam, very flaggy loamy sand.	SM, SC, GM, GC	A-4, A-2, A-1	20-50	20-60	30-70	5-50	12-40	<20	NP-10
	60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
551---------- Calamine	0-24	Silty clay loam	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	24-30	Silty clay loam, silt loam, clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	30-60	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	80-95	40-55	20-30

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
559---------- Talcot	0-19	Clay loam-------	CL	A-7	0	100	100	80-90	60-85	40-50	15-25
	19-33	Clay loam, silty clay loam, loam.	CL	A-7	0	95-100	85-100	70-90	60-85	40-50	15-25
	33-60	Stratified sandy loam to gravelly coarse sand.	SP, SP-SM, SW	A-1	0	65-90	50-85	20-50	2-10	---	NP
595---------- Harpster	0-19	Silty clay loam	CL, CH	A-7	0	100	95-100	95-100	90-100	45-60	20-35
	19-36	Silty clay loam, silt loam, loam.	CL, CH	A-7	0	100	95-100	95-100	80-100	40-60	20-35
	36-60	Stratified sandy loam to clay loam, silt loam.	CL, CL-ML, SC, SM-SC	A-6, A-4, A-7	0	100	95-100	95-100	45-95	20-50	5-25
612C2, 612E2------- Mottland	0-11	Loam----------	CL	A-6, A-4	3-10	90-95	75-85	70-80	55-65	25-40	5-15
	11-60	Channery sandy loam.	SM, SC, SM-SC	A-2	15-35	70-80	65-75	50-60	20-30	<20	2-8
613, 613B, 613C, 613C2, 613D2------ Rossfield	0-11	Silt loam-------	CL	A-6	0-1	95-100	95-100	90-100	70-80	30-40	11-20
	11-32	Silty clay loam, clay loam, sandy clay loam.	CL	A-6	5-10	80-90	70-80	60-70	55-65	30-40	11-20
	32-60	Channery sandy loam.	SM, SC, SM-SC	A-2, A-4	15-35	70-80	65-75	50-60	30-40	<20	2-8
620C, 620C2, 620D2, 620E2---------- Port Byron	0-47	Silt loam-------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	7-18
	47-60	Loam----------	ML, CL	A-4, A-6	0	100	100	85-95	50-70	30-40	5-15
621---------- Houghton	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
638C2*, 638D2*: Clarion----------	0-18	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	18-36	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	36-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden----------	0-8	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam----------	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
733---------- Calco	0-40	Silty clay loam	ML, MH, CH, CL	A-7	0	100	100	95-100	85-100	40-60	15-30
	40-60	Silty clay loam, loam, silt loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-7, A-6, A-4	0	90-100	85-100	65-90	45-90	20-50	5-25
760---------- Ansgar	0-11	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	11-30	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	30-60	Loam, sandy clay loam, clay loam.	CL	A-6	2-5	90-95	85-95	75-85	55-65	25-35	10-20
761---------- Franklin	0-14	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	14-34	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	34-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
771B, 771C---------	0-14	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	100	100	25-35	5-15
Waubeek	14-32	Silty clay loam	CL	A-7	0	100	100	100	100	40-50	15-25
	32-60	Loam, sandy clay loam, clay loam.	CL	A-6	0-5	90-95	85-95	75-85	50-65	25-35	10-20
782B, 782C2--------	0-9	Silt loam-------	CL, ML	A-4, A-6	0	100	100	85-95	65-80	30-40	5-15
Donnan	9-28	Clay loam, silty clay loam, silt loam.	CL	A-6, A-7	0-5	95-100	90-95	80-90	60-75	35-50	15-30
	28-60	Clay, silty clay	CH	A-7	0-5	95-100	90-95	80-90	60-75	55-70	30-40
828B, 828C---------	0-30	Sandy loam------	SM-SC, SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
Zenor	30-37	Sandy loam, loamy sand.	SM-SC, SM	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	37-60	Gravelly loamy sand, gravelly sand.	SW, SP, SP-SM	A-1-B	0-5	70-90	70-85	20-40	3-12	<20	NP-5
933----------	0-36	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	30-50	15-30
Sawmill	36-60	Stratified silty clay loam to loam.	CL	A-6, A-7	0	100	100	95-100	70-100	25-45	10-30
956*:											
Okoboji----------	0-36	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	36-55	Silty clay loam	CH	A-7	0	100	100	90-100	80-95	55-65	30-40
	55-60	Silty clay loam	CH	A-7	0	95-100	95-100	90-100	80-95	55-65	30-40
Harps----------	0-19	Loam----------	CL, CH	A-6, A-7	0-5	100	95-100	80-90	65-80	30-55	15-35
	19-42	Loam, clay loam, sandy clay loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-90	65-80	30-60	15-35
	42-61	Loam, sandy loam	CL, SC	A-6	0-5	95-100	90-100	60-70	40-60	25-40	10-25
1135---------	0-48	Clay loam-------	CL, CH	A-7	0	100	100	95-100	70-90	45-55	20-30
Coland	48-55	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	95-100	60-70	40-60	20-40	5-15
	55-60	Sand and gravel	GP, GW, SW, SP	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
1173---------	0-22	Sandy loam------	SM, SM-SC	A-2, A-4	0	100	100	70-85	25-50	20-40	5-10
Hoopeston Variant	22-37	Sandy loam------	SC, SM-SC	A-2, A-4	0	100	100	70-85	25-50	20-30	5-10
	37-72	Stratified silt loam to loamy sand.	SM-SC, CL-ML, CL, SC	A-2, A-4, A-6	0	100	100	70-90	25-60	20-30	5-15
5010*, 5030*. Pits											
5550*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
6	0-36	35-42	1.25-1.30	0.2-0.6	0.21-0.23	6.6-7.8	High	0.37	5	4	9-11
Okoboji	36-60	32-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
8B	0-31	25-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.28	5	7	4-5
Judson	31-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.8	Moderate	0.43			
11B*:											
Colo	0-40	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7	5-7
	40-60	32-36	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28			
Ely	0-30	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7	5-6
	30-60	28-32	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43			
27B	0-36	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	5	6	4-5
Terril	36-60	27-32	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.3	Low	0.32			
41B	0-39	3-10	1.50-1.55	2.0-6.0	0.10-0.12	5.1-7.3	Low	0.17	5	2	1-2
Sparta	39-60	2-8	1.55-1.65	6.0-20	0.06-0.11	5.1-6.0	Low	0.17			
55	0-20	24-35	1.35-1.40	0.6-2.0	0.17-0.22	5.6-7.3	Moderate	0.24	5	6	4-8
Nicollet	20-42	24-35	1.40-1.50	0.6-2.0	0.15-0.19	5.6-7.8	Moderate	0.32			
	42-60	22-28	1.50-1.70	0.6-2.0	0.14-0.19	7.4-7.8	Low	0.32			
62C2, 62D2, 62E2-	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	1-2
Storden	8-60	18-27	1.30-1.45	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
73C	0-7	5-15	1.50-1.55	2.0-6.0	0.10-0.12	6.1-8.4	Low	0.10	3	8	1-2
Salida	7-14	2-8	1.60-1.75	>20	0.02-0.04	7.4-8.4	Low	0.10			
	14-60	0-5	1.60-1.75	>20	0.02-0.04	7.4-8.4	Low	0.10			
83B, 83C2, 83D, 83F	0-18	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	3-4
Kenyon	18-22	20-28	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low	0.28			
	22-60	20-24	1.65-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low	0.37			
84	0-14	28-32	1.30-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate	0.28	5	7	9-11
Clyde	14-31	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.6-7.3	Moderate	0.37			
	31-37	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.6-7.3	Low	0.37			
	37-60	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Moderate	0.37			
90	0-14	20-26	1.20-1.25	0.6-2.0	0.24-0.26	6.6-7.8	High	0.37	5	4	15-18
Okoboji	14-36	32-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High	0.37			
	36-60	30-38	1.35-1.40	0.2-0.6	0.18-0.20	7.4-8.4	High	0.37			
95	0-19	25-35	1.35-1.40	0.6-2.0	0.19-0.21	7.9-8.4	Moderate	0.24	5	4L	4-5
Harps	19-42	26-32	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Moderate	0.32			
	42-61	20-26	1.50-1.70	0.6-2.0	0.17-0.19	7.9-8.4	Moderate	0.32			
96	0-35	20-27	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	5	6	4-5
Turlin	35-60	16-26	1.45-1.70	0.6-2.0	0.17-0.19	6.1-7.3	Low	0.32			
107	0-22	30-36	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate	0.24	5	6	6-7
Webster	22-46	28-34	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate	0.32			
	46-60	23-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			
118	0-22	30-35	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7	6-7
Garwin	22-34	28-34	1.28-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28			
	34-60	20-26	1.35-1.45	0.6-2.0	0.20-0.22	6.6-7.8	Moderate	0.28			
119	0-19	28-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate	0.28	5	6	5-6
Muscatine	19-45	30-34	1.28-1.35	0.6-2.0	0.18-0.20	5.1-7.3	Moderate	0.43			
	45-60	22-26	1.35-1.40	0.6-2.0	0.18-0.20	6.6-7.8	Moderate	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
120B----------	0-22	24-29	1.25-1.30	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	7	2-5
Tama	22-38	28-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	38-60	22-28	1.35-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
133----------	0-40	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
Colo	40-60	32-36	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
135----------	0-48	27-32	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
Coland	48-55	12-26	1.50-1.65	2.0-6.0	0.13-0.17	6.1-7.3	Low----------	0.28			
	55-70	<5	1.60-1.75	6.0-20	0.02-0.05	6.1-7.3	Low----------	0.15			
138B, 138C2, 138D2----------	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	3-4
Clarion	18-36	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	36-60	12-22	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
151----------	0-20	27-35	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	4	7	4-8
Marshan	20-28	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low----------	0.28			
	28-60	<5	1.60-1.75	6.0-20	0.02-0.05	6.1-7.3	Low----------	0.15			
152----------	0-20	27-35	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	4	7	4-8
Marshan	20-37	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low----------	0.28			
	37-60	<5	1.60-1.75	6.0-20	0.02-0.05	6.1-7.3	Low----------	0.15			
153----------	0-29	22-35	1.35-1.40	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.24	5	7	7-9
Shandep	29-45	22-35	1.40-1.50	0.6-2.0	0.17-0.20	6.1-7.3	Moderate-----	0.24			
	45-60	4-10	1.60-1.75	6.0-20	0.02-0.04	6.1-7.3	Low----------	0.15			
174B, 174C2------	0-14	20-26	1.40-1.45	0.6-2.0	0.20-0.22	6.6-7.3	Low----------	0.28	4	6	3-4
Bolan	14-26	14-20	1.45-1.50	0.6-2.0	0.17-0.19	5.6-7.3	Low----------	0.28			
	26-33	10-15	1.50-1.60	2.0-6.0	0.11-0.13	5.6-6.5	Low----------	0.28			
	33-60	2-8	1.60-1.70	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17			
175B, 175C-------	0-20	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.20	4	3	1-2
Dickinson	20-31	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.6-6.5	Low----------	0.20			
	31-60	5-10	1.55-1.65	6.0-20	0.08-0.10	5.6-6.5	Low----------	0.20			
177, 177B, 177C--	0-15	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	5	3-4
Saude	15-27	12-20	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	5.1-7.3	Very low-----	0.10			
178, 178B--------	0-20	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	4	6	3-4
Waukee	20-36	20-26	1.40-1.50	0.6-2.0	0.15-0.19	5.6-6.0	Low----------	0.32			
	36-60	2-8	1.50-1.75	>20	0.02-0.06	5.6-6.0	Low----------	0.10			
184----------	0-21	26-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	6	5-6
Klinger	21-35	30-34	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	35-60	22-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.43			
198B----------	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	5-7
Floyd	19-36	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.6-7.3	Low----------	0.32			
	36-60	18-24	1.65-1.80	0.6-2.0	0.16-0.18	6.6-7.8	Low----------	0.32			
201B*:											
Coland----------	0-50	27-32	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	50-60	12-26	1.50-1.65	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
	60-70	<5	1.60-1.75	6.0-20	0.02-0.05	6.1-7.3	Low----------	0.15			
Terril----------	0-36	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
	36-60	27-32	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
213B----------	0-20	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	2-6
Rockton	20-32	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	32-36	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High---------	0.28			
	36	---	---	---	---	---	----------	---			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
214B, 214C2-----	0-20	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	2-6
Rockton	20-24	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	24-28	35-60	1.35-1.45	0.6-2.0	0.10-0.14	5.6-7.3	High---------	0.28			
	28	---	---	---	---	---	----------	---			
216C2-----------	0-20	10-18	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.8	Low----------	0.32	4	5	2-4
Ripon	20-26	22-45	1.65-1.80	0.6-2.0	0.16-0.18	7.9-8.4	Moderate-----	0.32			
	26-60	---	---	---	---	---	----------	---			
217B------------	0-14	10-18	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.8	Low----------	0.32	4	5	2-4
Ripon	14-31	22-30	1.35-1.45	0.6-2.0	0.18-0.20	5.6-6.0	Moderate-----	0.32			
	31-36	22-45	1.65-1.80	0.6-2.0	0.16-0.18	7.9-8.4	Moderate-----	0.32			
	36-60	---	---	---	---	---	----------	---			
221-------------	0-34	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-8.4	----------	---	---	3	>25
Palms	34-60	7-35	1.46-2.00	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	---			
225-------------	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
Lawler	18-29	20-26	1.45-1.60	0.6-2.0	0.16-0.18	5.6-6.5	Low----------	0.28			
	29-60	2-12	1.60-1.75	6.0-20	0.02-0.04	6.1-6.5	Low----------	0.10			
226-------------	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
Lawler	18-37	20-26	1.45-1.60	0.6-2.0	0.16-0.18	5.6-6.5	Low----------	0.28			
	37-60	2-12	1.60-1.75	6.0-20	0.02-0.04	6.1-6.5	Low----------	0.10			
236B, 236C,											
236D2, 236F-----	0-11	18-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-6.5	Low----------	0.28	5	6	2-3
Lester	11-50	25-35	1.45-1.65	0.6-2.0	0.15-0.19	5.1-6.5	Moderate-----	0.28			
	50-60	22-30	1.70-1.80	0.6-2.0	0.14-0.19	6.6-7.8	Low----------	0.37			
284B, 284C------	0-18	12-18	1.50-1.55	2.0-6.0	0.12-0.14	6.1-7.3	Low----------	0.20	4	3	1-2
Flagler	18-30	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low----------	0.20			
	30-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low----------	0.20			
329*:											
Webster---------	0-22	30-36	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate-----	0.24	5	6	6-7
	22-46	28-34	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.32			
	46-60	23-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
Nicollet--------	0-20	24-35	1.35-1.40	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.24	5	6	4-8
	20-42	24-35	1.40-1.50	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	42-60	22-28	1.50-1.70	0.6-2.0	0.14-0.19	7.4-7.8	Low----------	0.32			
335-------------	0-20	20-27	1.40-1.45	0.6-2.0	0.20-0.22	7.9-8.4	Moderate-----	0.28	4	6	5-6
Harcot	20-37	24-32	1.45-1.55	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.28			
	37-60	4-10	1.60-1.75	>20	0.05-0.07	6.6-8.4	Low----------	0.15			
373C2, 373D2-----	0-7	16-24	1.30-1.35	0.6-2.0	0.22-0.24	6.6-7.8	Low----------	0.32	5-4	5	2-3
Tallula	7-20	16-24	1.30-1.35	0.6-2.0	0.20-0.22	6.6-7.8	Low----------	0.43			
	20-60	10-20	1.35-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
377, 377B, 377C,											
377C2-----------	0-14	25-29	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7	2-4
Dinsdale	14-32	30-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	32-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-8.4	Low----------	0.43			
382-------------	0-18	30-35	1.35-1.40	0.6-2.0	0.21-0.23	6.6-7.3	High---------	0.24	5	6	6-7
Maxfield	18-35	28-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.32			
	35-60	20-26	1.65-1.85	0.6-2.0	0.17-0.19	6.1-7.8	Low----------	0.32			
391B*:											
Clyde-----------	0-14	28-32	1.40-1.45	0.6-2.0	0.21-0.23	6.6-7.3	Moderate-----	0.28	5	7	9-11
	14-31	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.6-7.3	Moderate-----	0.37			
	31-37	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.6-7.3	Low----------	0.37			
	37-60	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Moderate-----	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
391B*:											
Floyd	0-19	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate	0.24	5	6	5-7
	19-36	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.6-7.3	Low	0.32			
	36-60	18-24	1.65-1.80	0.6-2.0	0.16-0.18	6.6-7.8	Low	0.32			
398	0-22	28-32	1.40-1.45	0.6-2.0	0.19-0.21	6.1-7.3	Moderate	0.24	5	6	6-7
Tripoli	22-60	20-28	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Low	0.32			
399	0-19	18-24	1.35-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.24	5	6	4-6
Readlyn	19-36	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low	0.32			
	36-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low	0.32			
407B	0-20	18-22	1.40-1.45	0.6-2.0	0.19-0.21	4.5-6.5	Moderate	0.32	5	6	2-3
Schley	20-33	15-28	1.45-1.65	0.6-2.0	0.12-0.16	4.5-5.5	Low	0.32			
	33-60	20-28	1.65-1.80	0.6-2.0	0.16-0.18	5.1-7.8	Low	0.32			
426, 426B, 426C, 426C2	0-17	20-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	2-4
Aredale	17-24	22-28	1.45-1.65	0.6-2.0	0.17-0.19	5.1-6.0	Low	0.28			
	24-56	8-15	1.60-1.70	2.0-6.0	0.11-0.13	5.1-6.0	Low	0.28			
	56-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	5.6-7.3	Low	0.37			
428B	0-36	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7	5-6
Ely	36-60	28-32	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43			
444B, 444C2	0-8	24-34	1.35-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate	0.28	5	6	2-6
Jacwin	8-28	24-34	1.40-1.45	0.6-2.0	0.17-0.19	6.6-7.3	Low	0.28			
	28-60	40-60	1.70-1.90	<0.06	0.12-0.14	7.4-8.4	Moderate	0.28			
506	0-14	30-36	1.20-1.25	0.6-2.0	0.21-0.23	6.6-7.3	High	0.28	5	7	8-10
Wacousta	14-23	32-40	1.25-1.30	0.6-2.0	0.18-0.20	7.4-7.8	High	0.43			
	23-70	16-24	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate	0.43			
507	0-20	18-35	1.35-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate	0.32	5	4L	4-8
Canisteo	20-36	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	36-60	10-35	1.30-1.50	0.6-6.0	0.12-0.18	7.4-8.4	Low	0.32			
512C, 512E, 512G-	0-12	18-24	1.40-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.24	2	6	2-3
Marlean	12-60	12-28	1.70-1.90	2.0-6.0	0.02-0.06	7.3-7.8	Very low	0.24			
	60	---	---	---	---	---	---	---			
551	0-24	27-40	1.40-1.50	0.6-2.0	0.18-0.23	6.1-7.8	Moderate	---	---	8	7-9
Calamine	24-30	25-40	1.50-1.60	0.06-0.6	0.18-0.20	7.4-8.4	High	---			
	30-60	40-50	1.60-1.90	<0.06	0.12-0.14	---	---	---			
559	0-19	27-35	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	Moderate	0.28	4	7	4-8
Talcot	19-33	25-35	1.25-1.35	0.6-2.0	0.17-0.20	7.4-8.4	Moderate	0.28			
	33-60	1-6	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low	0.15			
595	0-19	---	1.30-1.35	0.6-2.0	0.21-0.24	7.4-8.4	Moderate	0.28	5	4L	5-6
Harpster	19-36	---	1.30-1.35	0.6-2.0	0.17-0.22	7.4-8.4	Moderate	0.28			
	36-60	---	1.35-1.45	0.6-2.0	0.11-0.22	7.4-8.4	Low	0.28			
612C2, 612E2	0-11	---	1.40-1.50	0.6-2.0	0.16-0.18	7.4-8.4	Low	0.28	2	6	.5-1
Mottland	11-60	---	1.75-1.90	2.0-6.0	0.10-0.12	7.4-8.4	Low	---			
613, 613B, 613C, 613C2, 613D2	0-11	22-26	1.40-1.45	0.6-2.0	0.21-0.23	6.1-6.5	Low	0.32	4	6	2-4
Rossfield	11-32	25-34	1.50-1.70	0.6-2.0	0.18-0.20	6.1-7.3	Low	0.32			
	32-60	10-15	1.70-1.90	2.0-6.0	0.10-0.12	7.4-8.4	Low	0.10			
620C, 620C2, 620D2, 620E2	0-47	18-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.32	5-4	6	2-4
Port Byron	47-60	18-27	1.30-1.45	0.6-2.0	0.20-0.22	7.9-8.4	Low	0.28			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
621---------- Houghton	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	----------	---	---	3	>25
638C2*, 638D2*:											
Clarion---------	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	2-4
	18-36	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	36-60	12-22	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Storden---------	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	1-2
	8-60	18-27	1.30-1.45	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
733---------- Calco	0-40	28-33	1.25-1.30	0.6-2.0	0.21-0.23	7.4-8.4	High---------	0.28	5	7	5-7
	40-60	22-32	1.30-1.45	0.6-2.0	0.18-0.20	7.4-8.4	Moderate-----	0.28			
760---------- Ansgar	0-11	18-25	1.30-1.35	0.6-2.0	0.21-0.23	5.6-6.0	Moderate-----	0.32	5	6	2-3
	11-30	30-35	1.35-1.40	0.6-2.0	0.18-0.20	5.6-6.0	High---------	0.43			
	30-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-6.5	Low----------	0.43			
761---------- Franklin	0-14	18-25	1.30-1.35	0.6-2.0	0.21-0.23	4.5-7.3	Moderate-----	0.32	5	6	2-3
	14-34	30-34	1.35-1.40	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	34-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.1-7.8	Low----------	0.43			
771B, 771C------- Waubeek	0-14	19-24	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5-4	6	2-3
	14-32	29-34	1.25-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	32-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.43			
782B, 782C2------ Donnan	0-9	20-26	1.40-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.28	4	6	2-3
	9-28	28-34	1.45-1.55	0.6-2.0	0.17-0.19	5.1-5.5	Moderate-----	0.28			
	28-60	42-55	1.65-1.80	<0.06	0.11-0.14	5.6-6.5	High---------	0.28			
828B, 828C------- Zenor	0-30	12-20	1.50-1.55	2.0-6.0	0.14-0.16	5.6-7.3	Low----------	0.20	4	3	1-2
	30-37	12-20	1.55-1.60	2.0-6.0	0.13-0.15	6.1-8.4	Low----------	0.20			
	37-60	2-8	1.60-1.75	6.0-20	0.06-0.09	7.9-8.4	Very low-----	0.10			
933---------- Sawmill	0-36	27-35	1.28-1.32	0.2-2.0	0.18-0.23	6.1-7.8	Moderate-----	0.28	5	7	5-7
	36-60	20-35	1.30-1.35	0.2-2.0	0.11-0.20	7.4-8.4	Moderate-----	0.28			
956*:											
Okoboji---------	0-36	35-42	1.25-1.30	0.2-0.6	0.21-0.23	6.6-7.8	High---------	0.37	5	4	9-11
	36-55	32-42	1.30-1.35	0.2-0.6	0.18-0.20	6.6-7.8	High---------	0.37			
	55-60	30-38	1.35-1.40	0.2-0.6	0.18-0.20	7.4-8.4	High---------	0.37			
Harps----------	0-19	25-35	1.35-1.40	0.6-2.0	0.19-0.21	7.9-8.4	Moderate-----	0.24	5	4L	4-5
	19-42	26-32	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
	42-61	20-26	1.50-1.70	0.6-2.0	0.17-0.19	7.9-8.4	Moderate-----	0.32			
1135---------- Coland	0-48	27-32	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
	48-55	12-26	1.50-1.65	2.0-6.0	0.13-0.17	6.1-7.3	Low----------	0.28			
	55-60	<5	1.60-1.75	6.0-20	0.02-0.05	6.1-7.3	Low----------	0.15			
1173---------- Hoopeston Variant	0-22	12-20	1.50-1.55	2.0-6.0	0.13-0.15	5.6-6.5	Low----------	0.20	5	3	2-3
	22-37	12-20	1.55-1.60	2.0-6.0	0.12-0.14	5.6-6.5	Low----------	0.20			
	37-72	10-20	1.65-1.80	0.6-2.0	0.14-0.18	6.6-8.4	Low----------	0.20			
5010*, 5030*. Pits											
5550*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[Hydrologic groups and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

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				
6--Okoboji	B/D	Frequent	Long	Feb-Nov	0-1.0	Apparent	Nov-Jul	>60	---	High	High	Low.
8B--Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
11B*:												
Colo	B/D	Frequent	Very brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Ely	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
27B--Terril	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
41B--Sparta	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
55--Nicollet	B	None	---	---	2.5-5.0	Apparent	Apr-May	>60	---	High	High	Low.
62C2, 62D2, 62E2--Storden	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
73C--Salida	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
83B, 83C2, 83D, 83F--Kenyon	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
84--Clyde	B/D	Frequent	Very brief	Feb-Nov	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Low.
90--Okoboji	B/D	Frequent	Long	Feb-Nov	0-1.0	Apparent	Nov-Jul	>60	---	High	High	Low.
95--Harps	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High	High	Low.
96--Turlin	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
107--Webster	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Low.
118--Garwin	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
119---------- Muscatine	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
120B---------- Tama	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
133---------- Colo	B/D	Frequent----	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
135---------- Coland	B/D	Frequent----	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
138B, 138C2, 138D2---------- Clarion	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
151, 152---------- Marshan	B/D	Rare--------	---	---	1.0-2.5	Apparent	Oct-Jun	>60	---	High-----	High-----	Moderate.
153---------- Shandep	B/D	Frequent----	Brief to long.	Feb-Nov	0-1.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Moderate.
174B, 174C2------- Bolan	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
175B, 175C-------- Dickinson	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
177, 177B, 177C--- Saude	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
178, 178B--------- Waukee	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
184---------- Klinger	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
198B---------- Floyd	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
201B*:												
Coland----------	B/D	Frequent----	Very brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Terril----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
213B, 214B, 214C2- Rockton	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	Low------	Low.
216C2, 217B------- Ripon	B	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Moderate	Moderate.
221---------- Palms	A/D	Frequent----	Long------	Feb-Nov	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
225, 226---------- Lawler	B	None--------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
236B, 236C, 236D2, 236F---------- Lester	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
284B, 284C-------- Flagler	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
329*: Webster----------	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Nicollet---------	B	None--------	---	---	2.5-5.0	Apparent	Apr-May	>60	---	High-----	High-----	Low.
335---------- Harcot	B/D	Rare--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
373C2, 373D2------ Tallula	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
377, 377B, 377C, 377C2---------- Dinsdale	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
382---------- Maxfield	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
391B*: Clyde----------	B/D	Frequent----	Very brief	Feb-Nov	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Floyd----------	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
398---------- Tripoli	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
399---------- Readlyn	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
407B---------- Schley	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	High.
426, 426B, 426C, 426C2---------- Aredale	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
428B---------- Ely	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
444B, 444C2------- Jacwin	B	None--------	---	---	2.0-4.0	Perched	Nov-Jun	36-60	Rippable	High-----	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
506--- Wacousta	B/D	Frequent----	Brief to long.	Feb-Nov	0-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
507--- Canisteo	C/D	None--------	---	---	1.0-2.0	Apparent	Oct-Jul	>60	---	High-----	High-----	Low.
512C, 512E, 512G-- Marlean	B	None--------	---	---	>6.0	---	---	8-18	Rippable	Low------	Low------	Low.
551--- Calamine	D	Rare--------	---	---	0-1.0	Perched	Nov-May	30-50	Rippable	Moderate	High-----	Moderate.
559--- Talcot	B/D	Rare--------	---	---	0-2.0	Apparent	Oct-Jul	>60	---	High-----	High-----	Low.
595--- Harpster	B/D	Rare--------	---	---	0-2.0	Apparent	Feb-Jun	>60	---	High-----	High-----	Low.
612C2, 612E2------ Mottland	B	None--------	---	---	>6.0	---	---	7-20	Rippable	Low------	Low------	Moderate.
613, 613B, 613C, 613C2, 613D2----- Rossfield	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	Low------	Moderate.
620C, 620C2, 620D2, 620E2----- Port Byron	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
621--- Houghton	A/D	Frequent----	Long------	Feb-Nov	0-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
638C2*, 638D2*: Clarion----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Storden----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
733--- Calco	B/D	Frequent----	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
760--- Ansgar	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
761--- Franklin	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
771B, 771C-------- Waubeek	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
782B, 782C2------- Donnan	C	None--------	---	---	2.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
828B, 828C--------- Zenor	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
933---------- Sawmill	B/D	Frequent----	Very brief	Feb-Jun	0-2.0	Apparent	Mar-Jun	>60	---	High------	High------	Low.
956*: Okoboji----------	B/D	Frequent----	Long-------	Feb-Nov	0-1.0	Apparent	Nov-Jul	>60	---	High------	High------	Low.
Harps----------	B/D	None---------	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High------	High------	Low.
1135---------- Coland	B/D	Frequent----	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High------	High------	Low.
1173---------- Hoopeston Variant	B	None---------	---	---	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	Moderate	Moderate.
5010*, 5030*. Pits												
5550*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution									Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve						Percentage smaller than--						
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Maximum dry	Optimum moisture
												Pct		Lb/Ft^3	Pct
Coland clay loam:[1] (S75IA-069-003)															
A11-------0 to 40	A-7-6(18)	CL	100	100	100	100	98	82	52	28	22	46	21	98	22
C1g------48 to 55	A-2-4(00)	SC	100	98	92	85	60	27	18	12	8	23	10	127	10
IIc2g----55 to 70	A-1-B(01)	SP	100	100	99	94	34	3	2	1	1	--	NP	113	12
Franklin silt loam:[2] (S75IA-069-005)															
A1--------0 to 8	A-7-5(18)	ML-MH	100	100	100	100	99	91	51	18	9	50	15	88	28
A2--------8 to 14	A-6 (13)	CL	100	100	100	100	99	93	59	29	19	37	13	100	21
B21t-----14 to 34	A-6 (16)	CL	100	100	100	100	99	91	58	33	27	40	16	103	20
IIb31----34 to 60	A-6 (05)	CL	100	100	100	99	91	53	37	26	21	31	16	116	14
Mottland loam:[3] (S75IA-069-001)															
Ap--------0 to 7	A-4 (06)	ML	100	100	100	99	96	74	37	18	10	34	9	108	17
C2-------11 to 60	A-4 (01)	ML	100	100	100	100	99	76	29	15	9	25	3	110	16
Wacousta silt loam:[4] (S75IA-069-004)															
Ap--------0 to 14	A-7-5(18)	MH	100	100	100	100	98	89	58	26	14	56	14	83	31
Bg-------14 to 40	A-7-6(27)	CL	100	100	100	100	98	98	76	41	28	49	24	99	22
C2g------40 to 70	A-7-6(22)	CL	100	100	100	100	99	98	71	38	26	44	20	104	19

[1]Coland clay loam: 570 feet east and 20 feet north of southwest corner of NW1/4SW1/4, sec. 1, T. 93 N., R. 20 W.

[2]Franklin silt loam: 740 feet south and 635 feet east of northwest corner of sec. 21, T. 92 N., R. 20 W.

[3]Mottland loam: 35 feet south and 140 feet east of northwest corner of SW1/4SW1/4, sec. 6, T. 93 N., R. 20 W.

[4]Wacousta silt loam: 75 feet north and 10 feet west of southeast corner of SW1/4SW1/4, sec. 17, T. 93 N., R. 22 N.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Ansgar	Fine-silty, mixed, mesic Mollic Ochraqualfs
Aredale	Fine-loamy, mixed, mesic Typic Hapludolls
Bolan	Coarse-loamy, mixed, mesic Typic Hapludolls
Calamine	Fine, mixed, mesic Typic Argiaquolls
Calco	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Clarion	Fine-loamy, mixed, mesic Typic Hapludolls
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
*Dinsdale	Fine-silty, mixed, mesic Typic Argiudolls
*Donnan	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Ely	Fine-silty, mixed, mesic Cumulic Hapludolls
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Franklin	Fine-silty, mixed, mesic Udollic Ochraqualfs
Garwin	Fine-silty, mixed, mesic Typic Haplaquolls
Harcot	Fine-loamy over sandy or sandy-skeletal, mesic Typic Calciaquolls
Harps	Fine-loamy, mesic Typic Calciaquolls
Harpster	Fine-silty, mesic Typic Calciaquolls
Hoopeston Variant	Coarse-loamy, mixed, mesic Aquic Hapludolls
Houghton	Euic, mesic Typic Medisaprists
Jacwin	Fine-loamy over clayey, mixed, mesic Aquic Hapludolls
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Klinger	Fine-silty, mixed, mesic Aquic Hapludolls
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
*Lester	Fine-loamy, mixed, mesic Mollic Hapludalfs
Marlean	Loamy-skeletal, mixed, mesic Typic Hapludolls
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Maxfield	Fine-silty, mixed, mesic Typic Haplaquolls
Mottland	Coarse-loamy, carbonatic, mesic Entic Hapludolls
Muscatine	Fine-silty, mixed, mesic Aquic Hapludolls
Nicollet	Fine-loamy, mixed, mesic Aquic Hapludolls
Okoboji	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Orthents	Loamy, mixed, mesic Udorthents
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Port Byron	Fine-silty, mixed, mesic Typic Hapludolls
Readlyn	Fine-loamy, mixed, mesic Aquic Hapludolls
*Ripon	Fine-silty, mixed, mesic Typic Argiudolls
*Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
Rossfield	Fine-loamy, mixed, mesic Typic Hapludolls
*Salida	Sandy-skeletal, mixed, mesic Entic Hapludolls
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Sawmill	Fine-silty, mixed, mesic Cumulic Haplaquolls
Schley	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Shandep	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Talcot	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Haplaquolls
Tallula	Coarse-silty, mixed, mesic Typic Hapludolls
*Tama	Fine-silty, mixed, mesic Typic Argiudolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tripoli	Fine-loamy, mixed, mesic Typic Haplaquolls
Turlin	Fine-loamy, mixed, mesic Cumulic Hapludolls
Wacousta	Fine-silty, mixed, mesic Typic Haplaquolls
Waubeek	Fine-silty, mixed, mesic Mollic Hapludalfs
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Webster	Fine-loamy, mixed, mesic Typic Haplaquolls
Zenor	Coarse-loamy, mixed, mesic Typic Hapludolls

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